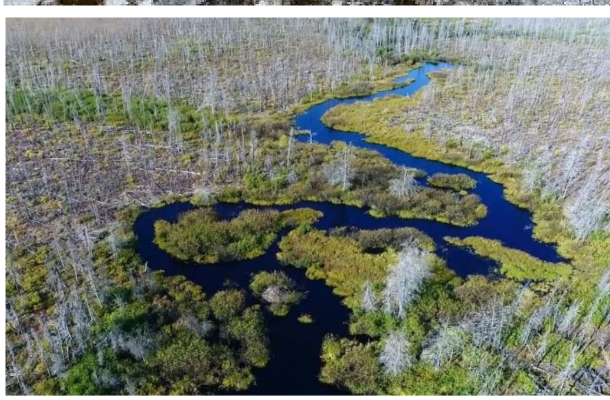
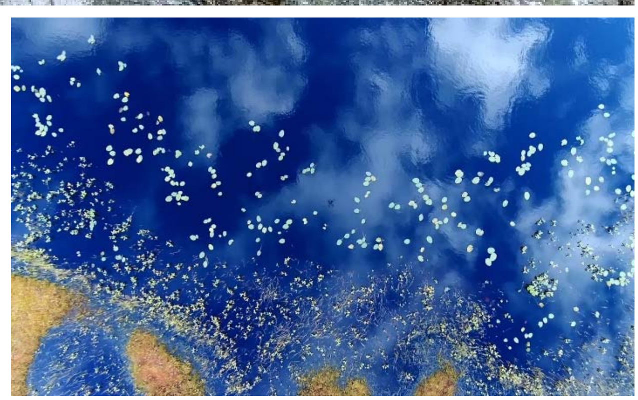
JAMES BAY LITHIUM MINE

ENVIRONMENTAL IMPACT ASSESSMENT

VOLUME 1: MAIN REPORT (CHAPTERS 1 TO 5)

OCTOBER 2018





JAMES BAY LITHIUM MINE

ENVIRONMENTAL IMPACT ASSESSMENT

GALAXY LITHIUM (CANADA) INC.

VOLUME 1: MAIN REPORT (CHAPTERS 1 TO 5)

PROJECT N[O].: 171-02562-00
DATE: OCTOBER 2018

Environmental Impact Assessment Presented to:

Environmental and Social Impact Review Committee (COMEX)
(File no.: 3214-14-055)
and
Canadian Environmental Assessment Agency

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The environmental impact assessment report for the James Bay Lithium Mine project is also available in French. The two versions are meant to be identical, however, if differences occur the French version prevails.

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TABLES OF CONCORDANCE

The following tables present the concordance between the information presented in the environmental impact assessment (EIA) of the James Bay Lithium Mine project of Galaxy Lithium (Canada) and the requirements set out in the documents titled *Guidelines for the Preparation of an Environmental Impact Statement pursuant to the Canadian Environmental Assessment Act, 2012* of the Canadian Environmental Assessment Agency (CEAA) and *Directive pour le projet de mine de lithium Baie James* of the Ministère du développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC).

Table 1: Table of concordance between the sections of the CEAA guidelines and the EIA

Section of the CEAA guidelines			Corresponding chapter or section of the EIA
1.	INTRODUCTION AND OVERVIEW		
1.1.	The proponent		1.1; 1.2; 1.6
1.2.	Project overview		1.5; 4
1.3.	Project location		1.4; 1.5.1; 6.1; 6.2; 6.3; 6.4; 8.5.4.1;
1.4.	Regulatory framework and the role of government		2.4; 6.4.3
2.	PROJECT JUSTIFICATION AND ALTERNATIVES CONSIDERED		
2.1.	Purpose of the project		2.3
2.2.	Alternative means of carrying out the project		3, 4.14
3.	PROJECT DESCRIPTION		
3.1.	Project components		4.1 to 4.12
3.2.	Project activities		4.4 to 4.13
	3.2.1.	Site preparation and construction	4.4
	3.2.2.	Operation	4.5 to 4.12
	3.2.3.	Decommissioning and abandonment	4.13
4.	PUBLIC CONSULTATION AND CONCERNS		
	Public consultation and concerns		5
5.	CONSULTATION WITH INDIGENOUS NATIONS AND CONCERNS RAISED		
5.1.	Aboriginal nations and consultation activities		5
6.	PROJECT EFFECTS ASSESSMENT		
6.1.	Project setting and baseline conditions		6
	6.1.1.	Atmospheric, light and noise environment	6.2.10; 6.2.11; 6.2.12
	6.1.2.	Geology and geochemistry	6.2.2; 4.1, 4.7
	6.1.3.	Topography, terrestrial environments and soil	6.2.4; 6.2.5; 6.2.6; 6.2.9
	6.1.4.	Riparian and wetland environments	6.2.7 and 6.3.1 to 6.3.6
	6.1.5.	Groundwater and surface water	6.2.6; 6.2.7; 6.2.8
	6.1.6.	Fish and fish habitat	6.3.3; 6.2.7

Table 1: Table of concordance between the sections of the CEAA guidelines and the EIA (cont.)

Section of the CEAA guidelines		Corresponding chapter or section of the EIA
6.1.7.	Migratory birds and their habitats	6.3.5
6.1.8.	Species at Risk	6.3; 8.5.4; 9.1.2.2
6.1.9.	Indigenous peoples	2.4; 6.4; 8.6.2
6.1.10.	Other changes to the environment arising as a result of a federal decision or due to changes on federal lands, in another province or outside Canada	N/A
6.1.11.	Human environment	6.4
6.2.	Predicted changes to the physical environment	7.2
6.2.1.	Changes to atmospheric, sound and light environments	7.2.5; 7.2.6; 7.2.7
6.2.2.	Changes to groundwater and surface water	7.2.2; 7.2.3; 7.2.4
6.2.3.	Changes to riparian, wetland and terrestrial environments	7.2.1; 7.2.2; 7.2.3
6.3.	Predicted effects on valued components	7.2; 7.3; 7.4
6.3.1.	Fish and fish habitat	7.2.2; 7.2.3; 7.2.4; 7.3.4
6.3.2.	Migratory birds	7.3.5
6.3.3.	Species at risk	7.3
6.3.4.	Indigenous peoples	7.4
6.3.5.	Other valued components that may be affected as a result of a federal decision or due to effects on federal lands, another province or outside Canada	N/A
6.4.	Mitigation measures	7.1
6.5.	Significance of residual effects	7.1 to 7.5
6.6.	Other effects to consider	8 and 9
6.6.1.	Effects of potential accidents or malfunctions	9
6.6.2.	Effects of the environment on the project	9.2.1
6.6.3.	Cumulative effects assessment	8
7.	SUMMARY OF ENVIRONMENTAL EFFECTS ASSESSMENT	
	Summary of Environmental Effects Assessment	7.5
8.	FOLLOW-UP AND MONITORING PROGRAMS	
8.1.	Follow-up program	10.3; 10.4
8.2.	Monitoring Program	10.2

Table 2: Table of concordance between the sections of MDDELCC directive and the EIA

Section of the MDDELCC directive		Corresponding chapter or section of the EIA
1	BACKGROUND	
1.1	Presentation of the proponent	1.1; 1.2
1.2	Context relating to the project	1.5; 1.6; 2; 4; 6.1.1;
1.3	Purpose of the project	2.3
2.	LOCATION AND TECHNOLOGY CHOICES	
2.1	Location and route variants	3.1.2; 3.1.3; 3.2.5, 4.14
2.2	Technological variants	3.1.1; 3.2.1 to 3.2.4; 3.3; 3.4, 4.15
3	PROJECT DESCRIPTION	
3.1	Description of the deposit and the facilities	4.1 to 4.3; 4.11
3.2	Extraction	4.5
3.3	Ore processing	4.6
3.4	Waste and tailings management	4.8
3.5	Water management	4.9
3.6	Water balance	4.9.3 to 4.9.6
3.7	Treatment and discharge of contaminated water	4.9
3.7.1	Water treatment	4.9.1 to 4.9.3; 4.10.2
3.7.2	Effluent(s)	4.9; 4.10.2
3.8	Related developments and projects	
3.8.1	Access infrastructure	4.11.2; 4.11.3
3.8.2	Lodging infrastructure	4.11.4
3.8.3	Transportation and storage of fuels or hazardous materials	4.10.4; 4.13.1; 4.13.3; 4.16.2
3.8.4	Borrow pits	4.4.3; 4.4.5; 4.8.2; 4.9.4
3.8.5	Concentrate transport	4.12
3.8.2	Energy supply	3.4; 3.5; 4.3
3.8.2	Employment and training	1.6.3; 2.3; 4.13, 6.4.3.4
4	DESCRIPTION OF THE ENVIRONMENT	
4.1	Study area boundaries	6.1
4.2	Description of the relevant components	
4.2.1	Biophysical environment	6.2; 6.3
4.2.2	Archeological and cultural potential	6.4.9
4.2.3	Social environment	6.4
5.	ANALYSIS OF PROJECT IMPACTS	
5.1	Determination and evaluation of the impacts	7
5.2	Cumulative impacts	8

Table 2: Table of concordance between the sections of MDDELCC directive and the EIA (cont.)

Section of the MDDELCC directive		Corresponding chapter or section of the EIA
6.	MITIGATION MEASURES, RESIDUAL IMPACTS AND COMPENSATORY MEASURE	
6.1	Mitigation of impacts	7.1 to 7.4
6.2	Residual impacts and compensatory measures	7.1 to 7.5; 8.6.2
7.	RISK MANAGEMENT	
7.1	Risks of technological accidents	9.3
7.2	Safety measures	9.3
7.3	Preliminary emergency response plans	9.4
8	MONITORING AND FOLLOW-UP PROGRAM	
8.1	Monitoring program	10.2
8.2	Environmental and social tracking program	10.3; 10.4

ABBREVIATIONS AND ACRONYMS

Acronym	Definition
ANFO	Ammonium Nitrate / Fuel Oil
ARIA	*Analyse, Recherche et Information sur les Accidents* (database)
CAPEX	Capital expenditures
CCME	Canadian Council of the Ministers of the Environment
CBHSSJB	Cree Board of Health and Social Services of James Bay
CDPNQ	*Centre de données sur le patrimoine naturel du Québec*
CEAAg	Canadian Environmental Assessment Agency
CEAA	*Canadian Environmental Assessment Act*
CFPBJ	Centre de formation professionnelle de la Baie-James
CHRD	Cree Human Resources Department
CMC	Community Miyupimaatisiiun (health) Centre
CNG	Cree Nation Government
COMEX	Review committee
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRRNTBJ	Regional Commission on Natural Resources and the James Bay Territory
CSB	Cree School Board
CTEU-9	Water leaching test
DMS	Dense media separation
DUC	Ducks Unlimited Canada
EC	Environment Canada
EC/ha	Equivalent-couple per hectare
EDOs	Effluent Discharge Objectives
EIA	Environmental impact assessment
EIJB	Eeyou Istchee James Bay
EIJBRG	Eeyou Istchee James Bay Regional Government
EMP	Emergency measures plan
ÉPOQ	*Étude des populations d'oiseaux du Québec*
EQA	*Environment Quality Act*
GCC	Grand Council of the Crees
GHG	Greenhouse gas
INSPQ	Institut national de santé publique du Québec
ISQ	Institut de la statistique du Québec
JBNQA	James Bay and Northern Québec Agreement

Acronym	Definition
LDL	Laboratory detection limit
Li_2O	Lithium oxide
LNG	Liquefied natural gas
LPFS	Low-pressure feed system
MABA	Static test to predict acid generation potential
MDDELCC	Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques
MDMER	*Metal and Diamond Mining Effluent Regulations*
MEND	Mine Environment Neutral Drainage program
MERN	Ministère de l'Énergie et des Ressources naturelles
MFFP	Ministère des Forêts, de la Faune et des Parcs
MIACC	Major Industrial Accidents Council of Canada
MRNF	Ministère des Ressources naturelles et de la Faune
MSSS	Ministère de la Santé et des Services sociaux du Québec
MTMDET	Ministère des Transports, de la Mobilité durable et de l'Électrification des transports
Non-PAG	Non-potentially acid generating
OPEX	Operating expenditures
PAG	Potentially acid generating
RES	*Résurgence dans les eaux de surface*
SARA	*Species at Risk Act*
SDBJ	Société de développement de la Baie-James
SOPFEU	Société de protection des forêts contre le feu
SPLP	Synthetic Precipitation Leachate Procedure
TCLP	Toxicity Characteristic Leachate Procedure
TJCM	Table jamésienne de concertation minière
URSTM	Unité de recherche et de service en technologie minérale (UQAT)
VCs	Values components
WEDC	Wabannutao Eeyou Development Corporation
WNS	White-nose syndrome
WSI	Weh-Sees Indohoun
WTP	Water treatment plant

GLOSSARY

Term / Symbol	Description
Accident	Any unforeseen and sudden event that causes or is likely to cause personal injuries or damage buildings, facilities, materials, the environment or living beings.
Acid-generating potential	The acid-generating potential associated with the oxidation of tailings.
Acute toxicity	A biological test result that exceeds the standard threshold of mortality of the tested species. It measures the inherent capacity or potential of a toxic substance to cause adverse effects (mortality) in a living organism. In the present context, it refers to a mine effluent that reaches the acute lethality level.
Anthropogenic	Refers to phenomena that essentially result from man's direct or indirect intervention.
Aquifer	A geological stratum or formation that is sufficiently porous and permeable to stock a significant quantity of water while being sufficiently permeable to allow water to flow freely through it.
Aquifer potential	The capacity to provide a high and sustained flow of groundwater. This potential depends on the geometrical characteristics, hydraulic conductivity and recharge rate of the aquifers.
Auto-ignition temperature	The lowest temperature of a hot surface from which, under certain specific conditions, the ignition of a flammable substance in the form of a mix of gas or vapour with air is possible.
Background concentration	The concentration of a chemical substance that corresponds to said substance's ambient presence.
Banded gneiss	Gneiss in which dark and light decimetric horizons alternate regularly.
Basalt	A volcanic magmatic rock produced by rapidly cooled magma and characterized by the following mineralogical composition: plagioclase (50%), pyroxenes (25–40%), olivine (10–25%) and magnetite (2–3%).
Beaver pond	A body of water that is usually shallow (a few metres deep) and was created by the presence of a beaver dam.
Benthic invertebrates	Small animals that do not have a spine (such as insects and mollusks) and that live at the bottom of water bodies.
Carbon oxide equivalent (CO_2 eq.)	A unit used to compare the radiative forcing of a GHG to carbon dioxide.
Claim	The only exploration mineral title on public land that confers on its holder the exclusive right to search for mineral substances, with the exception of surface mineral substances.
Compensatory measure	A measure, excluding the planned treatment of the mine's wastewater, aimed at compensating the residual impacts of the implementation of a project.
Concentrate	A substance of value that results from the spodumene concentration process and that contains approximately 6% of lithium oxide (Li_2O).
Contaminants	A solid, liquid or gaseous matter, microorganism, sound, vibration, ray, heat, odour, radiation or any combination thereof that is likely to somehow alter the quality of water or the environment.
Contaminated water	Water in which the concentration of any chemical substance exceeds its natural concentration because of mining activities (D019).
Criteria	Concentrations of a contaminant that, if they are exceeded, risk causing a complete or partial loss of the use for which they were established.

Term / Symbol	Description
Dense media separation	A density separation process that uses different material densities to apply gravity separation. This robust process is effective to separate minerals, mineralized bodies and metallic waste.
Deposit	A series of mineral layers in the ground. A mineralized zone that is large enough to justify its commercial development.
Dewatering	The action of evacuating infiltration water from a mine.
Diabase	A mafic igneous, holocrystalline rock that is equivalent to volcanic basalt or plutonic gabbro and is slightly modified by metamorphism.
Dike	A long construction designed to contain water.
Dyke (geology)	In geology, a dyke (or dike) is a tabular body of magmatic rock that has penetrated into a fracture through different layers of rock. Dykes cut through pre-existing rock vertically or quasi-vertically. A dyke can also be composed of sedimentary deposits in a pre-existing fissure.
Drainage system	A system that is used namely to intercept the mine site's drainage water and direct it to treatment units. It can also designate a system used to redirect uncontaminated runoff water to the periphery of the mine site.
Effect	The consequence of an accident: toxic concentration, thermal radiation, thermal load, overpressure.
Effect threshold	A value of toxic concentration (ppm or mg/m^3), thermal radiation (kW/m^2), thermal load ((kW/m^2)4/3•s) or overpressure (kPa) from which effects on life or health could be observed within an exposed population or structural damage could result.
Effluent Discharge Objectives	The maximum concentrations and loads of different contaminants that may be released into a receiving environment while ensuring the maintenance or retrieval of their uses.
Elevation	The vertical distance measured between a point located on the Earth's surface and a reference surface (usually the mean sea level).
Emission factor	A factor relating activity data to increased or decreased GHG levels.
Exfiltration	The movement of water from a saturated substrate through the surface of this substrate under the effect of a hydraulic gradient.
Expected detection limit	The detection limit associated with the analytical method of a given parameter specified in the list of analytical methods published by the Centre d'analyse environnementale du Québec of the Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques du Québec.
Extraction	The action of removing mineral material from excavation - open pit or underground.
Extraction capacity	The maximum quantity (in tons per day) of material that is extractable under optimal equipment conditions.
Filter press	An intermittently operating filter consisting of a series of flat vertical filtering surfaces into which the pulp to be filtered is injected under pressure. The pulp is released by separating the filter plates.
Final effluent	Mine wastewater that is no longer treated before being released at the discharge point into the receiving environment or a sewer system.
Final effluent discharge point	A point beyond which an operator no longer has control over the final effluent and can no longer improve its quality.
Flammable (or explosive) limits	When mixed with the oxygen in air, certain gasses or vapours emitted by certain liquids are flammable within the limits of a determined concentration range. Said limits are expressed in % by volume in the air with respect to the ambient temperature and atmospheric pressure. They are called: • LFL: lower flammable limit (or LEL: lower explosive limit); • UFL: upper flammable limit (or UEL: upper explosive limit).

Term / Symbol	Description
Flashpoint (for liquids)	The lowest temperature at which a liquid, at atmospheric pressure, emits a sufficient quantity of vapours to ignite in the presence of a flame.
Flood period	A significant increase in the water flow (and consequently the level) of a watercourse, a lake or a reservoir, most often attributable to precipitations or melting snow.
Flooded area	A terrestrial environment that has recently been affected by a rise of the water level attributable to an external activity, such as the construction of a beaver dam, without, however, having defined limits such as a beaver pond, or presenting hygrophile plants (e.g., rising waters along a lake's shores because of a beaver dam restricting its outflow).
Flow facies	The aspect of a watercourse defined by water height, flow speed and type of substrate. There are eight types of flow facies: waterfalls, cascades, rapids, rises, channels, meanders, basins and estuaries.
Fluvial deposits	Well-stratified deposits carried by a watercourse and composed of gravel, sand and—in lesser proportions—loam, clay and (occasionally) organic matter.
Forest management unit	A basic territorial unit used to manage the forest in such a way as to supply wood processing plants. It is also on the basis of this unit that potential annual sustainable yields are established.
Forest stand	A group of trees that forms a rather homogeneous whole, in terms namely of floristic composition, structure, age and spatial distribution to set is apart from neighbouring stands.
Formation (geological)	A body of rock identified by its lithologic features and stratigraphic position.
Freeboard	The vertical distance separating the embankment crest and the maximum water level in the tailings area.
Freshwater	Water drawn from the natural environment (surface water or groundwater) or from an aqueduct.
Geochemistry	The study of the chemical behaviour of the elements, in particular in rocks (magmatic, metamorphic and sedimentary) as well as in water (coastal and marine) and the atmosphere.
Geological province	A geological province is an extensive continental region that corresponds to a morphostructural set of the terrestrial globe. There are three main types of geological provinces, which are occasionally divided into subtypes: cratons, mountain ranges corresponding to zones of recent orogeny and magmatic provinces.
Geology	A science that includes the study of the parts of the Earth that can be observed directly and the development of hypotheses to reconstitute their history and explain how they fit together. The main geological disciplines are petrography, la mineralogy, la crystallography, volcanology, sedimentology, geochemistry, stratigraphy, tectonics, structure, paleontology and geomorphology.
Geomorphology	The study of the evolution of the Earth's topographic features and the causes of this evolution. This science is midway between geology and geography.
Glaciofluvial deposits	Continental sediments originating from matter ripped off by a glacier and carried by a watercourse.
Global warming potential	A factor that describes the impact of the radiative forcing of one unit of a given greenhouse gas compared to one equivalent unit of carbon dioxide for a defined period.
Gneiss	Metamorphic rock from the continental crust that contains particles of quartz, mica, plagioclase feldspar and (occasionally) alkali feldspar that are all visible to the naked eye.
Greenhouse gas	Gaseous component in the atmosphere, both natural and artificial, that absorbs and re-radiates the infrared radiation of a specific wavelength emitted by the surface of the Earth, the atmosphere and the clouds.
Greenhouse gas source	A physical unit or process that releases a GHG into the atmosphere.
Groundwater flow system	The hydrodynamic characteristics of the movement of groundwater in an aquifer over time.
Hauling road	A road taken by motor vehicles in an open-pit mine.

Term / Symbol	Description
Hazardous material	A material which, by reason of its properties, is a hazard to health or to the environment and which is explosive, gaseous, flammable, poisonous, radioactive, corrosive, oxidizing or leachable or is designated as a hazardous material, and any object classed by regulation as a hazardous material by virtue of the *Environment Quality Act.*
High water	Elevation of the water level following abundant rainfalls or melting snow or ice.
High-water mark	This line is located at the natural high-water mark, i.e., where the predominance of aquatic plants passes to a predominance of terrestrial plants or, if there are no aquatic plants, where the terrestrial plants stop towards the body of water. This mark delineates the shorelines and shores of lakes and watercourses.
Home range	The area where an animal normally lives and that enables it to satisfy its basic needs.
Hydraulic conductivity	A property of geological materials that characterizes the ease with which they allow the movement of water.
Hydraulic property	Hydraulic properties make it possible to analyze in quantitative terms the capacity of a geological formation to contain water and allow it to flow. These properties depend on the proprieties of the liquid, i.e., water, and the physical properties of the environment with respect to water storage and flow.
Hydrogeological conditions	A set of elements and characteristics that define the hydrology (groundwater science) and geology of a sector. It includes, among other things, the hydrostratigraphic units, granulometry and hydraulic properties of geological materials as well as groundwater levels and characteristics.
Hydrogeological property	Refer to Hydrogeological conditions.
Hydrogeological unit	A permeable and porous geological unit, delimited by one or several impermeable units, the whole of which has a structure that allows to form and feed, as least temporarily, a groundwater table within the permeable unit.
Hydrogeology	A geological discipline that studies groundwater (the underground flow of water, the search for groundwater, the evaluation of reservoirs, possible catchments and flows).
Hydrostratigraphic units	Geological units (superficial deposits or rocks) that are characterized by a distinct flow of the groundwater in consideration of their respective permeability levels.
Ignition	The state of a burning body.
In situ	Latin expression that means on site.
Invasive alien species	An invasive alien species is a plant, animal or microorganism (virus, bacterium or fungus) that is introduced outside of its natural range. Its establishment and spreading may constitute a threat to the environment, economy or society.
Land use	The traditional and contemporary use of resources and the full occupation of the traditional territory.
Lands in the domain of the State or public lands	Public lands in Québec.
Leaching	The dissolution of certain mineral constituents.
Leaching tests	These tests make it possible to establish the risks associated with the potential leaching of toxic substances into the groundwater table.

Term / Symbol	Description
Lithium	A soft alkaline metal that is silver-white in colour and that has the lowest molar mass and density of all metals. Its lightness and high reactivity make it particularly suitable for use in the manufacturing of batteries as well as in a variety of industrial processes. The applications of lithium are highly diverse and include the manufacturing of glass and ceramics, lubricants, polymers and pharmaceutical products, the purification of air and, recently and especially, the manufacturing of lithium ion batteries.
Lithostratigraphic	In geology, regarding lithostratigraphy, the branch of stratigraphy that analyzes the organization of strata based on lithologic criteria (composition of the sediments or rocks, including physical and chemical characteristics such as colour, mineralogical composition, harness or grain size).
Lixiviation	A technique consisting of using a solvent, namely water flowing in the soil or a substrate containing toxic products, to extract soluble products.
Low water level	The lowest recorded level of a watercourse or any other body of water.
Low-water period	The period of the year during which the flow of a watercourse reaches its lowest level (minimum flow).
Lugeon test	The Lugeon test consists of injecting pressurized water into a cavity comprised of a portion of a drilling of known dimensions and of measuring the injection rate at different pressure levels over a given period.
Marsh	A wetland that is dominated by herbaceous vegetation (emergent, grass-like or broad-leaved) growing in a mineral or organic soil. Shrubs and trees, when present, cover at least 25% of the environment’s surface area. A marsh is usually connected to fluvial, riparian and lacustrine areas and its water level varies according to tides, flooding and evapotranspiration. A marsh may be flooded on a permanent, semi-permanent or temporary basis.
Maternity	A fauna breeding site.
Measurement site	The location where water samples are taken to analyze the quality of the final effluent and measure the flow and the pH. The measurement site is located immediately upstream of the final effluent discharge point.
Mine	A set of surface and underground infrastructures, with the exception of pits covered by the *Regulation respecting pits and quarries* (R.Q. c.Q-2, r.2), designed to extract mineral for economic purpose.
Mine site	A site on which unfolds or had unfolded work to explore or develop a mineral deposit, to extract or process the material. Includes, without limiting the generality of the foregoing, mines, surface infrastructures, storage areas, stockpile areas, and basins as well as adjacent cleared or disrupted sectors.
Mine water	Water, not including domestic wastewater, that is pumped from a mine excavation to keep it dry during exploration and development operations.
Mining lease	A mineral title that confers on its holder, on a given public territory, the exclusive right to mine mineral substances, except for those found on the surface. Since 1966, mining leases have replaced mining claims for new applications to operate.
Mitigation measure	A measure designed to reduce or eliminate the adverse effects of a project.
Modelling	The design of a model, i.e., a diagram representing a defined system, chosen following its intended use, followed by the development of a simulator (or an analogue, digital or other simulation model) of the system.

Term / Symbol	Description
Observation well	A well used to observe, on an episodic or regular basis, a characteristic of the groundwater that may vary: level, chemical quality, temperature, etc. More specifically, a well used to measure the hydraulic load of a water table, in general near its surface, by surveying the depth of the table, and to observe its natural or influenced variations, through periodic measurements (less rigorously than when using a piezometer).
Organic deposits	Deposits that are composed of more or less decomposed organic matter.
Organic matter	A substance of biological origin that results from the decomposition of plant debris, dejections and animal carcasses.
Outcrop	An exposure of rock or mineral deposit that can be seen on the surface, i.e., that is not covered by soil or vegetation.
Outflow	A watercourse that releases the water of a lake or pond.
Overburden	The unconsolidated natural layer of sediments that must be penetrated to reach the economic material, i.e., soil that does not contain any material of value to mining companies.
Peatland	A wetland in which the production of organic matter, regardless of the composition of the plant remains, has prevailed over its decomposition. The result is a natural accumulation of peat that constitutes organic soil. Peatland soil is either poorly or very poorly drained and the groundwater table is usually at the same depth as the soil or close to its surface. There are two main types of peatland—ombrotrophic (bogs) and minerotrophic (fens)—that are fed by different water sources. Peatland may be wooded or not (open). Wooded peatland is covered with trees that measure more than 4 m in height over 25% or more of its surface.
Permeability test	In the case of this impact study, the permeability tests conducted on site consisted of collecting a known volume of water from a well and evaluating how quickly it rises through the water table. How quickly the water rises makes it possible to establish the hydraulic conductivity of a determined horizon.
Piezometer	A tube well with a screened extremity used to measure the piezometric level at a specific point.
Piezometric high	The zone where the elevation of the water table is at its highest.
Piezometric level	The depth of the upper limit of the water table.
Pit	Refers to the excavated zone in the shape of a funnel in the open-pit mining process.
Pit wall	The sides (walls) of the pit.
Pond	A wetland with a water level of less than 2 m during the low-water season. It is characterized by the presence of floating or submerged aquatic vegetation as well as emergent vegetation covering at least 25% of the environment’s surface area. Temporary ponds, often called vernal or forest pools, are shallow (< 1 m), isolated and usually fed in water by precipitations, melting or the water table. Ponds retain stagnant water in the spring for a period of approximately two months and then dry out during the summer. Given they are not inhabited by fish, they tend to favour species that are adapted to the recurrent flooddrought cycles such as salamanders and certain frog species.
Post-rehabilitation	The period that follows the end of the rehabilitation work planned to return the receiving environment to a satisfactory state for its protection.
Pumping test	Continuous pumping at a regular flow in a pumped well such as to generate a permanent flow until the water level is stable in the pumped well and the observation wells drilled around the pumped well. This test makes it possible to measure the drawdown of the water table in the observation wells during the pumping (downward flow) and once the pumping has stopped (upward flow) and, in turn, to measure the permeability coefficient.
Radius of impact	The distance measured from the source of an effect to the selected effect threshold.

Term / Symbol	Description
Receiving environment	The environment in which the project unfolds and that is likely to be affected by the completion of the project.
Recharge	The recharge corresponds to the quantity of water that enters the aquifer after infiltrating the surface and renews the groundwater.
Recirculation	Action by which mine wastewater is retrieved to be reused in equipment and processes.
Reduction	The mitigation of flood peaks due to the reduction and lag of the water volumes.
Reference state	The characteristics of an environmental component as they were before the project.
Regular monitoring	The complete environmental monitoring (weekly, three times weekly and acute toxicity) of the final effluent.
Resurgence	Refer to Resurgence water.
Retention basin	A retention structure designed to contain runoff water.
Rim	The edge of a well
Risk analysis	The use of information such as to identify the hazards and estimate the probability and seriousness of adverse effects on people or populations, the environment and property.
Scarification	An operation by which the indurated surface of a pavement (or a layer of pavement) is at once isolated from the pavement's underlying structure and reduced to blocks through ploughing using a machine such as a harrow, a rake arm or a scarifier.
Sediment	An unconsolidated deposit of detritic, chemical or organic origin formed by the grouping of small and larger particles or precipitated matter having been transported separately.
Sedimentation basin	A retention structure designed to retain water long enough for the suspended solids to settle at the bottom of the basin before the water is released.
Seismic	Which relates to earthquakes or which is prone to earthquakes.
Shoreline	The part of a lake or watercourse that extends from the high-water line to the centre of the body of water.
Sorption	The uptake and retention of a substance (the sorbed) on the surface (adsorption) as well as within (absorption, in the broader sense) another substance (the sorbent).
Special status species	Special status species are plant and animal species at risk according to the MDDELCC, i.e., those that are designated as threatened or vulnerable Québec by virtue of the *Act respecting threatened or vulnerable species* and those that are likely to be designated as such as well as plant and animal species that are at risk in Canada by virtue of the *Species at Risk Act*.
Spodumene	Spodumene is a silicate of aluminum and lithium. It is the most important mineral making up commercially mined lithium in the world.
Spodumene-bearing pegmatite	The minerals contained in lithium (spodumene, petalite, lepidolite, amblygonite) are namely associated with rocks such as rare-metal granitic pegmatites. These granitic pegmatites often constitute peraluminous instructive complexes.
Spot sample	The volume of undiluted effluent collected at a given time.
Stockpile	Land where mineral substances, topsoil, concentrates or mine tailings are accumulated.
Stratigraphy	The science that studies the succession of sedimentary deposits, generally laid out in layers (or strata). The study of the order in which layers of rock that make up the Earth's crust formed over geological times.

Term / Symbol	Description
Surface mineral substances	Peat; sand including silica sand; gravel; limestone; calcite; dolomite; common clay and argillaceous rocks used in the manufacture of clay products; all types of rocks used as dimension stone, crushed stone, silica or mineral in the making of cement; and every mineral substance that is found in its natural state as a loose deposit, except the tilth, as well as inert mine tailings, where such substances and tailings are used for construction purposes, for the manufacture of construction materials, or for the improvement of soils *(chapter I-1, Mining Act)*.
Surface or superficial deposits	Unconsolidated sediments (clay, sand, gravel, stones, etc.) of various origins, natures, morphologies and thicknesses that rest on the surface of the bedrock.
Swamp	A wetland that is dominated by woody, shrub or tree vegetation (covering more than 25% of the environment's surface area) that grows in a mineral soil that is poorly or very poorly drained. A riverine swamp is seasonally flooded or characterized by a high-water table and a water flow that is high in dissolved minerals. As for an isolated swamp, it is fed by runoff water or resurgences of the water table.
Tailings	Solid or liquid substances, with the exception of the final effluent, resulting from the extraction, preparation, enrichment and separation of an economic material, including the sludge and dust resulting from the treatment or purification of mine wastewater or air emissions. Are considered as tailings the slag and sludge, including sewage sludge, released during the treatment by pyrometallurgy, hydrometallurgy or electroextraction. Are also considered as tailings the substances released during the extraction of a marketable substance from tailings and that correspond to those already defined in the first two paragraphs. Are excluded the tailings resulting from the working of a pit within the meaning of the *Regulation respecting pits and quarries* (R.Q., c.Q-2, r.2).
Tallyman	A trapper in charge of supervising other trappers and whose primary responsibility is managing animal populations within the limits of the land for which he is responsible.
Topsoil	Surface soil that is composed of a mix of organic matter as well as sand, silt and clay or a combination thereof and that is conducive to vegetation growth.
Traditional activities	Refer to Traditional practices.
Traditional practices (traditional activities)	All of the traditional hunting, fishing, gathering and general activities as well as land and resource use activities for livelihood, ritual and social purposes.
Treatment capacity	The maximum quantity of material (in tons per day) that is treatable under optimal equipment conditions.
Tributary	A watercourse that flows into a larger watercourse or into a lake (affluent).
Unconsolidated deposits	Unconsolidated matter that covers a deposit or the bedrock.
Water table	The underground water table that feeds catchment works. The water table is the first table of groundwater under the soil surface.
Watercourse	Any water mass that flows into a bed at a regular or intermittent rate, including those created or modified by human intervention as well as the St. Lawrence River and the Gulf of St. Lawrence and all seas surrounding Québec.
Watershed	A watershed is a territory, bounded by drainage divides, over which water flows to a single point called an outflow.
Wetland	Wetlands comprise all sites that are saturated with water or flooded during a sufficiently long period to exert an influence on the "soil" and "vegetation" components, to the extent they are present.
Wind erosion	Erosion caused by the wind.
Winter concentration area (or wintering area)	A forest territory of variable size that is used as shelter by a large or small group of crevids during the winter.

Term / Symbol	Description
	Explosion Hazard.
	Flammable Material.
	Oxidizing.
	Compressed Gas.
	Corrosive.
	Harmful of Fatal.
	Harmful.
	Health Hazard.
	Harmful to the Environment.

TABLE OF CONTENTS

TABLES

MAPS

FIGURES

PHOTOS

APPENDICES

1 INTRODUCTION

1.1 PROJECT PROPONENT

Galaxy is a fully owned subsidiary of Galaxy Resources Limited (Galaxy Resources), a major mining company listed on the Australian Stock Exchange (ASX). The firm currently operates the Mt. Cattlin Spodumene Mine in Australia and is developing the Sal de Vida Brine Project in Argentina (in an area known as the "lithium triangle"). Thus, Galaxy Lithium (Canada) Inc. (hereinafter called Galaxy) is the subsidiary acting as the proponent of the James Bay Lithium Mine project. The contact information of Galaxy in Canada is as follows:

Name of project proponent	GALAXY LITHIUM (CANADA) INC.
Project office	2000 Peel St., Suite 720 Montréal, QC H3A 2W5
Website:	www.galaxylithium.com
Project manager	Ms. Gail Amyot, Director EHS gail.amyot@galaxylithium.com
Phone number	514-558-1855
Québec enterprise number (NEQ)	1167071928

1.2 MANDATE OF THE ENVIRONMENTAL IMPACT ASSESSMENT

Galaxy has retained the services of WSP for the preparation of the environmental impact assessment (EIA) for the James Bay Lithium Mine project. Contact information for their representative is as follows:

Name of consultant	WSP CANADA INC.
Project office	1600 René-Lévesque Blvd. West, 16th Floor Montréal, QC H3H 1P9
Website:	www.wsp.com
Project director	Ms. Andréanne Boisvert andreanne.boisvert@wsp.com
Phone number:	873-387-0133
Fax:	819-375-1217

1.3 PRESENTATION OF THE REPORT

This study contains all of the relevant information and analysis components for meeting the directive of Québec's Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC) by way of the environmental and social protection regime applicable in the James Bay region, established under Chapter 22 of the James Bay and Northern Québec Agreement (JBNQA); for meeting the guidelines of the Canadian Environmental Assessment Agency (CEAAg, the “Agency”) and, by extension, for meeting the requirements of the *Environment Quality Act* (EQA) and the *Canadian Environmental Assessment Act* (CEAA). The provincial directive, to which the environmental evaluation committee (COMEV) has made recommendations, are included in Appendix A, along with the federal guidelines.

In this report, Chapter 1 presents the project proponent and its main consultant, who is responsible the various environmental approaches. Next, we find the main tenets of its environmental policy and an overview of the project, while the specifics are presented in Chapter 4.

Chapter 2 describes the project information and justification by highlighting the history of the mining operations and the components enabling its achievement. This chapter also provides the legal and regulatory framework for this project, outlining its legislative features.

Chapter 3 compares the different alternatives of the project which were analyzed for material deposit sites, such as the areas to stockpile waste rock and overburden. The variants are studied to target each one’s advantages and disadvantages, on an environmental, technical, social and economical level.

Chapter 4 presents a detailed description of the project and its various components. This description includes (but is not limited to) mining infrastructure, activities to take place on-site, the deposition plan for waste rock and tailings, water treatment on the mine site, related projects and infrastructure and the mine rehabilitation plan. Completion schedule and cost of work are also presented here, along with project planning and design.

Chapter 5 outlines the consultation activities which were conducted among the population from the very start of the project. A communications plan is also outlined. Finally, this chapter highlights the concerns and expectations of the various stakeholders to enhance the project and minimize the adverse effects on the environment and on the population.

Chapter 6 describes the receiving environment, or the various components from the physical, biological or social environments, in the study areas which were used in assessing the environmental and social effects.

The effects on the environment and on humans are identified and assessed in Chapter 7. This assessment considers proposed mitigation measures for each environmental component for the project's construction, operation, rehabilitation and post-rehabilitation phases. An assessment of the project’s residual effects, following mitigation, concludes this section.

Chapter 8 deals with the project’s cumulative effects for each of the valued components (VCs) selected, namely, the chiroptera and traditional use of the territory by Indigenous peoples. Therefore, all projects, activities or events (past, current or future) which may result in project cumulative effects on these VCs are assessed.

Chapter 9 lists the general procedures for managing accidents that may occur during project construction and operation.

Chapter 10 presents an overview of the follow-up and monitoring programs. Monitoring mainly concerns the construction phase and will be worked out at the planning and specifications phase. Among other things, follow-up aims at evaluating the effectiveness of the mitigation measures proposed, confirming whether certain negative effects do in fact occur, verifying compliance with standards and at applying solutions, if necessary, to protect the environment or the population.

In addition to the main report presented in two volumes (volumes 1 and 2), this study also includes another volume, regrouping all the appendices (volume 3). Moreover, several technical reports can be consulted for further details:

- Hydrogeological technical study;
- Hydrological technical study;
- Aquatic inventory and baseline study;
- Soil background concentration technical study;
- Geochemical technical study;
- Air dispersion modelling survey;
- Noise modelling survey;
- Terrestrial vegetation baseline study;

- Terrestrial wildlife and avifauna baseline study;
- Survey on the archaeological potential;
- Survey on economic spinoffs.

1.4 PROJECT LOCATION

The James Bay Lithium Mine project is located in the Nord-du-Québec administrative region, on the territory of the Eeyou Istchee James Bay Regional Government. It is located approximately 10 km south of the Eastmain River, 100 km east from James Bay and close to the Eastmain Cree village (Map 1-1). The project is on Category III lands of the JBNQA.

The geographical coordinates in UTM (zone 18, NAD83) of the site are presented below:

- X: 358,891
- Y: 5,789,180

The lands subject to the mining claim of the James Bay Lithium Mine project (Project Property) are easily accessed by the James Bay road that connects Matagami and Radisson. This road crosses the James Bay Property at kilometre 381 of the road, close to the truck stop (*relais routier)* managed by the *Société de développement de la Baie-James* (SDBJ) at that kilometre point.

A Phase I Environmental Site Assessment (ESA) was done to determine the site's environmental history, i.e. to identify potential and real environmental risks associated with past and present activities carried out on the site and in the immediate area. The full report is attached in Appendix B.

1.5 GENERAL PROJECT DESCRIPTION

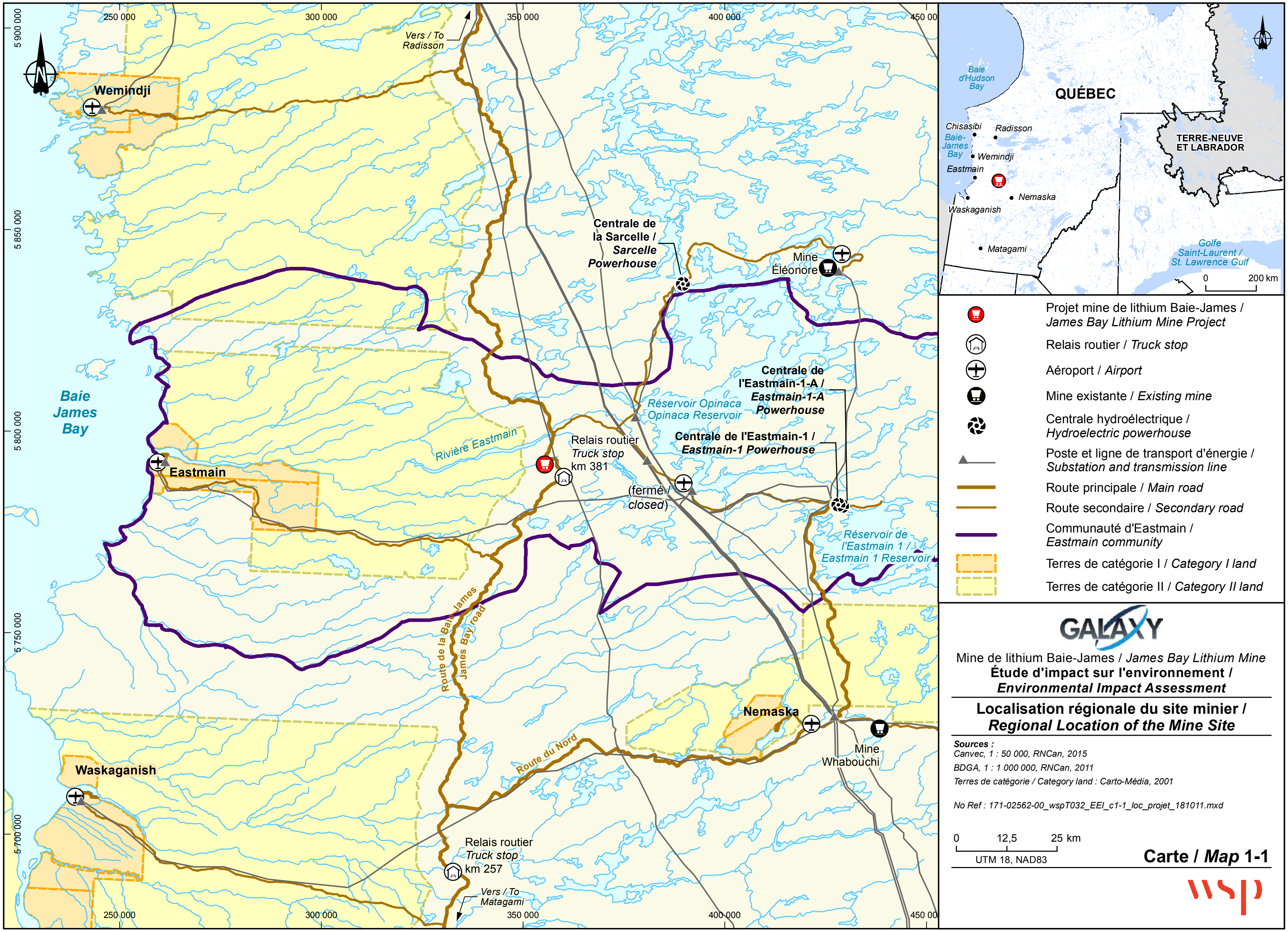
The project title is: "James Bay Lithium Mine". Its location on maps is identified with its title. Of noteworthy mention, there is currently no mine in existence.

1.5.1 MAIN INFRASTRUCTURE

The following infrastructures are planned for the James Bay Lithium Mine project. These are conventional facilities for an open pit mining operation. They include the following:

- a pit;
- a 2,000,000 t/yr spodumene concentrator;
- areas to store and stockpile overburden, topsoil, dry tailing/waste rock, extracted material and concentrates;
- raw and process water retention ponds;
- administrative and operations buildings;
- worker' camp;
- water treatment plant;
- maintenance facilities for maintenance and repair of mechanical equipment, including spare part warehousing, laboratories and emergency services facilities;
- explosive magazine.

Project details are outlined in Chapter 4.



Baie James Bay
Wemindji
Eastmain
Waskaganish
Nemaska
Vers / To Radisson
Vers / To Matagami
Rivière Eastmain
Réservoir Opinaca / Opinaca Reservoir
Réservoir de l'Eastmain 1 / Eastmain 1 Reservoir
Centrale de la Sarcelle / Sarcelle Powerhouse
Centrale de l'Eastmain-1-A / Eastmain-1-A Powerhouse
Centrale de l'Eastmain-1 / Eastmain-1 Powerhouse
Mine Éléonore
Mine Whabouchi
Relais routier / Truck stop km 381
(fermé / closed)
Relais routier / Truck stop km 257
Route de la Baie-James / James Bay road
Route du Nord
250 000
300 000
350 000
400 000
450 000
5 900 000
5 850 000
5 800 000
5 750 000
5 700 000
Baie d'Hudson Bay
QUÉBEC
TERRE-NEUVE ET LABRADOR
Chisasibi
Radisson
Baie-James Bay
Wemindji
Eastmain
Nemaska
Waskaganish
Matagami
Golfe Saint-Laurent / St. Lawrence Gulf
0 200 km
Projet mine de lithium Baie-James / James Bay Lithium Mine Project
Relais routier / Truck stop
Aéroport / Airport
Mine existante / Existing mine
Centrale hydroélectrique / Hydroelectric powerhouse
Poste et ligne de transport d'énergie / Substation and transmission line
Route principale / Main road
Route secondaire / Secondary road
Communauté d'Eastmain / Eastmain community
Terres de catégorie I / Category I land
Terres de catégorie II / Category II land
GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine
Étude d'impact sur l'environnement / Environmental Impact Assessment
Localisation régionale du site minier / Regional Location of the Mine Site
Sources :
Canvec, 1 : 50 000, RNCan, 2015
BDGA, 1 : 1 000 000, RNCan, 2011
Terres de catégorie / Category land : Carto-Média, 2001
No Ref : 171-02562-00_wspT032_EEI_c1-1_loc_projet_181011.mxd
0 12,5 25 km
UTM 18, NAD83
Carte / Map 1-1
wsp

1.5.2 MINING

The James Bay Lithium Mine project consists of the operation of a mine. The material will be mined from a pit using conventional mining methods. Rock mining will require the use of drill rigs and blasting. Tracked excavators will be used to load 61.5 t trucks that will carry economic material for processing at the concentrator. The waste rock will be transported to the designated waste rock stockpile.

1.5.3 PROCESSING

The onsite process will consist of a process of concentration of spodumene. The concentrator will allow the spodumene to be separated to obtain approximately 6.0% lithium oxide (Li_2O) concentrate. The selected process involves the crushing of the material followed by a dense media separation (DMS).

1.5.4 STORAGE AREAS

An area to stockpile and store economic material, waste rock, dry tailings, spodumene concentrate, overburden, and topsoil will be built on the site of the James Bay Lithium Mine project site. A combined stockpile will be built to store the waste rock and dry tailings. All storage areas will be set out to limit environmental impacts. Surface drainage channels will be built to divert water from every extracted and processed material. The same strategy will be used to control surface water around the infrastructure, namely, the concentrator, buildings and roads.

1.5.5 WATER MANAGEMENT

Process water is used throughout the plant to wash and rinse material. It will be recovered and recycled via the dewatering screens, tails thickener and tails filtration. Recirculation of the water will be facilitated by the fact that no chemical reagents are present in the tailings following processing. Raw water will be used to top up the process water system as required. Raw water shall be directed to the concentrator from the main retention pond.

Surface water runoff will be directed to the raw water storage pond. Appropriate wastewater management will be applied on this project. Before being released into the receiving environment, if required, the effluent will be treated to meet the applicable effluent discharge standards, including those specified in *Directive 019 for the mining industry* (D019) of the MDDELCC (MDDEP, 2012) and the federal *Metal and Diamond Mining Effluent Regulations* (MDMER).

1.5.6 WASTE MANAGEMENT

The collection and sorting of reusable, recyclable and waste materials (whether harmless or hazardous) will be carried out on site. They will then be managed by specialized contractors and transported off-site to a certified disposal site or toward appropriate services.

1.5.7 OTHER INFRASTRUCTURE

Additional infrastructure related to the development and proper management of the site will be required, namely:

- an administrative and operations building;
- an autonomous worker' camp;
- a tank farm for the fuelling of the mining equipment, for heating purposes and for backup generators.

Furthermore, Galaxy is planning to connect the mining site to Hydro-Québec's 69-kV power distribution system. This could require up to 11 km of additional power lines, depending on the route set by Hydro-Québec. The site will also be connected to the optic fiber network.

1.5.8 SITE REHABILITATION

Following the end of mining operations, rehabilitation measures will be required to bring the receiving environment back as close as possible to its original state. These measures will include management of the mining complex, waste rock piles, tailings and water from the settling ponds; and the demolition of the infrastructure and of the administrative and processing facilities. A progressive rehabilitation approach will be deployed. A mine rehabilitation plan will be filed with the Ministère de l'Énergie et des Ressources naturelles (MERN) before the start of the mine operations, as provided for under Québec's *Mining Act* (RSQ, c. M-13.1).

1.5.9 PROJECT SCHEDULE

Galaxy plans to start construction works at the mine in 2020 for its commissioning in 2022. According to the latest forecast, the mine will be in operation for about 15 to 20 years.

1.6 GALAXY'S CORPORATE SUSTAINABLE DEVELOPMENT POLICY

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

This commitment is put into practice daily by integrating the social, economic and environmental dimensions to the company's decision-making process and through the ongoing respect of the interests of its many stakeholders. Galaxy's commitment toward sustainability is reflected in its environmental and social policies, which are set forth in this section.

1.6.1 ENVIRONMENTAL POLICY

In its environmental policy, Galaxy plans to conduct its activities in a manner that respects the environment and all applicable regulations and to implement a management system that will ensure the application of the highest environmental standards possible to its products, services and processes. More specifically, Galaxy undertakes to:

- include environmental considerations in all its planning decisions and in its overall business strategy;
- evaluate the potential impact on the environment of all services and processes, from the project design to delivery and disposal;
- develop products and services and operate the facilities in a manner that prevents pollution, improves efficiency, reduces energy consumption, uses renewable resources and minimizes waste by recycling wherever possible;
- promote a culture in which all employees, contractors, suppliers, customers and community members share its commitment;
- respect cultural heritage and the local communities in which it operates;
- aim to continuously improve its environmental management system and performance by taking into account technical developments, scientific understanding, consumer needs and community expectations;
- prevent environmental incidents and have effective emergency plans;
- provide adequate training at all levels, make resource people available and ensure that the policy is well understood and applied;
- comply with applicable legislative and sectoral requirements.

1.6.2 HEALTH AND SAFETY POLICY

In its health and safety policies, Galaxy wants to take all possible and feasible measures to ensure the health and safety of its employees and other members of its personnel directly or indirectly involved in the project by eliminating all occupational injuries and diseases. Galaxy guarantees that no business objectives will compromise safety. More specifically, Galaxy undertakes to:

- make the health and safety of all employees, contractors and the public its top priority;
- promote a culture that obliges and authorizes all employees and contractors to stop work when they deem it to be hazardous;
- provide a work environment that allows each individual to be "able to work", meaning in a physical, mental and emotional state that allows them to work efficiently, free of risks to their well-being or that of others;
- plan to consult with employees on safety initiatives and measures to prevent accidents;
- offer continuous integration training and instructions to ensure that all employees and contractors understand their responsibilities and Galaxy's expectations with regard to safety;
- provide and update safe work methods for which hazards and risks have been identified and reduced to the lowest level possible;
- ensure that safe work practices are developed, implemented and continuously reviewed;
- ensure that all mobile equipment and fixed facilities are safely operated and maintained;
- ensure that all new substances, activities and processes are assessed for potential risks to health and safety;
- investigate all accidents, incidents or hazards and take corrective measures;
- comply with all applicable legislative requirements and industry standards.

1.6.3 POLICY ON HARASSMENT AND EQUAL ACCESS TO EMPLOYMENT

The principles of equal access to employment are crucial for Galaxy. These principles apply to all employees regardless of gender, sexual orientation, family situation, pregnancy, family responsibilities, race, disability, political or religious convictions, age and sex.

Furthermore, Galaxy wishes to create a work environment free of harassment and intimidation and to treat all people with dignity and respect. Galaxy will not tolerate any discriminatory behaviour whatsoever by anyone on its property.

2 PROJECT CONTEXT AND RATIONALE

2.1 HISTORY OF MINING DEVELOPMENT

Spodumene-bearing pegmatite was discovered on the project mining property in 1964 by Jean Cyr, a prospector, who then staked its boundaries in 1966. The project property was acquired by the SDBJ in 1974, which, after doing additional exploratory work, returned the property to Mr. Cyr on June 10, 1986. Little work was done over the 20 years that followed, except for a few geological compilations and some project conceptual analysis.

In April 2008, Lithium One Inc. signed a letter of intent with the SDBJ to explore a group of claims covering the territory known as the "CYR Lithium bearing Pegmatite Deposit". The Lithium One drilling campaigns done in 2008 and 2009 confirmed the presence of large pegmatite dykes, numerous swarms several hundred metres wide, one-kilometre long and up to 150 m deep. The finding of this drilling campaign was that a significant pegmatite resource could be found on this portion of the property.

In 2010, Galaxy Resources signed a memorandum of understanding with Lithium One Inc. (TSX-V LI) to acquire up to 70% of the James Bay lithium project and to form a joint venture for its development. In accordance with this memorandum of understanding, the joint venture made up of Galaxy (the subsidiary of Galaxy Resources) and Lithium One Inc. was created in 2011, in respect of the joint venture mentioned earlier, and then Galaxy immediately acquired 20% of an undivided interest in the James Bay Lithium Mine project.

In April 2012, Galaxy Resources announced that it intended to take over Lithium One Inc. by way of an arrangement transaction to acquire all issued and outstanding common shares of Lithium One Inc., the end result being that once the transaction was completed, the rights and interests of Lithium One Inc. to the James Bay Lithium Mine Project as well as its Sal de Vida lithium potash brine project in Argentina would be under the sole control of Galaxy Resources, by way of wholly owned subsidiaries. Lithium One thus became a wholly owned subsidiary of Galaxy Resources, which resulted in it being delisted from the TSX.

In 2012, Galaxy issued a project description for the James Bay Lithium Mine project, but this was suspended in 2012 because the price of lithium had fallen on the market, compromising the viability of the project. A few years later, the significant increase in the demand for lithium and promising forecasts for this market made it possible for Galaxy to relaunch its project. A new project description was submitted to provincial and federal authorities in October 2017.

The main activities conducted since the fall of 2017 include:

- further geological drilling leading to new calculations of the resources present in the deposit;
- sterilization drilling confirming the location of the various infrastructures planned;
- geotechnical drilling to evaluate the bearing capacity of the soil beneath the infrastructures;
- progress on the engineering portion of the project (Project Defintion Document);
- determination of basic design criteria for the project, more specifically, the positioning of all infrastructures to the west of the James Bay road to avoid any interference with the highway and the Hydro-Québec power line;
- the production of technical studies requiring several field surveys to document the physical, biological and socail components of the environment into which the project will be inserted;
- the opening of temporary roads and construction of observation wells in conjunction with the above activities;
- discussion regarding partnerships with local and regional organizations, the SDBJ in particular for the lodging of workers during pre-construction phase and the rental of space for the core racks;
- negotiations to reach an agreement with Hydro-Québec for the addition of a power line to serve the future facilities;
- exchanges with other mining companies on best practices for relations with the community and on local or regional sources of goods and services.

The knowledge drawn from these activities has helped to better define the project and to consider certain issues regarding the project's receiving environment:

- the traditional activities practised by the Cree within the study area of the social environment;
- the geotechnical stability of the future waste rock stockpile in relation to the nature of superficial deposits (clay).

2.2 MINING RIGHTS AND LAND TITLE

The site of the James Bay Lithium Mine project is located on Québec public lands (public land belonging to Her Majesty in right of the province of Québec). Wholly owned subsidiaries of Galaxy Resources, including the project promoter, Galaxy, are the holders of the mining claims currently comprising the mining property of the project.

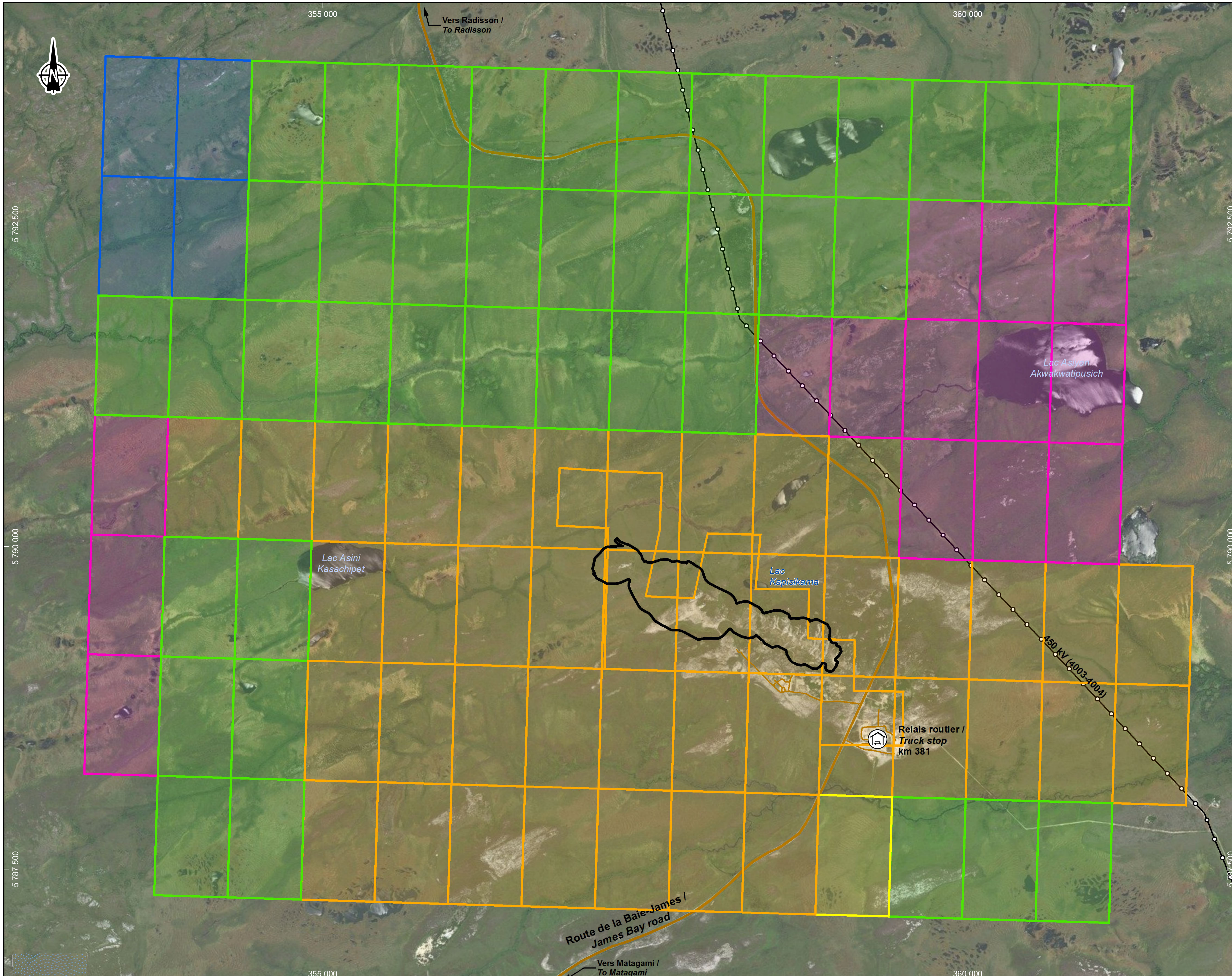
The land covered by all 54 claims forming the mining property of the project is 2,163.75 ha in area (Map 2-1). These 54 claims will expire between June 12, 2019 and March 17, 2023. Although they can be renewed for an additional two years, an application for a mining lease under section 100 of the *Mining Act* (R.S.Q. c. M-13.1) will be filed for the operation of a pit mine and concentrator with an annual production capacity of 2,000,000 t of material. This application will be submitted to MERN.

2.3 PROJECT RATIONALE

Lithium is the lightest metal in the periodic table. Its symbol is Li and it is assigned the number 3. It is a soft silvery-white metal that belongs to the alkali metals group. Lithium is highly reactive and flammable. It is never found in a free neutral state in nature, but often as a compound in minerals, the most common being spodumene, or as an ion in ocean water, as well as in brines and clays. Its lightness and high reactivity make it particularly suitable for use in the manufacture of batteries as well as in various industrial processes.

The applications for lithium are highly diverse and include the manufacture of glass and ceramics, lubricants, pharmaceutical polymers and products, air treatment and, recently and very significantly, in the manufacture of lithium ion batteries. In the past, the bulk of the lithium market was monopolized by glass and ceramics manufacturing. Today, the manufacture of lithium-ion batteries is the largest market for lithium. Hybrid and electric vehicles, portable electronic devices and renewable energy storage systems for homes and businesses are all applications that have grown significantly in recent years.

Between 2011 and 2015, there was no major change in the demand for lithium and electric vehicle sales remained insignificant. However, demand surged toward the end of 2015 in reaction to real commitments from some automobile manufacturers (Volkswagen, Ford, GM, etc.) and to the adoption of new government policies (Swiss Resource Capital AG, 2018). In 2016, it was estimated that approximately 190 KT of lithium carbonate equivalent (LCE) were produced worldwide, and roughly 44% of this LCE was used to manufacture batteries. Considering the growing interest worldwide in adopting vehicles powered by new energies (electric and hybrid) and the implementation of mass energy storage systems made up of lithium batteries, demand for this metal is expected to grow strongly in years to come. Based on the most recent growth projections for all applications combined, the demand for lithium will increase to more than 500 KT of LCE by 2025 (Swiss Resource Capital AG, 2018; BMO Capital Markets, 2018).



Contour de la fosse / *Open pit*

Propriété des claims / *Claim Owner*

- Galaxy
- Lithium MetalsTech Kapiwak inc.
- Les Explorations Carat inc.
- Jean-Pier Frigon
- Osisko Baie-James SENC

Infrastructures / Infrastructure

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

GALAXY

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

Étude d'impact sur l'environnement /
Environmental Impact Assessment

Claims miniers / *Mining Claims*

Sources :
Othoimage : Microsoft Bing (ESRI, 2017)
Gestim : MRNF Québec, 180424

No Ref : 171-02562-00_wspT033_EIE_c2-1_claims_180820.mxd

0 300 600 m
UTM 18, NAD83

Carte / *Map* 2-1

wsp

More specifically, the global demand for automobile batteries for electric vehicles will experience sustained growth until 2025, especially in China (Figure 2-1). Meanwhile, the energy storage market could double up to 12 times between now and 2030 (Figure 2-2).

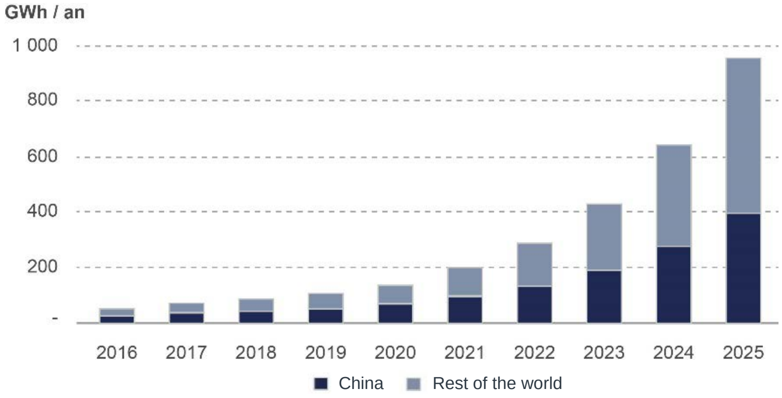


Figure 2-1: Demand for lithium-ion automobile batteries

Source: Bloomberg New Energy Finance, 2018.

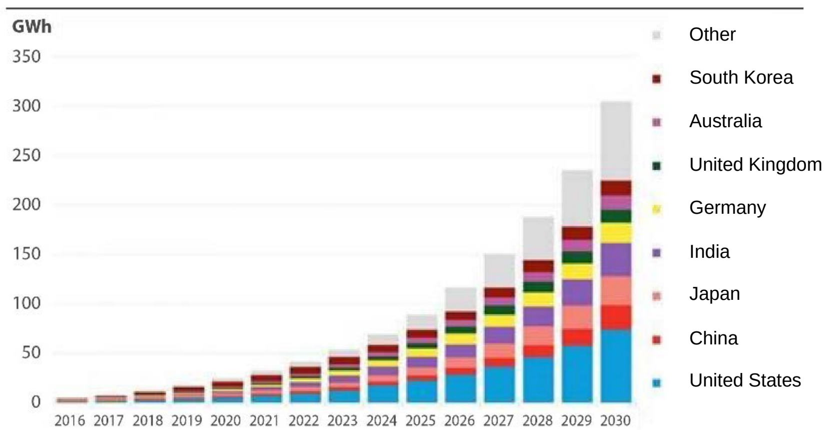


Figure 2-2: Energy storage market forecasts

Source: Bloomberg New Energy Finance, 2018.

Furthermore, the average price for LCE, which was roughly $6,000/t in 2015, should peak at around $14,000/t in 2018, drop again in 2019 and then stabilize at around $10,000/t thereafter (BMO Capital Markets, 2018).

The James Bay Lithium Mine is part of the portfolio diversification strategy of Galaxy Resources projects, joining exploitation of a brine deposit in Argentina and current exploitation of a spodumene-bearing pegmatite deposit in Australia, to adjust better to demand.

In regard to the environment into which the project will be inserted, the mine site is located in an area little disturbed by human activity, covered mainly by peatland, a typical vegetation of the James Bay region. One watercourse is present on the northern border of the site; a second is located in the south; and a small lake is found in the centre. With the exception of a km 381 truck stop 500 m southeast of the pit, no permanent or temporary dwellings are located within a radius 8 km of the projected facilities. Furthermore, the study area is used by the Cree for their traditional activities, although usage dropped following forest fires in 2005, 2009 and 2013.

From a socioeconomic standpoint, the James Bay area offers a significant pool of labour for Galaxy. Furthermore, the company plans to participate with the James Bay School board to develop training programs for the mining industry, in collaboration with Goldcorp (Éléonore Mine), Stornoway (Renard Diamond Mine) and Nemaska

Lithium (Whabouchi Mine). Attractive employment prospects will be available to qualified people, not only at the James Bay Lithium Mine, but also in other similar potential operations in the region.

The proposed project enjoys a very positive context, the following elements weighing in favour of its completion:

- the growing demand for raw lithium;
- promising market forecasts for lithium compounds for the battery manufacturing sector (including lithium carbonate and lithium hydroxide), supported by various government policies around the world as well as the new direction being taken by automobile manufacturers;
- the quality and size of the deposit, facilitating the extraction and concentration of material (low overburden and impurities), in addition to significant potential for expansion;
- the presence of hydroelectric facilities nearby, offering an accessible and reliable source of energy;
- the similarity of the James Bay deposit with that of Mt. Cattlin in Australia, making possible transfer of expertise for process development.

In addition, the project offers several advantages from an environmental and socioeconomic standpoint:

- a supply of power for the processing plant from a renewable source (hydroelectricity);
- a contribution to reducing global greenhouse gas (GHG) emissions through the processing of lithium, a raw material in the manufacture of lithium-ion batteries for electric vehicles;
- onsite primary processing to concentrate, a high-value-added product;
- the proximity of road transport infrastructure for the export of concentrate;
- the creation of good, well-paying jobs;
- significant economic impacts for Québec, especially the Nord-du-Québec administrative region.

2.4 REGULATORY FRAMEWORK

The James Bay Lithium Mine project is in the James Bay agreement territory. The JBNQA was signed in 1975 by the governments of Canada and Québec, the Grand Council of the Crees and the Northern Quebec Inuit Association. The JBNQA divides the territory into two zones at the 55th parallel: James Bay and Nunavik. Because of the project's position, legislative provisions associated with the James Bay territory apply. Section 22 of the JBNQA defines the environmental and social protection regime of the Cree people, their societies and communities and their economy in connection with development activities that affect the territory. Schedule 1 of Section 22 sets out a list of projects that are automatically subject to environmental assessment.

The territorial regime introduced by the JBNQA is a determining factor governing use of the territory. It divides the territory into Category I, II and III lands. Category I lands are allocated to the Crees for their exclusive use. They may be used for residential, community, commercial, industrial or other purposes. In addition, the Cree have exclusive hunting, fishing and trapping rights there. Category II lands are contiguous with Category I lands. They are part of the Québec public domain. These are lands in which the Cree have exclusive hunting, fishing and trapping rights. Category III lands are all agreement territory lands that are not included in Categories I and II. On these lands, the Cree have the exclusive right to trap fur-bearing animals. Furthermore, certain wildlife species are reserved for their hunting and fishing activities. On these territories, both native and non-native people may engage in hunting and fishing activities. In Category III lands, mining rights belong to the provincial government. The James Bay Lithium Mine project is located on Category III lands.

Section 22 of the JBNQA also defines the process leading to the granting of permits through the agency of three committees—the evaluation and review committees. The Evaluation Committee (COMEV), made up of representatives of the Cree nation and federal and provincial authorities, examines the notice of application and prepares guidelines in consultation with the community. The Review Committee (COMEX), made up of representatives of the Cree nation and the provincial government, studies the Environmental Impact Assessment (EIA) and recommends whether or not the project should be authorized.

2.4.1 ENVIRONMENTAL ASSESSMENT TRIGGERS

2.4.1.1 ENVIRONMENT QUALITY ACT

Opening of the James Bay Lithium Mine is subject to the provincial environmental assessment and review procedure, as provided in section 153 of chapter II of the EQA. This chapter deals with the provisions applicable to the James Bay and Northern Québec region. Schedule A of the EQA lists projects that are automatically subject to the assessment and review procedure. The James Bay Lithium Mine project is subject to the procedure because Schedule A lists "all mining developments, including additions to, alterations or modifications of existing mining developments."

The nature, scope and extent of the environmental impact assessment are defined in the Directive for the project developed by the MDDELCC (Appendix A).

2.4.1.2 JAMES BAY AND NORTHERN QUÉBEC AGREEMENT

Like the EQA, schedule 1 of section 22 of the JBNQA lists projects that are subject to the assessment process, such as mining projects.

2.4.1.3 CANADIAN ENVIRONMENTAL ASSESSMENT ACT

The project is also subject to a federal environmental assessment, as required under section 13 of the *Canadian Environmental Assessment Act* (CEAA) (2012) (S.C. 2012, c. 19, s. 52), because economic material production will exceed 3,000 t/day (par. 16[a]) and the capacity of the mill will exceed 4,000 t/day (par.16[b]) of the *Regulations Designating Physical Activities* (SOR/2012-147).

The nature, scope and extent of the environmental assessment are defined in the guidelines developed by the Canadian Environmental Assessment Agency (Appendix A).

2.4.2 APPLICABLE LAWS AND REGULATIONS

At the conclusion of the EIA, the final design of the project must comply with provincial and federal regulations applicable to the planned equipment and infrastructure. The legislation governing the project includes a number of laws, regulations, policies and directives, the most significant of which are specified below.

2.4.2.1 QUÉBEC

MINING ACT (CQLR, CHAPTER M-13.1)

The *Mining Act* (chapter M-13.1), together with the *Regulation respecting mineral substances other than petroleum, natural gas and brine* (CQLR, chapter M-13.1, r. 2), establishes the manner in which mines must be developed, operated and closed. Under the Act, mining companies must submit a site rehabilitation plan for approval by the MERN. This plan must be reviewed every five years, or whenever changes in mining operations warrant its amendment. Such a plan must therefore be developed for the present project, as required by the provincial directive setting out the requirements of the EIA.

Lastly, the Act requires that, during the two-year period following approval of the plan, the promoter must supply a financial security equivalent to 100% of the anticipated costs of completing the planned rehabilitation work. This security must be supplied in three instalments: the first instalment of 50% within 90 days of approval of the plan and each subsequent instalment of 25% on the anniversary date of approval of the plan.

DIRECTIVE 019 ON THE MINING INDUSTRY (MARCH 2012 ISSUE)

Mine operation (development, extraction and processing) and closure activities are also subject to D019, a tool widely used to analyze mining projects requiring the issue of a certificate of authorization under the EQA. As well as specifying the information to be supplied when presenting an application for a certificate of authorization, this directive includes standards for the safe management of dry tailings and the MDDELCC's major environmental protection orientations.

This directive was considered in the design of the present project, particularly with regard to mine water management and waterproofing criteria.

ENVIRONMENT QUALITY ACT (CQLR, CHAPTER Q-2)

Section 22 of the EQA stipulates that authorization must be obtained for mining projects. The main regulations to which the James Bay Lithium Mine project is subject under the EQA include:

- *Regulation respecting the application of the Environment Quality Act* (CQLR, chapter Q-2, r. 3);
- *Clean Air Regulation* (CQLR, chapter Q-2, r. 4.1);
- *Regulation respecting the landfilling and incineration of residual materials* (CQLR, chapter Q-2, r. 19);
- *Regulation respecting hazardous materials* (CQLR, chapter Q-2, r. 32);
- *Regulation respecting waste water disposal systems for isolated dwellings* (CQLR, chapter Q 2, r. 22);
- *Protection Policy for Lakeshores, Riverbanks, Littoral Zones and Floodplains* (CQLR, chapter Q-2, r. 35);
- *Water Withdrawal and Protection Regulation* (CQLR, chapter Q-2, r. 35.2);
- *Regulation respecting the quality of drinking water* (CQLR, chapter Q-2, r. 40);
- *Land Protection and Rehabilitation Regulation* (CQLR, chapter Q-2, r. 37);
- *Politique de protection des sols et de réhabilitation des terrains contaminés* (policy on the protection of soil and rehabilitation of contaminated land);
- *Regulation respecting pits and quarries* (CQLR, chapter Q-2, r. 7);
- *Regulation respecting industrial depollution attestations* (CQLR, chapter Q-2, r. 5).

ACT RESPECTING OCCUPATIONAL HEALTH AND SAFETY (CQLR, CHAPTER S-2.1)

The main health and safety law in Québec is the *Act respecting occupational health and safety*, with which the project must comply. Among its implementing regulations are the *Regulation respecting occupational health and safety* (CQLR, chapter S-2.1, r. 13), the *Regulation respecting occupational health and safety in mines* (CQLR, chapter S-2.1, r. 14), the *Hazardous Products Information Regulation* (CQLR, chapter S-2.1, r. 8.1), the *Regulation respecting prevention programs* (CQLR, chapter S-2.1, r. 10) and the *First-aid Minimum Standards Regulations* (CQLR, chapter A-3.001, r. 10).

OTHER PROVINCIAL LAWS AND REGULATIONS

- *Transportation of Dangerous Substances Regulation* (CQLR, chapter C-24.2, r. 43) of the Highway Safety Code;
- *Sustainable Forest Development Act* (CQLR, chapter A-18.1);
- *Regulation respecting standards of forest management for forests in the domain of the State*;
- *Act respecting the lands in the domain of the State* (CQLR, chapter T-8.1);
- *Petroleum Products Act* (CQLR, chapter P-30.01) and its implementing regulation;
- *Act respecting threatened or vulnerable species* (CQLR, chapter E-12.01);
- *Act respecting the conservation and development of wildlife* (CQLR, chapter C-61.1);
- *Regulation respecting wildlife habitats* (CQLR, chapter C-61.1, r. 18);
- Construction Code (CQLR, chapter B-1.1, r. 2) and Safety Code (CQLR, chapter B-1.1, r. 3) for the installation of petroleum equipment, both governed by the *Building Act*;
- *Act respecting explosives* (CQLR, chapter E-22) and its implementing regulation.

2.4.2.2 *CANADA*

CANADIAN ENVIRONMENTAL PROTECTION ACT, 1999 (S.C. 1999, C. 33)

The *Canadian Environmental Protection Act* (CEPA) is aimed at preventing pollution and protecting the environment and human health to contribute to sustainable development. Among the main regulations to which the project is subject under the implementation of the Act are the following:

- *Ozone-depleting Substances Regulations* (1998) (SOR/99-7);
- *Environmental Emergency Regulations* (SOR/2003-307).

FISHERIES ACT (R.S.C. [1985], CH. F 14).

Under the *Fisheries Act*, the *Metal and Diamond Mining Effluent Regulations* (MDMER) (SOR/2002-222) govern mining activities with regard to protection of fish habitat and the fish resource and require that environmental effects monitoring (EEM) studies be carried out. The regulations also set out mine effluent compliance requirements regarding tests to be performed and parameters to be monitored.

OTHER FEDERAL LAWS AND REGULATIONS

- *Migratory Birds Convention Act, 1994* (S.C. 1994, c. 22);
- *Transportation of Dangerous Goods Act, 1992* (S.C. 1992, c. 34) and *Transportation of Dangerous Goods Regulations* (SOR/2014 152);
- *Explosives Act* (R.S.C. [1985], c. E-17);
- *Species at Risk Act* (S.C. 2002, c. 29);
- *Hazardous Products Act* (R.S.C. [1985], c. H-3).

2.4.3 PERMITS AND AUTHORIZATIONS

After obtaining general authorizations from the provincial and federal governments, Galaxy will file applications for authorizations and permits for the construction and operation of the project, which will include detailed plans and specifications of infrastructure and facilities. A non-exhaustive list of these applications is set out below.

2.4.3.1 QUÉBEC

- Authorization under section 22 of the EQA for:
  - construction of project infrastructure;
  - groundwater catchment, water intake and the wastewater treatment system;
  - operations of an industrial establishment under the *Regulation respecting industrial depollution attestations*;
  - devices or equipment intended to prevent, reduce or stop the release of contaminants into the atmosphere (e.g. crusher deduster);
  - all work in wetlands.
- A rehabilitation and rehabilitation plan under section 232.1 of the *Mining Act*.
- An explosive permit in accordance with Division II of the *Regulation under the Act respecting explosives*.
- A permit for the use of high-risk petroleum equipment in accordance with section 120 of the Safety Code and section 8.01 of chapter VIII of the Construction Code.
- Application for use of public land (lease) for the waste rock stockpile under section 239 of the *Mining Act* and section 47 of the *Act respecting the lands in the domain of the State*.
- Authorization from the MERN for the location of the waste rock stockpile under section 241 of the *Mining Act*.
- Forest management permit from the ministère des Forêts, de la Faune et des Parcs (MFFP) for deforestation activities under the *Regulation respecting standards of forest management for forests in the domain of the State*.

2.4.3.2 CANADA

- A permit from Transport Canada under the *Transportation of Dangerous Goods Regulations*.
- An explosive permit under sections 2 and 3 of the *Explosives Act*.
- A permit for the storage of chemicals to treat mine water under the *Canadian Environemental Protection Act* (CEPA).
- Authorization for lake dewatering under the *Navigation Protection Act*.

- A permit for the use of a nuclear gauge under the *Nuclear Substances and Radiation Devices Regulations*.
- A report to the National Pollutant Release Inventory (NPRI).

2.4.3.3 *EEYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT*

Under the terms of the *James Bay Region Development Act* (L.R.Q., chapter D-8.0.1), Galaxy will file applications for authorization and permits for the construction and operation of the project with the Eeyou Istchee James Bay Regional Government (formerly the James Bay Region Municipal Organization), in particular:

- a certificate of compliance with regional regulations concerning service infrastructures, roads and mining infrastructures;
- authorization under section 5.1 of the *Règlement relatif aux permis et certificats, aux conditions préalables à l'émission de permis de construction ainsi qu'à l'administration des règlements de zonage, de lotissement et de construction;*
- a permit for a septic installation under section 4.1 of the *Règlement relatif aux permis et certificats, aux conditions préalables à l'émission de permis de construction, ainsi qu'à l'administration des règlements de zonage, de lotissement et de construction.*

3 PROJECT ALTERNATIVES

To meet the requirements of provincial and federal guidelines issued for this impact assessment, Galaxy must analyze alternatives for specific components of its project. However, some general criteria were established from the outset, thereby influencing the location of infrastructure.

First, it was determined that all the project's components would be located west of the James Bay power line and road, to avoid any interference with these infrastructures, mainly for safety and traffic reasons. This choice also made it possible to minimize the travel distances on site and the scope of transport infrastructure to be built. In addition, since the site is primarily comprised of wetlands, the effort was focused on reducing the overall footprint of the project rather than on the positioning of each of its components. Lastly, safety distances were also be considered around the pit, namely, a 200-m radius of total exclusion (no construction) and a 500-m radius of partial exclusion (restricted construction zone).

Therefore, considering the nature and location of the deposit and in the light of the general criteria set out above, no alternative study was conducted for the following aspects:

- **Mining and material extraction method:** Exploitation of the resource partially or completely underground has not been assessed since the project targets spodumene pegmatite on the surface. In addition, for economic reason, open-pit mining is the method typically preferred for mining this material.
- **Concentrator (DMS plant) location for processing:** This component was positioned in the only sector located near the pit (while respecting the exclusion radius). The few small areas without a wetland were favoured for geotechnical considerations. In fact, the bearing capacity of the soil at this location was confirmed as adequate for receiving production equipment, without major excavation of existing soil.
- **Worker's camp site:** The camp was positioned near the main infrastructure, including the concentrator and the pit, to minimize the transport of workers. In fact, the camp is within walking distance of buildings, which will help to reduce the fleet of vehicles made available to employees and prevent GHG emissions associated with them.
- **Road alignment:** The site selected for the concentrator is located 750 m from James Bay road and is outside the exclusion radius of the pit. Therefore, there is no significant access road to build, the needs being limited to site access and various roads connecting the infrastructures (pit, concentrator, waste rock and overburden stockpiles, water treatment plant, dike and explosive storage facilities) for a total of just over 8 km of roads to build. To facilitate travel and for increased safety, the decision was made that all roads on site would be two lanes. The shortest possible route was preferred with a few curves to follow the topography, limit speed and therefore improve driving safety. The preliminary alignments met these criteria, but were optimized to ensure that no road be built within 60 m of a watercourse, as stipulated in the *Regulation respecting standards of forest management for forests in the domain of the State*.
- **Water supply:** Since the project site is located in an isolated environment, there are only two viable options for the site's water supply: developing a well (or wells), or transporting water to the site. For economic and environmental reasons, the decision was made to develop water supply wells. The location of the well or wells will be determined following additional field work.

Furthermore, the components for an assessment of the technological alternatives or location has been carried out as follows:

- waste rock, tailings and overburden stockpiles (location);
- domestic wastewater treatment (technology);
- mine water management and final effluent discharge points (location).

In addition, to reduce GHG emissions associated with the project, an assessment of possible energy sources was conducted for the following components:

- mine site (process and buildings);
- mobile equipment.

3.1 WASTE ROCK, TAILINGS AND OVERBURDEN STOCKPILES

The first step in this alternative analysis consists of preselecting the possible deposition methods. Afterwards, the techniques selected undergo a comparative analysis based on different locations.

3.1.1 DEPOSITION METHODS

The deposition techniques considered at a high level included:

— the deposit as a mixture (process tailings with waste rock);
— the use of the pit as a deposit place;
— the hydraulic deposit of tailings (in sludge form) as well as a separation of coarse and fine tailings;
— the production of dewatered tailings that can be stacked;
— the production of thickened tailings.

The quantities considered for the assessment were 233.4 Mt of waste rock and 36.4 Mt of tailings[1]. Since the data concerning the density for these materials were not available at the time of the study, assumptions were made, namely, 2.4 t/m^3 for waste rock and 1.7 t/m^3 for tailings, giving them volumes of 100 Mm^3 and 20 Mm^3 respectively. In addition, considering the acid generation potential identified in the preliminary results of the geochemical technical assessment, it was assumed that protection would be installed to prevent leakeage to the environment whether it be a stockpile or a retention basin.

The hydraulic deposit was rejected from the outset due to limited space on the site and to the absence of favourable topographic features. In this case, this option would increase the environmental risks because of the sludge lagoons, in addition to increasing the footprint.

The thickened tailings option was not selected in the analysis because the reduction in water content does not provide any technical or economic benefit nor does it contribute to reducing the environmental risk associated with deposits of tailings. In fact, given the particle size distribution of tailings, their water content is low.

Finally, considering the lack of information available on the economic viability of extracting the resources that will be left in the deposit once the operation phase is completed, the deposit-in-the-pit option was also not assessed.

Therefore, the remaining management options all involve a stack of dried tailings, either as a mixed deposit (co-disposal) or by arranging a separate deposit for the tailings (co-mingling) in the same stockpile. At this stage, the deposit techniques are considered equivalent for the purposes of the analysis, the co-disposal presenting minor differences with the co-mingling regarding the areas and volumes required.

3.1.2 LOCATION OF WASTE ROCK AND TAILINGS STOCKPILES

In total, four scenarios were selected for comparative analysis. For calculation purposes, a slope of 2.5H:1V was selected for the waste rock stockpile and mixed material stockpile, while a slope of 5H:1V is applied to the tailings stockpile. Note that no bed or access ramp was considered in the calculations at this stage.

The Pugh decision matrix was selected as a decision support tool. Multi-criteria analysis was conducted to determine the best option for locating stockpile from an environmental, technical, economic and socioeconomic point of view. Criteria were then developed for each of these categories, with the aim of differentiating the options between them. The criteria were measured using quantitative or qualitative indicators. A weight has been assigned to each of them based on its relative importance within the same category. The categories themselves are also weighted, the environment considered the most important. Option 1 is defined as the reference scenario with a score of zero for

[1] Based on data available on January 5, 2018.

each of the indicators, except for those that were clearly favourable or unfavourable for this scenario from the start. The other three options receive scores of -2 (worse), 0 (neutral) or +2 (best) compared to option 1.

The four options are summarized below and the technical details for each of them are provided on Table 3-1. Their location is shown on Map 3-1.

Table 3-1: Details of assessed stockpile options

Parameter	Option 1	Option 2	Option 3	Option 4	
				North	South
Stockpile capacity (Mm^3)	120	77.5	120	20	100
Stockpile elevation (m)	300	330	280	255	290
Stockpile height (m)	94	128	68	53	84
Retention basin capacity (Mm^3)	1.05	0.43	1.65	0.24	1.05
Required WTP capacity (estimate) (m^3/s)	0.3	0.3	0.06	0.45	

Option 1

The first option is tailings and waste rock deposit in the form of a mixture. The stockpile is located south of the pit, near the James Bay road and the km 381 truck stop. Two peripheral ditches collect the water and an auxiliary pumping station is needed to transport them to the retention basin.

Option 2

Option 2 is tailings and waste rock deposit as a mixture. The stockpile is located on the north side of the pit. The two bodies of water and the mining property line are constraints that reduce the capacity of the stockpile. A peripheral ditch collects water flowing by gravity toward the retention basin.

Option 3

Option 3 is also tailings and rock waste deposit as a mixture. The stockpile is located on the west side of the pit. The stockpile extends outside the property line and encompasses a body of water. For this reason, creek CE3 and lac Asini Kasachipet must be dry. No peripheral ditches are required and the water is directed toward the gravity retention basin.

Option 4

The last option involves the development of two separate stockpiles for tailings and waste rock. The waste rock stockpile is located to the south of the pit, near the James Bay road and the km 381 truck stop. The tailings stockpiles can be found on the north side of the pit. Each of the stockpiles requires two peripheral ditches. First, a pumping station steers the water from the ditches of the northern stockpile toward its retention basin, then a second pumping station transfers the water from the northern basin to the southern basin.

Table 3-2 presents the alternative assessment summary while Table 3-3 presents the decision matrix by count. The highest score was assigned to Option 2 with 746 points. This option also offers the best performance from an environmental and socioeconomic point of view. Option 4 was the best in technical terms while Option 1 was the most economical.

Since the environmental component is the most important category of the assessment, the criteria for wildlife and aquatic habitat put Option 3 at a significant disadvantage, as it requires the destruction of fish habitat. In addition, a permit is required for this option, which leads to delays in the project schedule.

The economic component is also important, especially the indicators with the most weight, the installation of waterproof membranes and closure. These two indicators are unfavourable for Options 3 and 4.

Considering the above, Options 3 and 4 are considered the worst and are abandoned at this stage.

Table 3-2: Summary score of the assessment of site alternatives for waste rock and tailings stockpiles

Score	Option 1	Option 2	Option 3	Option 4
Environment	0	110	-90	-60
Technical	0	-65	-40	25
Economic	0	-3	-82	-102
Socioeconomic	-65	190	160	65
Total before weighting	-65	232	-52	-72
Total weighted	**-130**	**746**	**-326**	**-391**
Note: The weighting factors are: environment = 4, technical = 1, economic = 3, socioeconomic = 2.				

Option 2 is more beneficial than Option 1 from an environmental and socioeconomic point of view. In fact, Option 1 is at a disadvantage because it affects the creek CE2 downstream from the stockpile. In addition, certain socioeconomic indicators (atmospheric emissions, noise, traditional way of life and landscape) are unfavourable to Option 1 since the stockpile is located near the km 381 truck stop and the creek CE5, in addition to presenting the highest final elevation.

At the time of preparation of the project description, the location of the stockpile was to the south of the pit (Option 1). During consultations with the Cree of Eastmain, the tallyman of trapline RE2 indicated that, among the watercourses in the study area, the creek CE5 was the one his family valued. The concerns of this stakeholder, in addition to the results of the assessment, led to the selection of Option 2, despite its lack of required capacity (78 vs. 120 Mm^3). Option 2 was considered the best and was recommended. Optimization of the design of the stockpile at the engineering stage has made up for the shortfall in volume.

3.1.3 LOCATION OF OVERBURDEN STOCKPILES

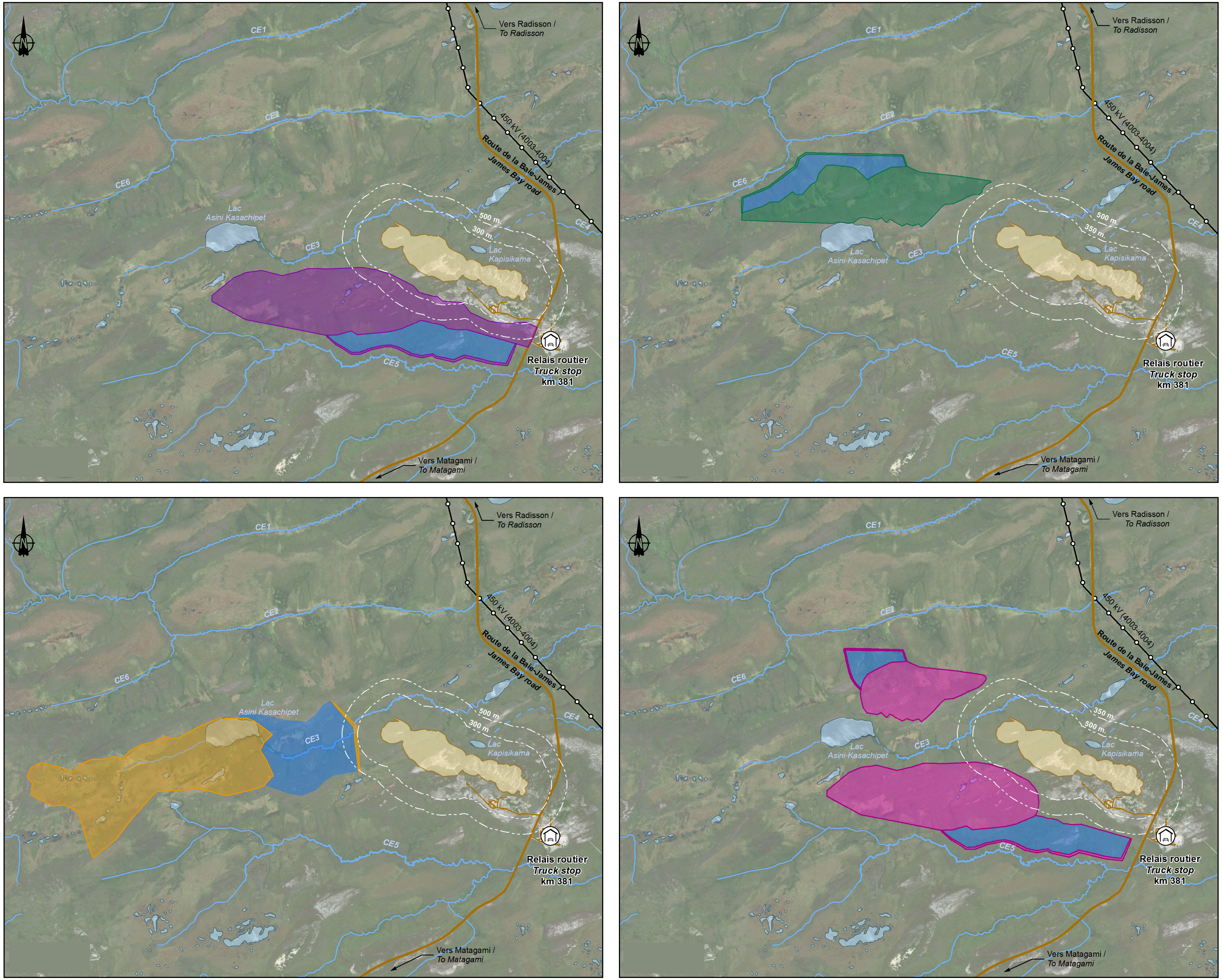
Prior to the geotechnical investigations, an area north of the pit had been identified as preferable for accommodating the overburden stockpile. The results of the field campaign made it possible to calculate the volumes of unconsolidated deposits and organic matter (mainly peat) that would have to be stored in this stockpile. These volumes were considerably higher than anticipated. Therefore, the north footprint had to be increased and the overburden stockpile split up into two stockpiles, one for organic matter and the other for unconsolidated deposits.

At this point, it was agreed that a second mining effluent would be developed in the sector harbouring organic matter and unconsolidated deposits, by delineating drainage basins on the territory. In fact, the stockpiles cover a significant enough overall area that if the runoff water had been pumped toward the main retention basin, it would have modified the nearby water levels and creek flows. Furthermore, the geochemical characteristics of the superficial deposits were an indication that the latter were not leaching metals and had no acid generating potential.

A second option was explored west of the pit. A comparative analysis was performed to identify which option would best support the project. The locations of the various options analyzed are illustrated on Map 3-2. The main findings of this analysis were as follows:

- The North option called for a stockpile several metres in height close to the James Bay road (which created some worry as to possible problems with visibility on the road).
- Kapisikama Lake, creek CE4 and a special status plant in the North sector also curtailed the available storage options.
- The West option was located further from the pit (longer route for stripping). After an examination, however, it was determined that most of the materials stored in the stockpiles would be peat from the waste rock stockpile and topsoil stripping from the industrial sector.
- The North option was partially located in a terrestrial environment, which would have had the advantage of limiting losses associated with the wetlands.
- The West option was fully within the limits of a single drainage basin, meaning any impacts would have only involved a portion of one creek.

After having carefully considered all this information, the West option was selected.



Variantes des haldes / *Stockpile Alternative*

- Option 1 / *Option 1*
- Option 2 / *Option 2*
- Option 3 / *Option 3*
- Option 4 / *Option 4*

Composantes du projet / *Project Component*

- Fosse / *Pit*
- Bassin de rétention / *Retention basin*
- Zone tampon / *Buffer zone*

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

Étude d'impact sur l'environnement / *Environmental Impact Assessment*

Options d'emplacement de la halde à stériles / *Waste Rock Stockpile Location Options*

Sources :
Orthoimage : Galaxy août / august 2017
Inventaire / Inventory : WSP 2017

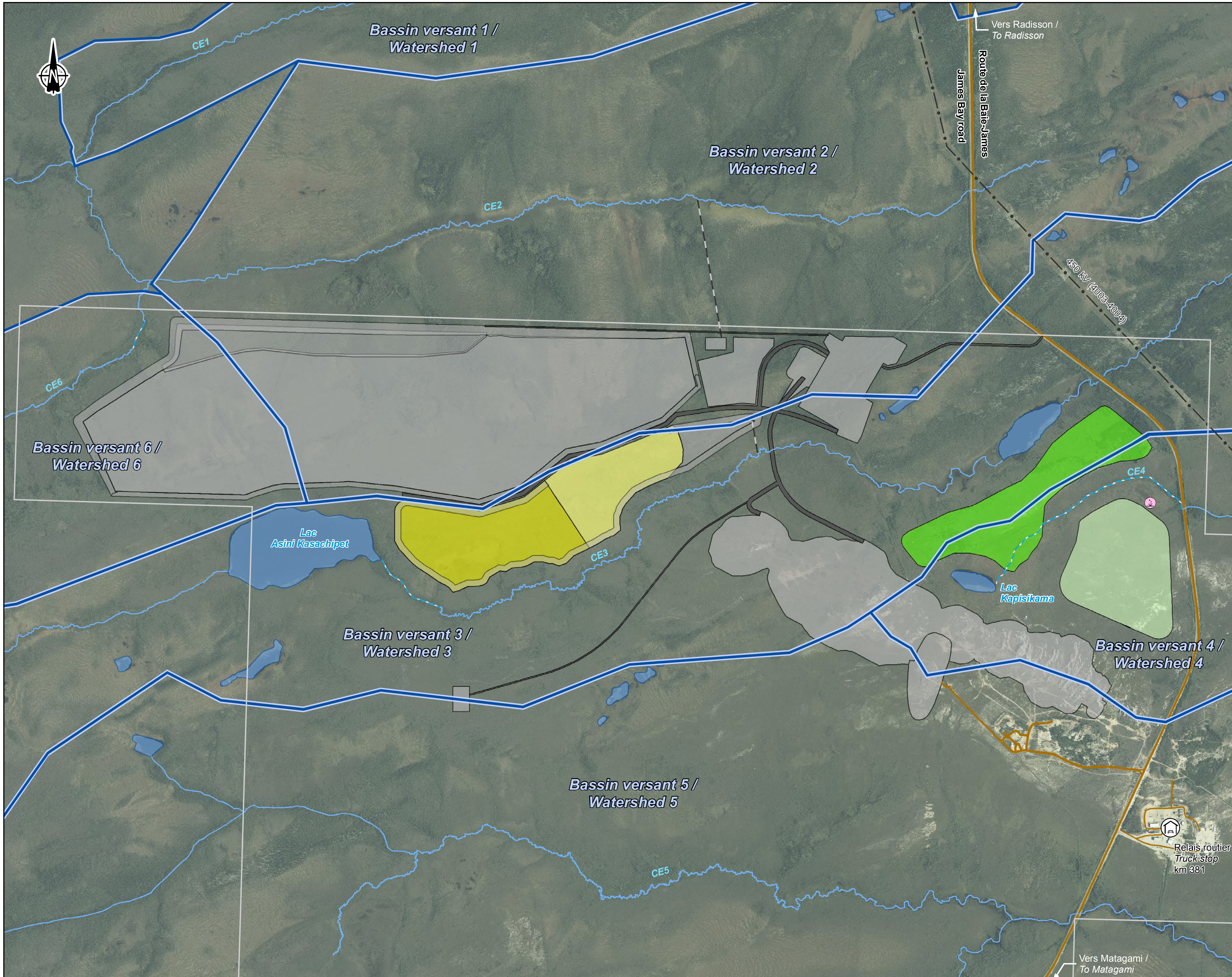
No Ref : 171-02562-00_wspT073_EIE_c3-1_var_halde_180831.mxd

0 475 950 m

UTM 18, NAD83

Carte / *Map 3-1*

wsp



Limite de propriété / *Property limit*

Variante des haldes / *Stockpile Alternative*

Option nord / *North Option*

Halde à matière organique / *Organic matter stockpile*

Halde à dépôts meubles / *Unconsolidated deposit stockpile*

Option ouest / *West Option*

Halde à matière organique / *Organic matter stockpile*

Halde à dépôts meubles / *Unconsolidated deposit stockpile*

Composantes du projet / *Project Component*

Route / *Road*

Effluent minier / *Mine effluent*

Infrastructures minières / *Mining infrastructure*

Infrastructure / *Infrastructure*

Route principale / *Main road*

Route d'accès / *Access road*

Ligne de transport d'énergie / *Transmission line*

Relais routier / *Truck stop*

Espèce végétale susceptible d'être désignée / *Plant Species Likely to be Designated*

Carex sterilis

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 flowstream*

Plan d'eau / *Waterbody*

Bassin versant / *Watershed*

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Étude d'impact sur l'environnement / *Environmental Impact Assessment*

Options d'emplacement des haldes à mort-terrain / *Overburden Stockpiles Location Options*

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018

No Ref : 171-02562-00_wspT108_EIE_c3-2_halde_peat_dep_180831.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 3-2

wsp

Table 3-3: Multi-criteria analysis for the location of tailings stockpiles

			Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
Criteria	Indicator	Weight	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
1 Environmental elements														
1.1: Hydrology	Number of affected drainage basins	10	0	0	2 drainage basins	2	20	1 drainage basin	2	20	1 drainage basin	-2	-20	3 drainage basins
1.2: Total ground footprint	Area	10	0	0	3,075,000 m^2	0	0	3,097,745 m^2	-1	-10	3,624,000 m^2	-1	-10	3,822,500 m^2
1.3: Fauna and aquatic habitats	Habitat destruction. Impact of the hydrologic budget on watercourses and fish populations.	50	0	0	No habitat destruction. Moderate impact of the hydrologic budget on creek CE5. Negligible impact of the hydrologic budget on creek CE3. Creek CE5 is home to the largest fish population of all of the five watercourses inventoried.	2	100	No habitat destruction. Low impact of the hydrologic budget on creek CE2.	-2	-100	Habitat destruction: 188,500 m^2 of lake habitat and 2,830 m of watercourses. Strong impact of the hydrologic budget on creek CE3.	0	0	Effluent in creek CE5. No habitat destruction. Low to moderate impact of the hydrologic budget on creek CE5. Very low impact of the hydrologic budget on creek CE2. Negligible impact of the hydrologic budget on creek CE3. Creek CE5 is home to the largest fish population of all of the five watercourses inventoried.
1.4: Fauna and terrestrial habitats	Wetlands area	20	0	0	3,003,000 m^2	0	0	3,023,960 m^2	0	0	3,406,400 m^2	-1	-20	3,673,500 m^2
1.5: Threatened or vulnerable species	Presence or absence of threatened or vulnerable species	10	0	0	No plant species, mammals, birds, reptiles or fish with a special status.	-1	-10	Presence of a plant likely to be designated threatened or vulnerable. No mammals, birds, reptiles or fish with a special status.	0	0	No plant species, mammals, birds, reptiles or fish with a special status.	-1	-10	Presence of a plant likely to be designated threatened or vulnerable. No mammals, birds, reptiles or fish with a special status.
Subtotal		**100**		**0**			**110**			**-90**			**-60**	

Score: -2 = worse, 0 = neutral, 2 = best.

Table 3-3: Multi-criteria analysis for the location of tailings stockpiles (cont.)

			Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
Criteria	Indicator	Weight	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
2 Technical elements														
2.1: Stability of the works	Maximum stockpile height	5	0	0	94 m	-2	-10	128 m	2	10	69 m	1	5	53 m (North) and 84 m (South)
2.2: Simplicity of design and construction	Length and height of the levees	5	0	0	h = 6.5 m l = 2.5 km	0	0	h = 5.5 m l = 2.7 km	2	10	h = 6.9 m 1.0 km	-2	-10	h = 6 m l = 5.2 km
2.3: Water management system design	Number of facilities and their capacity	10	0	0	1 pumping station 1 WTP Capacity: 0.3 m^3/s	1	10	0 pumping stations 1 WTP Capacity: 0.3 m^3/s	2	20	0 pumping stations 1 WTP Capacity: 0.06 m^3/s	-2	-20	2 pumping stations 1 WTP Capacity: 0.3 + 0.15 m^3/s
2.4: Access roads and hauling roads design	Qualitative assessment (maximum slope, number of creek crossings)	5	0	0	One creek crossing (from the plant to the stockpile), slope of 10%, 90 m of vertical relief	-1	-5	One creek crossing (from the plant to the stockpile), slope of 10%, 120 m of vertical relief	0	0	One creek crossing (from the plant to the stockpile), slope of 10%, 65 m of vertical relief	-1	-5	1 creek crossing (from the plant to the stockpile), slope of 10%, 80 m of vertical relief
2.5: Stockpiles design	Stockpile capacity	30	0	0	120 Mm^3	-2	-60	78 Mm^3	0	0	120 Mm^3	2	60	120 Mm^3 + available capacity
2.6: Ease of stockpile development	Qualitative assessment	10	0	0	Access: easy, near the James Bay road. Proximity of physical barriers: One section near a creek, not contiguous to the property lines. Surface: plan with a slight slope, one section near a creek.	-1	-10	Access: surrounded by wetlands, far from any road. Proximity of physical barriers: contour of the stockpile half on the property line or near a creek. Surface: slight slope.	-2	-20	Access: surrounded by wetlands, far from any road, creek crossing. Proximity of physical barriers: acquisition of land required and encroachment on a lake and creek. Surface: slight slope, inside a valley.	-1	-10	Access: surrounded by wetlands, far from any road. Proximity of physical barriers: sections of the contour of the stockpile half on the property line or near a creek. Surface: slight slope.
2.7: Land ownership and permits	Qualitative assessment	30	0	0	Inside the property lines, no fish habitat compensation required.	0	0	Inside the property lines, no fish habitat compensation required.	-2	-60	Land acquisition and fish habitat compensation (lakes and creeks) required.	0	0	Inside the property lines, no fish habitat compensation required.
2.8: Blasting risk management	Presence of infrastructure inside the exclusion zones.	5	0	0	Stockpile partially inside the restricted construction zone.	2	10	Stockpile outside the restricted construction zone.	0	0	Retention basins and levees inside the restricted construction zone.	1	5	One of the two stockpiles partially inside the restricted construction zone.
Subtotal		**100**		**0**			**-65**			**-40**			**25**	
Score: -2 = worse, 0 = neutral, 2 = best.														

Table 3-3: Multi-criteria analysis for the location of tailings stockpiles (cont.)

Criteria	Indicator	Weight	Option 1 South stockpile (reference scenario) Score	Weighted result	Justification	Option 2 North stockpile Score	Weighted result	Justification	Option 3 West stockpile Score	Weighted result	Justification	Option 4 2 separate stockpiles Score	Weighted result	Justification
3 Economic elements														
3.1 Capital expenditures (CAPEX)														
3.1.1: Surrounding ditches	Length of ditches	3	0	0	4,150 m ($3.5M)	1	3	1,150 m ($1M)	2	6	None	-1	-3	5,700 m ($4.8M)
3.1.2: Surrounding levees	Volume of levees	4	0	0	205,000 m^3 ($4.7M)	1	4	116,000 m^3 ($2.7M)	2	8	65,000 m^3 ($1.5M)	-2	-8	290,000 m^3 ($6.7M)
3.1.3: Protection for the stockpiles and basins	Total area to seal/keep dry	50	0	0	3,075,000 m^2 ($67M)	0	0	3,097,745 m^2 ($68M)	-1	-50	3,624,000 m^2 ($80M)	-1	-50	3,822,500 m^2 ($84M)
3.1.4: Water treatment	WTP capacity	2	0	0	0.30 m^3/s ($2M)	0	0	0.30 m^3/s ($2M)	2	4	0.06 m^3/s ($400K)	-2	-4	0.45 m^3/s ($3M)
3.1.5: Water management														
3.1.5.1: Pumping stations	Number of auxiliary pumping stations	1	0	0	One pumping station to steer the ditch water to the retention basin ($100,000).	2	2	No auxiliary pumping station required.	2	2	No auxiliary pumping station required.	-2	-2	Two auxiliary pumping stations required ($200,000): • one from the North stockpile ditches to its retention basin; • one to transfer the water from the North stockpile to the South stockpile facilities.
3.1.5.2: Pipes	Pumping distance	1	0	0	3,345 m from the WTP to the plant and 1,055 m between the ditches	2	2	1,745 m from the WTP to the plant	2	2	1,165 m from the WTP to the plant	-1	-1	5,090 m from the WTP to the plant and 1,055 m between the ditches
3.1.6: Fish habitat compensation and land acquisition	Qualitative assessment	1	0	0	No compensation required. No acquisition required.	0	0	No compensation required. No acquisition required.	-2	-2	Fish habitat compensation required. Land acquisition required.	0	0	No compensation required. No acquisition required.
3.1.7: Closing costs	Area to restore	24	0	0	3,075,000 m^2 ($37M)	0	0	3,097,745 m^2 ($37M)	-1	-24	3,624,000 m^2 ($43.5M)	-2	-48	3,822,500 m^2 ($46M)
3.2 Operating expenses (OPEX)														
3.2.1: Transportation of waste rock	Distance between the ditch and the stockpiles	7	0	0	3.1 km from ditch to stockpile	-1	-7	4.0 km from ditch to stockpile	-2	-14	5.3 km from ditch to stockpile	0	0	3.1 km from ditch to tailings stockpile
3.2.2: Transportation of tailings	Distance from the plant to the stockpiles	7	0	0	2.7 km from the plant to the stockpile	-1	-7	3.4 km from the plant to the stockpile	-2	-14	4.5 km from the plant to the stockpile	2	14	1.9 km from the plant to the tailings stockpile
Subtotal		**100**		**0**			**-3**			**-82**			**-102**	

Score: -2 = worse, 0 = neutral, 2 = best.

Table 3-3: Multi-criteria analysis for the location of tailings stockpiles (cont.)

			Option 1			Option 2			Option 3			Option 4		
			South stockpile (reference scenario)			North stockpile			West stockpile			2 separate stockpiles		
Criteria	Indicator	Weight	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification	Score	Weighted result	Justification
4 Socioeconomic elements														
4.1: Atmospheric emissions	Qualitative assessment at the km 381 truck stop	40	-1	-40	Majority of the hauling carried out near the km 381 truck stop	2	80	Majority of the hauling carried out far from the km 381 truck stop	2	80	Majority of the hauling carried out far from the km 381 truck stop	1	40	Part of the hauling carried out near the km 381 truck stop
4.2: Noise nuisance	Qualitative assessment at the km 381 truck stop	25	-1	-25	Majority of the hauling carried out near the km 381 truck stop	2	50	Majority of the hauling carried out far from the km 381 truck stop	2	50	Majority of the hauling carried out far from the km 381 truck stop	1	25	Part of the hauling carried out near the km 381 truck stop
4.3: Upholding of the traditional lifestyle	Qualitative assessment of loss of hunting, fishing or gathering zones, as well as loss of access.	20	0	0	Pond for active goose hunting and beaver tapping downstream on the creek CE5.	2	40	No traditional activity identified in the surrounding area.	2	40	No traditional activity identified in the surrounding area.	0	0	Pond for active goose hunting and beaver tapping downstream on the creek CE5.
4.4: Landscape	Qualitative assessment of the perspective and relief, compared with the existing topography.	10	0	0	Maximum elevation of the stockpile: 300 m	2	20	Maximum elevation of the stockpile: 330 m	0	0	Preliminary result, directly proportional to the maximum elevation of the stockpile: 280 m	0	0	Preliminary result, directly proportional to the maximum elevation of the stockpile: 290 m
4.5: Archaeology	Number of sites with archaeological potential	5	0	0	None	0	0	None	-2	-10	Three sites with potential near the infrastructure	0	0	None
Subtotal		**100**		**-65**			**190**			**160**			**65**	

Score: -2 = worse, 0 = neutral, 2 = best.

3.2 DOMESTIC WASTEWATER TREATMENT

3.2.1 DESIGN CRITERIA

The worker' camp must have a domestic wastewater treatment system for personnel during the mine's construction and operation phases. Design criteria were developed to evaluate the various possible treatment technologies. These criteria, based on the number of people requiring service and the requirements of the *Guide pour l'étude des technologies conventionnelles de traitement des eaux usées d'origine domestique* (MDDELCC 2017), are as follows:

System capacity

- Unit flow for a camp: 200 L/pers/d
- Unit flow for the cafeteria: 12 L/pers/d
- Number of meals served in the cafeteria: breakfast 100%, lunch 20%, dinner 100%
- Construction phase:
  - number of people: 280
  - total flow of water to be treated: 280 pers * 200 L/pers/d = 56,000 L/d
- Operation phase:
  - number of people: 150
  - total flow of water to be treated: 150 pers * 200 L/pers/d = 30,000 L/d

Disposal site (in the case of an absorption or leaching field)

- Maximum grade: 10%
- Depth of rock: > 2.5 m
- Depth of water table: > 2.5 m
- Permeability of site: very permeable and homogeneous on a horizon up to 2.5 m
- Distance of site from bodies of water: $\geq$ 200 m from a lake and $\geq$ 100 m from the tributary stream of that lake
- Distance of site from drinking water supply wells: $\geq$ 100 m

3.2.2 TREATMENT TECHNOLOGIES CONSIDERED

Seepage of treated water into the soil has been preferred from the outset, even though some technologies offer a tertiary treatment option that discharges treated water directly into a creek. The environmental requirements for water seepage into natural soil are far less stringent than for discharge into a creek, even with tertiary treatment. Considering that the flow to be treated is higher than 10,000 L/d (10 m^3/d), the treatment systems considered that include seepage into soil require a low pressure feed system.

The following four technologies were studied:

- absorption field with a seepage bed for very permeable soil;
- absorption field, Enviro-Septic technology for permeable to very permeable soil;
- modular units combined with mobile units (Bionest SA-10000 and KODIAK technology), with a leaching field;
- modular unit of a rotating biological contactor type (Ecoprocess, MBBR technology).

The first three technologies may or may not be combined with a retention basin, as described below, to reduce the scale of the treatment system selected. For MBBR technology, since the system cannot be reduced, there would be no benefit to adding a basin.

Absorption field with seepage bed

For this conventional technology, the soil thickness below the absorption field after the water table rises must be 0.9 m. This space may have to be increased to 1.5 m depending on the proximity of lakes and streams. The natural sand below the seepage bed must be very permeable. A septic tank provides primary treatment upstream. The absorption field is then supplied by a low pressure feed system (LPFS) and a dosing (pumping) station. The field is divided into three separate areas, each supplied by a force main fitted at the outlet of the dosing station. Each main is shut off one at a time to give one section a break. Regular environmental monitoring is required during the year through sampling below the seepage bed.

Absorption field, Enviro-Septic technology

This advanced secondary treatment absorption field allows for a seepage rate of up to 50 L/m². A smaller soil thickness of 0.3 m is required below the absorption field after the water table rises. The sand filter must meet certain specifications and be certified by a laboratory. Just like the seepage bed, a septic tank provides primary treatment upstream, and the absorption field is then supplied by an LPFS and a dosing station. The absorption field works the same way, meaning that it is divided into three separate areas, each of which is given a break one at a time. Regular environmental monitoring is required during the year through sampling below the seepage bed. Enviro-Septic must visit annually.

Fixed unit, Bionest technology with leaching field

This technology is an advanced secondary treatment system whose Bionest treatment components are inserted into a reactor composed of fixed modular units (SA-10000) or mobile units (Kodiak). Both types of unit can be combined depending on the project scope and duration. The group of modular units would be installed permanently to meet needs during the operation phase (30,000 L/d), whereas the group of mobile units could be used temporarily to fill additional needs during the construction phase (26,000 L/d). The treated water would be discharged into a leaching field.

- SA-10000 modular units:
  - oversized septic tank (V= 2.3 * Q) required upstream, with pumping station;
  - 3 buried units, measuring 6 m x 2 m x 2 m, with a capacity of 10,000 L/d each;
  - biofilm mounted on filament requiring a recirculation station and forced ventilation;
  - regular environmental monitoring, sampling at Bionest outlet and annual visit by supplier.
- Kodiak mobile units:
  - 3 above-ground units, mounted in insulated containers, with a capacity of 11,000 L/d each;
  - oversized septic tank (V= 2.3 * Q) included in each unit;
  - biofilm mounted on filament requiring a recirculation station and forced ventilation;
  - possibility of reselling the units at the end of the construction phase;
  - regular environmental monitoring, sampling at Bionest outlet and annual visit by supplier.
- Leaching field:
  - LPFS-type installation;
  - use of natural soils suitable for seepage;
  - minimum soil thickness of 0.3 m below the field after the water table rises.

Fixed unit, Ecoprocess MBBR technology with leaching field

This treatment solution works with a Moving Bed Biofilm Reactor (MBBR). The treatment process consists of four stages: primary settling, which allows secondary sludge to be stored, a buffer tank, an MBBR-type secondary aerobic treatment and secondary settling. The secondary settling separates the sludge that formed in the biological reactor and discharges clarified water to a seepage area (in this case, a leaching field).

The reactor is designed based on the flow and load to be treated. Installation on the site is fixed and permanent. Regular environmental monitoring is required during the year through sampling at the reactor outlet, and a visit from the supplier is required annually.

Retention basin

A retention basin can be set up to store surplus domestic wastewater during the construction phase for offsite treatment. The basin would have a storage capacity that meets the needs of 130 people for one month, that is, a filling volume of 780 m^3 given a daily flow of 26,000 L/d. The collected water would be drained periodically at a rate of one to two tanker trucks per day. During the operation phase, a permanent treatment system would be installed to serve the 150 expected workers. This option requires a prior agreement between the mine and the owner of the sanitary treatment system.

Tables 3-4 and 3-5 summarize the design criteria and features of the various systems studied, depending on whether or not they will be combined with a retention basin.

3.2.3 METHODOLOGY

To characterize the alternative technologies for domestic wastewater treatment, indicators were formulated in the categories deemed relevant based on the context and the issues involved in this project (economic, technical and environmental aspects). The following weightings were selected for these categories: economic (5), technical (3) and environment (2). The indicators were then assessed, qualitatively or quantitatively, using a scale from 1 (worst) to 5 (best). A quantitative analysis was performed for the technologies studied (scenario 1) but was not completed for the combination of these technologies with a retention basin (scenario 2) since the transport costs for emptying the basin were not known at the time it was performed. The results and the detailed analysis are presented in Tables 3-6 and 3-7.

3.2.4 RESULTS

The basin scenario, which entails adding a retention basin to each of the technologies studied, is not considered economically advantageous at this stage since transport and off-site water treatment costs must be considered.

Therefore, of the four alternatives studied in the scenario without a retention basin, the rotating biological contactor (Ecoprocess MBBR technology) seems to be the best choice, all criteria combined. It is also the most economical choice.

Nevertheless, after checking the information available at this stage, it was found that an absorption or leaching field could not be installed in the immediate camp environment. According to the results of the geotechnical surveys, the soil in place is not adequate for the installation of such a system on the mine property. In general, the water table is less than one metre from the ground surface and the desired sand horizon is invariably under a layer of peat 0.7 to 1.5 m thick. For this reason, a tertiary treatment was added to the selected alternative.

Thus, the prospective supplier for the rotating biological contactor could also offer the tertiary treatment unit to comply with the disinfection and phosphorus standards required for direct discharge into a creek. This system requires a service building (3 m x 4 m) to accommodate dosage pumps for phosphorus removal and the disinfection unit (UV lamp) at the exit of the Ecoflo.

Additional costs for the addition of this tertiary treatment are estimated at $21,000 for the equipment only, excluding delivery, installation and annual operating costs.

3.2.5 EFFLUENT DISCHARGE LOCATION

The current plan is to have the discharge point on the creek CE3, through the overburden stockpiles' sedimentation basin or directly into the creek. The final choice will be made following further work based on technical and environmental considerations (characterization results, field visit, request for Effluent Discharge Objectives [EDOs] to be filed, etc.).

3.3 MINE WATER MANAGEMENT AND FINAL EFFLUENT DISCHARGE LOCATIONS

As presented in this chapter, the project's infrastructure has been positioned to minimize watershed changes (quantities of water to be redirected) and to simplify water management at the site. The details of this water management are presented in Chapter 4. The WTP was placed as far upstream as possible from creek CE2 to avoid a reduced flow area on this creek. Thus, since the mining infrastructure was optimized throughout the project design, no analysis of alternatives was necessary on the position of the mining effluent. The mining effluent site on the creek CE2 was selected using videos of creeks taken with a drone to position it at the best location along the stream, over a segment of 200 m. The mining effluent on the creek CE3 has been placed near the crossing of the hauling road to facilitate sampling and minimize the deposit footprint.

3.4 POWER SUPPLY AT THE MINE SITE

The project, as defined in the Project Defintion Document, requires 8.3 MW to power the fixed infrastructure. Near the project, Hydro-Québec's network includes three 735-kV transmission lines and a 450-kV line from the La Grande-2 and La Grande-2A generating stations, which head south in Québec and a 315-kV line between the Sarcelle and Eastmain-1 generating stations. Also, a 69-kV line from the Muskeg generating station near the former Opinaca airport heads west to supply the community of Eastmain, running 7 km south of the mine site. Using this renewable energy network to supply the concentrator and other project infrastructure was therefore the first option considered.

The construction of a substation of 75 kV or more and a transmission line of 75 kV or more would require an impact assessment as per the requirements of Schedule A of the EQA. Hydro-Québec would be responsible for this assessment since it owns the network. According to Hydro-Québec’s representatives, the time required to obtain authorizations and build the infrastructure for this option, which involves a connection to the 315-kV line, is four years, whereas a connection to the 69-kV line would be two years. To optimize management of the preliminary design studies and permit applications, the option to connect to the 69-kV line has been prioritized. With this option, Hydro-Québec will be able to supply a maximum of 7.6 MW.

To make up the difference, another source of energy is needed to supply the mine site. The choices are solar, wind, natural gas, liquefied natural gas (LNG) and propane. Natural gas has been eliminated since there is no distribution system in the area.

Renewable energy seems attractive at first glance because it minimizes GHG emissions and reduces operating expenses (OPEX). However, because it is direct energy, it must be used as soon as it is produced or accumulated in a battery. Since they are still very expensive, batteries increase capital expenditure (CAPEX). A study conducted by a specialized firm (Tugliq) revealed that the installation of solar or wind farms first requires local availability studies to determine sunshine constancy, radiation strength as well as wind speed and constancy. It is also important to consider that a wind farm can interfere with airport radars and requires social acceptance by neighbouring communities, mainly because of its visual impact. An environmental impact assessment is required. Finally, the cost of installing a wind or solar infrastructure, including accumulators, is too high for a mine with about 20 years lifespan, even for one or two megawatts.

LNG and propane therefore remain the two solutions to study. Both require pressurized tanks on site and could be used for the mobile fleet. Vehicle conversion costs and fuel costs are about the same. Compared with propane, LNG emits fewer GHGs but is more difficult to obtain.

As an alternate power source to the hydropower supplied by Hydro-Québec to meet the demand for the fixed infrastructure at the mine site, propane gas was chosen because of its ease of supply compared with LNG. It will be used to heat the buildings in the administrative and industrial sector, which require 1.2 MW. In addition, the possibility of powering a few mobile generators with solar panels with batteries will be evaluated.

Table 3-4: Domestic water treatment systems, scenario without basin

Treatment chain components	Absorption field Seepage bed	Enviro-Septic absorption field	Bionest SA-10000 and Kodiak	Ecoprocess MBBR
Grease trap, kitchen (15 m^3)	1	1	1	1
Septic tank	84 m^3	84 m^3	3 X 23 m^3	2 X 46 m^3
Pumping station	1	1	3	1
Sanitary treatment	2,800 m^2 seepage 3,700 m^2 total to soil (37 m x 100 m) Total load of 30 L/m^2/d for very permeable soil	1,680 m^2 seepage 2,200 m^2 total to soil (22 m x 100 m) Total load of 50 L/m^2/d for very permeable soil	3 biological reactors SA-10000 (permanent) Flow treated: 30,000 L/d 3 biological reactors Kodiak (temporary)	Ecoprocess MBBR, secondary settling and 8 Ecoflo units
Leaching field with LPFS	Not applicable	Not applicable	560 m^2 seepage 725 m^2 total to soil (18 m x 40 m) Total load of 100 L/m^2/d for very permeable soil	Included under Ecoflo units
Specific material required	840 m^3 of crushed stone LPFS pipes	1,170 m^3 of laboratory-certified sand filter (quality of natural sand at site to be determined) Enviro-Septic pipes	170 m^3 of crushed stone LPFS pipes	30 m^3 of crushed stone
Estimated budget (purchase and installation)	$580,000	$785,000	$900,000, including resale of Kodiak units	$580,000
Notes	Hypothesis of very permeable soil available with water table at more than 2.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Lake and stream more than 200 m away. SA-10000 units can be replaced with a unit built on site. At the end of the construction phase, the Kodiak units can be resold.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.

Table 3-5: Domestic water treatment systems, scenario with basin

Treatment chain components	Absorption field Seepage bed	Enviro-Septic absorption field	Bionest SA-10000 and Kodiak
Grease trap, kitchen (24 m^3)	1	1	1
Septic tank	45 m^3	45 m^3	3 X 23 m^3
Pumping station	1	1	2
Sanitary treatment	1,500 m^2 seepage 2,000 m^2 total to soil (40 m x 50 m) Total load of 30 L/m^2/d for very permeable soil Flow treated: 30,000 L/d	1,200 m^2 seepage 1,500 m^2 total to soil (30 m x 50 m) Total load of 40 L/m^2/d for permeable to very permeable soil Flow treated: 30,000 L/d	3 biological reactors SA-10000 (permanent - mining operation phase) Flow treated: 30,000 L/d
Leaching field with LPFS	Not applicable	Not applicable	300 m^2 seepage 400 m^2 total to soil (20 m x 20 m) Total load of 100 L/m^2/d for very permeable soil
Retention basin (1,500 m^3)	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d	1 (35 m x 15 m) Flow to be treated off site: 26,000 L/d
Specific material required	450 m^3 of crushed stone LPFS pipes Geomembrane and sand for basin base Access road to basin for tanker truck	800 m^3 of laboratory-certified sand filter (quality of natural sand at site to be determined) Enviro-Septic pipes Geomembrane and sand for basin base Access road to basin for tanker truck	90 m^3 of crushed stone LPFS pipes Geomembrane and sand for basin base Access road to basin for tanker truck
Estimated budget (purchase and installation)	$575,000	$735,000	$765,000
Notes	Hypothesis of very permeable soil available with water table at more than 2.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Distance of less than 400 m from camp. Lake and stream more than 200 m away.	Hypothesis of very permeable soil available with water table at more than 1.5 m deep. Lake and stream more than 200 m away. The three SA-10000 units can be replaced with a unit built on site.

Table 3-6: Scores for alternative domestic wastewater treatment technologies

Score	Option 1	Option 2	Option 3	Option 4
Environment	1.5	2.5	4.0	4.0
Technical	2.7	2.7	3.0	2.7
Economic	3.4	3.0	2.2	3.3
Total before weighting	7.6	8.2	9.2	9.9
Weighted total	**28.2**	**28.2**	**28.1**	**32.3**
Note: The weighting factors are: environment = 2, technical = 3, economic = 5.				

Table 3-7: Multi-criteria analysis of domestic wastewater treatment technology

		Option 1		Option 2		Option 3		Option 4	
Criteria	Weighting	Score	Weighted result	Score	Weighted result	Score	Weighted result	Score	Weighted result
Environmental aspects									
Impact on surface water quality	3	1.0	3.0	2.0	6.0	4.0	12.0	4.0	12.0
Impact on underground water quality	3	2.0	6.0	3.0	9.0	4.0	12.0	4.0	12.0
Subtotal	-	3.0	9.0	5.0	15.0	8.0	24.0	8.0	24.0
Environmental score subtotal	-	-	1.5	-	2.5	-	4.0	-	4.0
Technical aspects									
Collection system design	1	3.0	3.0	3.0	3.0	3.0	3.0	2.5	2.5
Treatment system design	3	1.4	4.1	1.9	5.8	3.4	10.1	3.0	9.0
S. 32 request	2	1.7	3.3	2.3	4.7	4.0	8.0	4.0	8.0
Operation	5	3.8	19.0	3.3	16.5	2.4	12.0	2.0	10.0
Subtotal	-	-	29.4	-	30.0	-	33.1	-	29.5
Technical score subtotal	-	-	2.7	-	2.7	-	3.0	-	2.7
Economic aspects									
Investment cost	5	3.1	15.6	3.0	15.0	2.3	11.7	4.0	20.0
Operating cost	3	4.0	12.0	3.0	9.0	2.0	6.0	2.0	6.0
Subtotal	-	-	27.6	-	24.0	-	17.7	-	26.0
Economic score subtotal	-	-	3.4	-	3.0	-	2.2	-	3.3

3.5 POWER SUPPLY FOR MOBILE EQUIPMENT

The possibility of obtaining electric motors abroad for hauling and road trucks, as well as for heavy equipment such as excavators and shovels, was examined with a view to reducing GHG emissions since the models required for the mining project, as currently defined, were not available in Canada.

The mobile fleet, including the pick-up trucks, will be diesel powered. Some electric-powered equipment will be tested provided it becomes more readily available in Canada by the time construction begins.

3.5.1 EQUIPMENT AVAILABILITY

The search for electric options for the main mobile equipment was conducted based on the capacity required for each item:

- Mining trucks: a 60-t to 100-t hauler and a 50-t articulated hauler;
- Excavators: a hydraulic shovel with a bucket capacity of 6 m^3 to 11 m^3 and an excavator with a bucket capacity of 5 m^3;
- 152-mm down the hole drill hammer.

Mining trucks

All electric haulers currently available on the market have a capacity of 200 t or more. However, a conversion test was conducted on a 65-t truck used in a Swiss quarry. Based on this prototype, it would cost $1 million to convert a diesel truck to an electric truck powered by a 600-kWh iron-lithium battery.

Another option would be to power the trucks from an onsite power line. Such a system involves adding a device on the trucks so they can connect directly to the power line, like a tramway. This type of system is usually installed on ramps since loaded trucks consume more energy going back up the slope. This option is advantageous for large-scale projects and is therefore not applicable here. Weather conditions are also a major impediment to installing such a system as freezing rain could lead to power failures.

Excavators

A search for suppliers did not produce any results that meet our excavator needs. Hitachi's EX1900E-6 model had the required capacity but is no longer on the market since it could not compete price-wise with equivalent diesel models. The smallest model available is the EX3600E-6 with a 22-m^3 bucket. Caterpillar's CAT 6018AC was also a good option; however, further investigation revealed that it has been discontinued. Their smallest model has a 16.5-m^3 bucket. P&H offers the 2650 hybrid shovel, which regenerates power during braking, reducing fuel consumption by about 25%. However, just like the previously mentioned models, its 27.1-m^3 bucket is too large for the project.

The only model with the required capacity is the Komatsu PC3000-6, which offers a 10-m^3 bucket to replace its basic 15-m^3 bucket. Unfortunately, discussions with a local representative revealed that the model is not offered in North America because it does not meet current safety standards.

Drill rigs

Electric drill rigs were considered. A search for suppliers shows that only drill rigs handling 229- to 444-mm hole diameters offered this option. This diameter will not deliver the expected results set out in the blasting plan.

3.5.2 COMPARABLE PROJECTS

Most of the electrical mining equipment currently available is used in underground mines primarily because they help reduce ventilation costs.

For comparison purposes, note the Lac-à-Paul project, a phosphate deposit that will be operated as an open-pit phosphate mine in Saguenay–Lac-Saint-Jean. However, the scale of the project is not the same. The expected Lac-à-Paul production is much greater than that of the James Bay Lithium Mine project, i.e. on average, 37 Mt of excavated material per year (with peaks of 60 to 90 Mt) compared with 10 Mt for Galaxy. The Lac-à-Paul feasibility study includes Komatsu hydraulic excavators (model PC 5500-6 with a 28-m^3 bucket) combined with Caterpillar diesel trucks (model CAT 793F, 226 t). The study shows that the use of electric drill rigs (203.2 mm) is currently being evaluated.

3.5.3 COST-BENEFIT ANALYSIS

A high-level economic assessment was conducted comparing the use of smaller electric shovels available on the market (Komatsu PC 3000, 250-260 t, 10-m^3 bucket) with diesel shovels adapted to the project's size (Komatsu PC-1250, 100 t, 5.75-m^3 bucket). The costs considered included only the initial outlay and energy consumption. The calculations are presented in Table 3-8.

Table 3-8: Cost-benefit analysis of electric and diesel shovels

Parameter	PC 1250 Diesel	PC 3000 Electric	Difference
Operations (hrs)	288,000	166,000	122,000
Shovel purchase (qty)	5	3	2
Energy cost ($)[1]	21,500,000	7,000,000	14,500,000
Initial outlay ($)	2,000,000	6,000,000	-4,000,000
Maintenance cost ($)	3,900,000	12,000,000	-8,100,000
Financial aspects			
Undiscounted net profit ($)	2,400,000		
Payback time (years)	15		
Net profit discounted at 5% ($)	-1,500,000		
Internal rate of return (%)	2.62		

1 Based on the following unit costs: diesel $0.940/l and electricity $0.0475/kWh.

In general, the results are unfavourable for electric equipment. The calculations show a minimal undiscounted net profit with a long payback period. The energy savings would be cancelled out by the additional costs.

3.5.4 RECOMMENDATION

The market offers a limited choice of electric mining equipment for an open-pit mine like Galaxy's. Most of the electric equipment available is for underground facilities due to the savings on ventilation costs. Electric battery trucks are not available for the pits while electric drill rigs and mechanical shovels are available only at capacities that exceed Galaxy's needs. Smaller equipment is either no longer available on the market or not recommended by suppliers due to the high cost compared with equivalent diesel equipment. Consequently, given the size of the James Bay Lithium Mine, the use of electric equipment on the market today is not suitable for the project and is therefore not recommended.

4 PROJECT DESCRIPTION

The following sections describe the various mining infrastructure and the technologies selected from those presented in the previous section. They also outline the other infrastructure likely to be used by the project such as the power supply, road usage, and airport services. All values are considered the best information available as indicated in the project definition document.

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 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 Galaxy's 2017 drilling program. The mineralization consists essentially of spodumene. Spodumene is a relatively rare pyroxene that is composed of lithium (8.03% Li_2O), aluminum (27.40% Al_2O_3) and silicon (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 analyses reveal the property spodumene with the following 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).

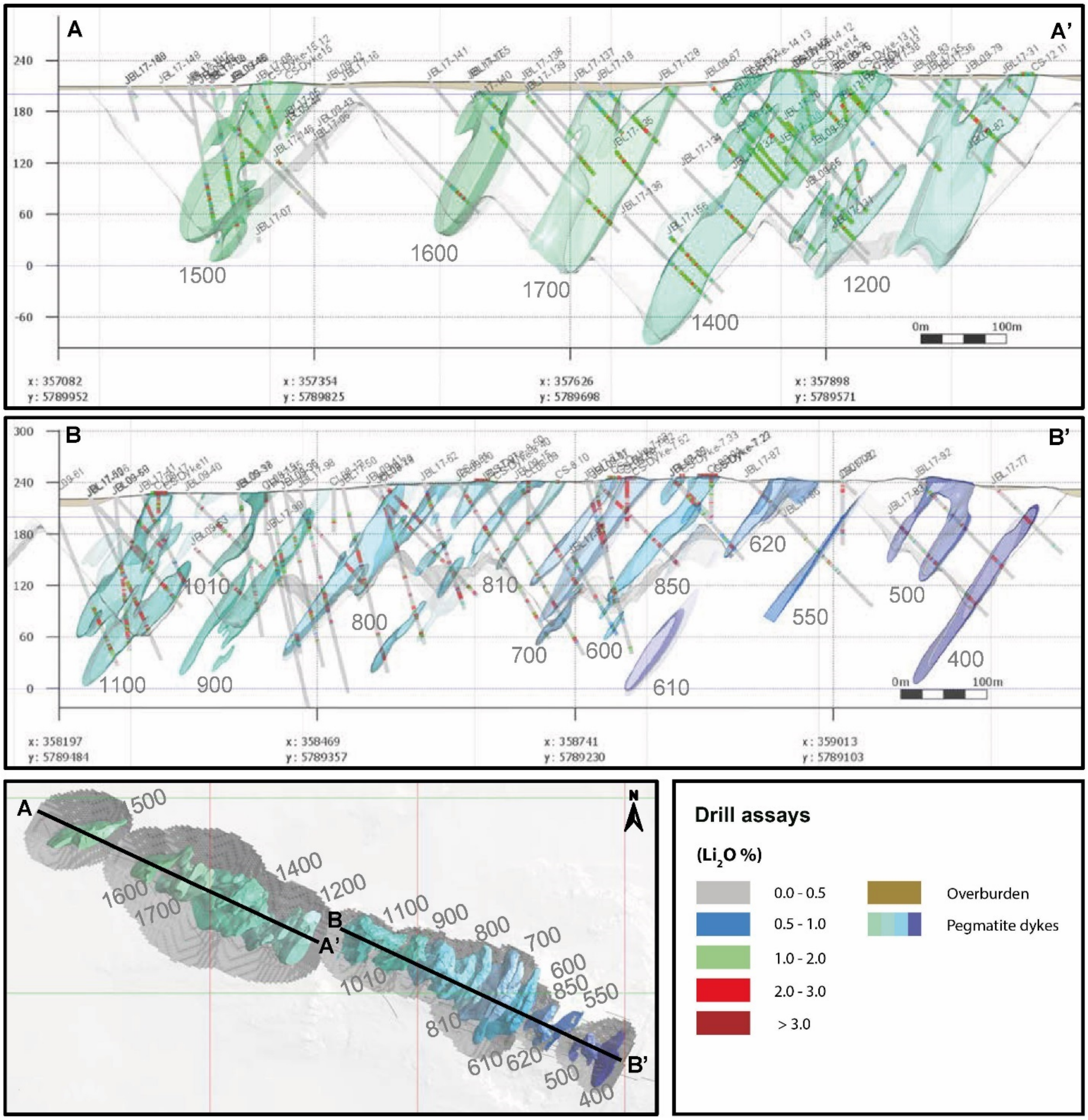


Figure 4-1: Model of pegmatite dykes

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 resistive and stand above their surroundings, as is the case for the project pegmatites, and are readily recognizable due to their light 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: Primero, 2018.

4.1.2 MINERAL RESOURCES

The mineral resource presented in this section is extracted from the Project Definition Document (Primero, 2018) as prepared by SRK. The mineral resource model 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 stockpile for the combined waste rock and tailings (hereinafter the waste rock stockpile), the overburden stockpiles as well as industrial and administrative area (Map 4-1). Details of the various project components are found in the following sections of this chapter.

The industrial and administrative area holds the Run-of-Mine (ROM) pad, the industrial area, the mechanical workshops and warehouses, the administrative buildings as well as the housing infrastructure. An explosives magazine is located at a safe distance from key infrastructure. Finally, there is one site access road as well as many site roads for haulage and/or servicing.

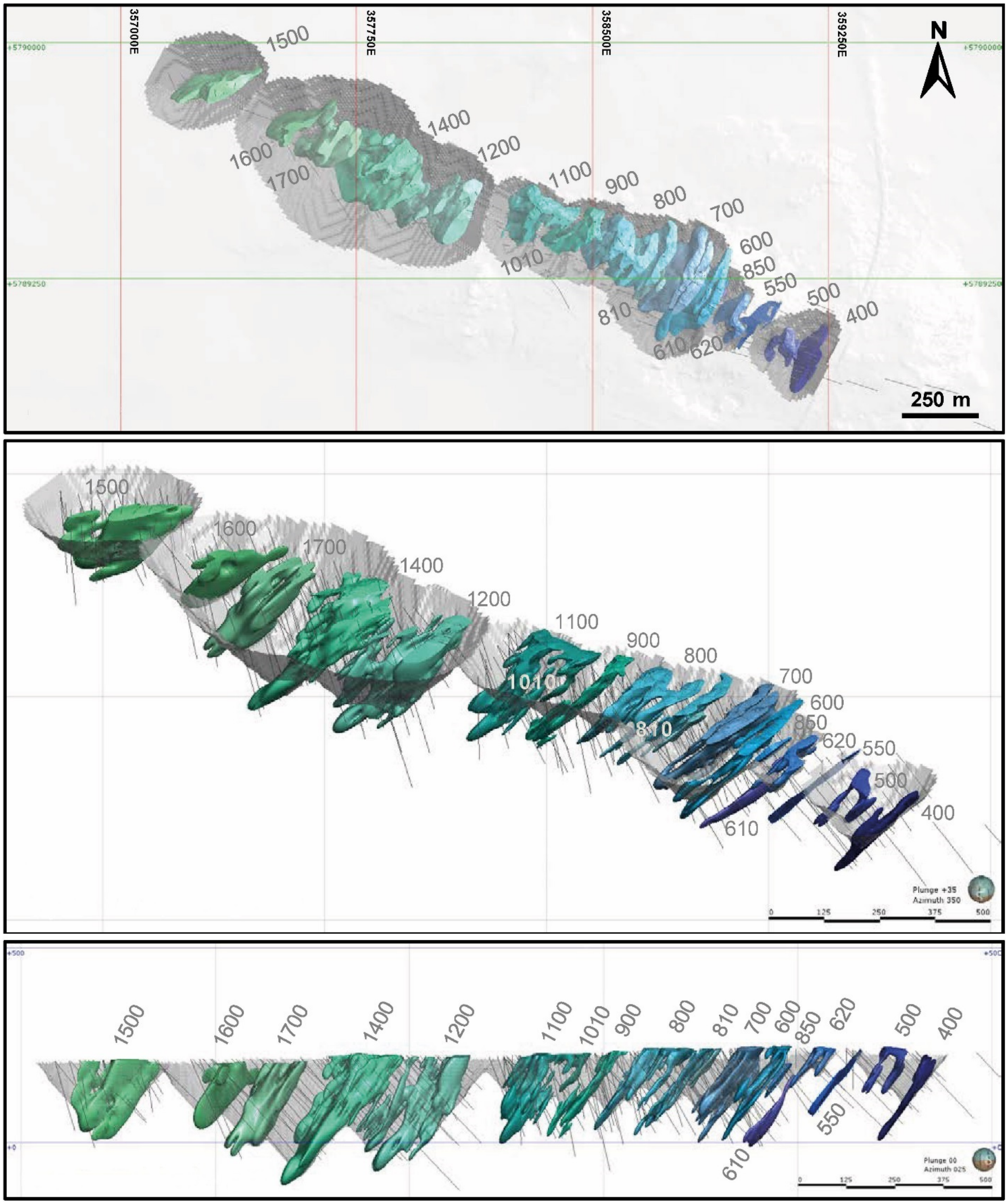


Figure 4-2: Representative cross-sections of pegmatite domains

Source: SRK, 2018.

As for water management infrastructure, there are two larger water basins: one located north of the combined waste and tailing stockpile and the other located east of the unconsolidated deposit stockpile. A WTP is positioned near the northern basin. There are two clean water discharges: one from the water collected from the waste rock stockpile and the other from the water collected from the overburden stockpiles. For the construction phase, there will also be a concrete batch plant; its location will be converted into a dry storage area once construction is completed.

Table 4-1 summarizes the surfaces for each of the infrastructures mentioned in this section, for a total of 396.93 ha.

Table 4-1: Infrastructure surface areas

Infrastructure	Area (ha)
Open pit	69.55
Construction quarry	4.65
Waste rock stockpile (including dikes and berms)	208.97
Unconsolidated deposit and organic matter stockpiles (including berms and water basin)	55.27
Industrial and administrative area	20.49
Concrete batch plant (construction phase) / Dry storage area (operations phase)	8.46
Water treatment plant and pumping stations	2.84
Explosives magazine	2.74
Roads and ditches	23.97
Total	**396.93**

4.3 INDUSTRIAL AND ADMINISTRATIVE AREA GENERAL ARRANGEMENT

The industrial and administrative area comprises the ROM pad, the processing plant, mechanical workshop and warehouses, the administrative buildings, and the workcamp. The 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;
— A couple of 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 laboratories;
— A weighbridge (scale) and gate;
— A high-voltage switchyard;
— A mechanical warehouse and workshop;
— 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; Figure 4-3 presents oblique views of the sector.

Most buildings will be supported on reinforced concrete foundations. The concentrator building will consist of a steel structure covered with metal cladding on concrete slab and footings. Heavy equipment will be supported on a heavy duty reinforced foundation. The ferrosilicon will be stored in vertical metal tanks located in the DMS storage warehouse. The warehouse will also be built on concrete slabs. The tailing thickener is a reinforced concrete reservoir.

The workshop and warehouse buildings will consist of structural steel covered with metal cladding. The administration and medical buildings will be modular type buildings supported on wood pilling or cribbage and they will connect to each other by hallways. All buildings will be insulated and heated/ventilated. It will include one personnel access door and one steel roller door (wide enough for a large forklift to access).

All buildings in the plant, except for cold storage facilities, are designed to have a heating-ventilation-air-conditioning (HVAC) system. The HVAC system will carry the heaviest burden in the winter when site temperatures can drop to -45 °C. The heat source in HVAC units will be supplied from propane heaters. The propane will be stored in six 30,000 US gallons (113,562 L) tanks for a total of 180,000 US gallons (681,374 L). These tanks will also supply the worker's camp. Air handling units, including all fans, louvres and control systems will be powered by electricity. The compressors and pumps in the air conditioning units will also be electrically driven. Other energy sources for heating are under investigation.

The site will be fenced and will include a gatehouse as well as closed-circuit cameras at key locations.

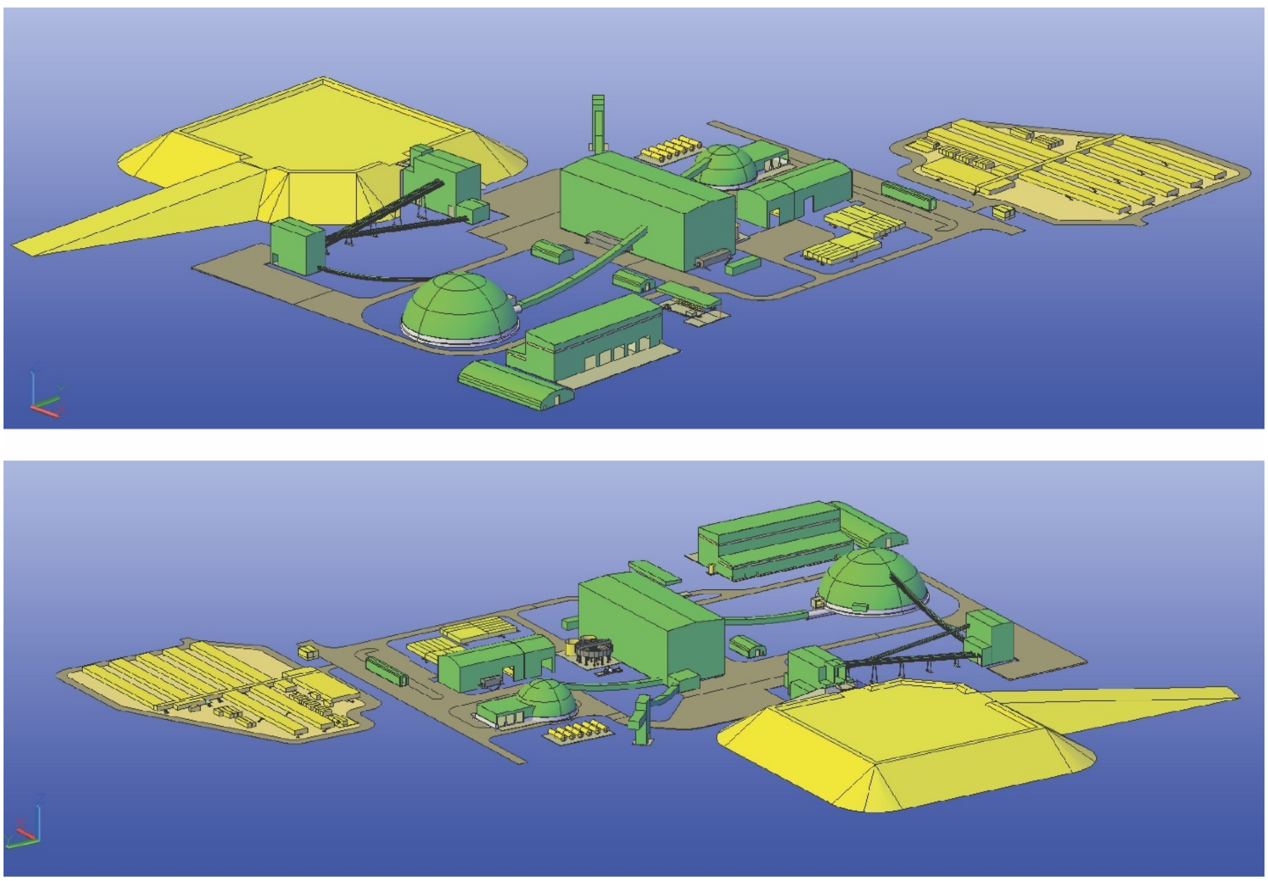
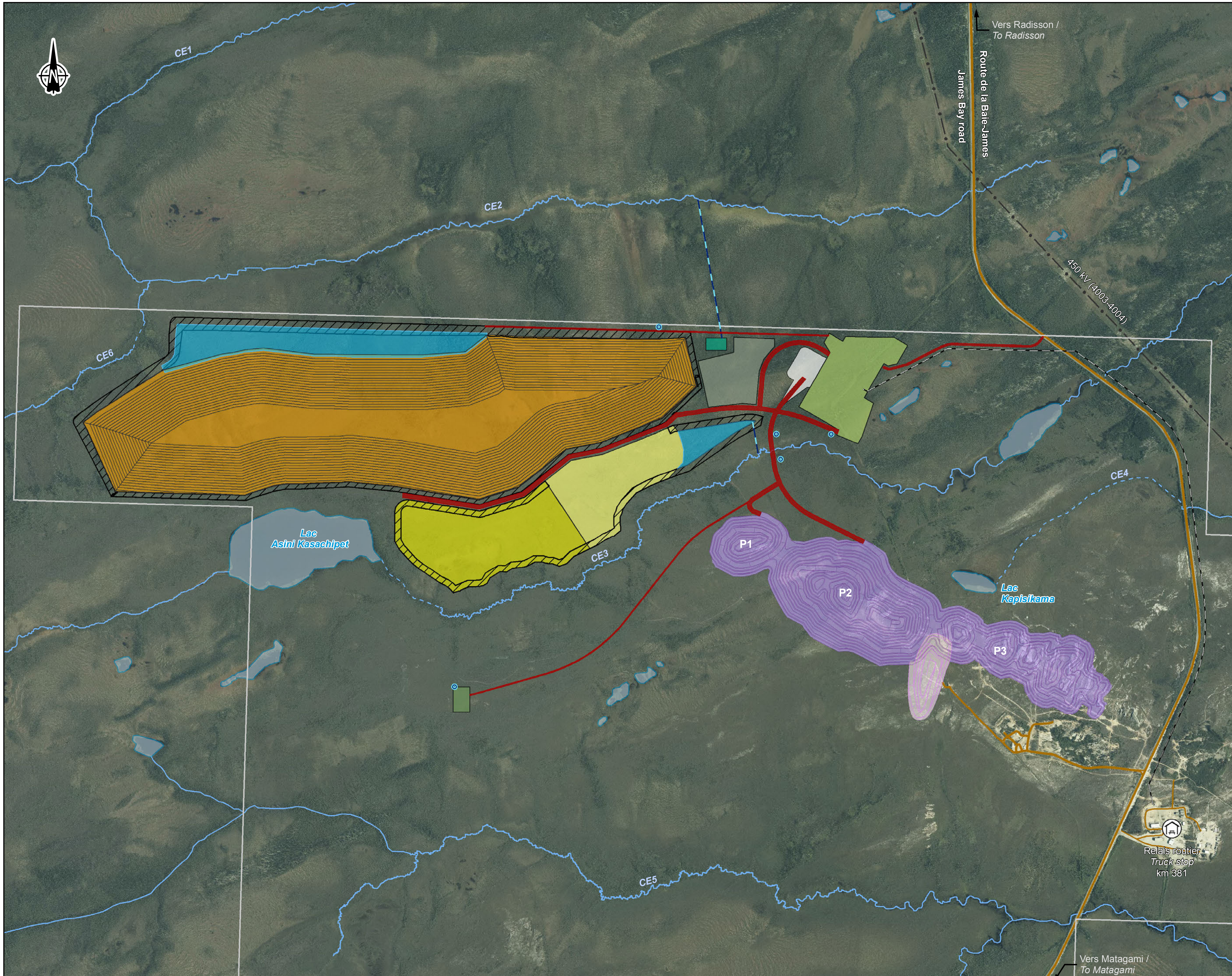


Figure 4-3: Industrial and administrative area views

Source: Primero, 2018.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

Route / *Road*

Effluent minier / *Mine effluent*

Station de pompage / *Pumping station*

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 matière organique / *Organic matter stockpile*

Halde à dépôts meubles / *Unconsolidated deposit stockpile*

Entrepôt à explosifs / *Explosives magazine*

Cour d'entreposage / *Dry storage area*

Carrière / *Quarry*

Digue et berme / *Dike and berm*

Bassin de rétention d'eau / *Water retention basin*

Câble de fibre optique / *Optical fiber cable*

Infrastructures / *Infrastructure*

Route principale / *Main road*

Route d'accès / *Access road*

Ligne de transport d'énergie / *Transmission line*

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

Étude d'impact sur l'environnement /
Environmental Impact Assessment

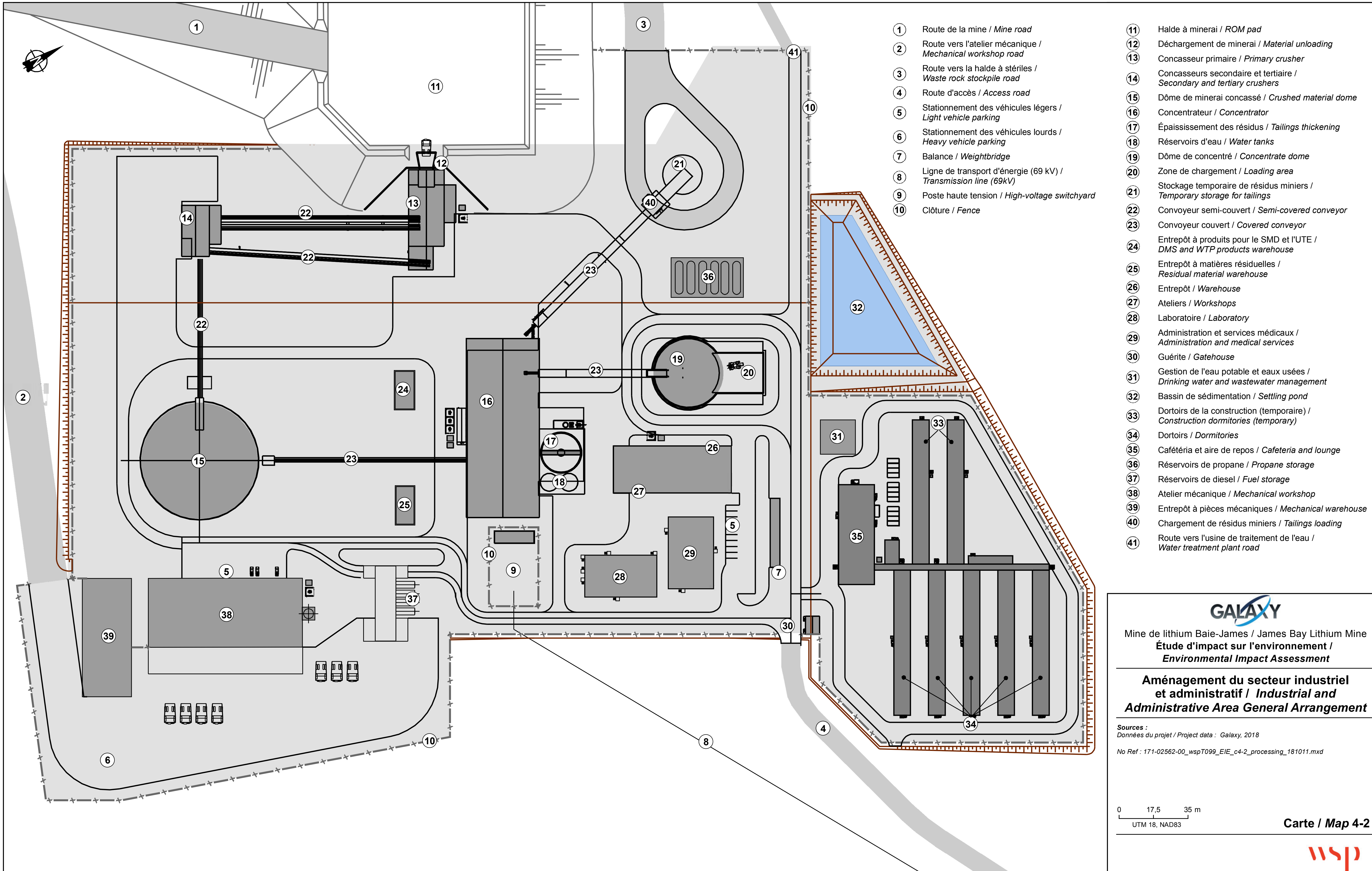
Aménagement du site minier / *Mine Site General Arrangement*

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018
Fosse, carrière et entreposage des explosifs /
Pit, quarry and explosives magasine : Mining Plus, 2018
Secteur administratif et industriel et aire de minerai /
Administrative and industrial sector and ROM pad : Primero, 2018

No Ref : 171-02562-00_wspT098_EIE_c4-1_mine_GA_180831.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-1



1 Route de la mine / Mine road
2 Route vers l'atelier mécanique / Mechanical workshop road
3 Route vers la halde à stériles / Waste rock stockpile road
4 Route d'accès / Access road
5 Stationnement des véhicules légers / Light vehicle parking
6 Stationnement des véhicules lourds / Heavy vehicle parking
7 Balance / Weightbridge
8 Ligne de transport d'énergie (69 kV) / Transmission line (69kV)
9 Poste haute tension / High-voltage switchyard
10 Clôture / Fence
11 Halde à minerai / ROM pad
12 Déchargement de minerai / Material unloading
13 Concasseur primaire / Primary crusher
14 Concasseurs secondaire et tertiaire / Secondary and tertiary crushers
15 Dôme de minerai concassé / Crushed material dome
16 Concentrateur / Concentrator
17 Épaississement des résidus / Tailings thickening
18 Réservoirs d'eau / Water tanks
19 Dôme de concentré / Concentrate dome
20 Zone de chargement / Loading area
21 Stockage temporaire de résidus miniers / Temporary storage for tailings
22 Convoyeur semi-couvert / Semi-covered conveyor
23 Convoyeur couvert / Covered conveyor
24 Entrepôt à produits pour le SMD et l'UTE / DMS and WTP products warehouse
25 Entrepôt à matières résiduelles / Residual material warehouse
26 Entrepôt / Warehouse
27 Ateliers / Workshops
28 Laboratoire / Laboratory
29 Administration et services médicaux / Administration and medical services
30 Guérite / Gatehouse
31 Gestion de l'eau potable et eaux usées / Drinking water and wastewater management
32 Bassin de sédimentation / Settling pond
33 Dortoirs de la construction (temporaire) / Construction dormitories (temporary)
34 Dortoirs / Dormitories
35 Cafétéria et aire de repos / Cafeteria and lounge
36 Réservoirs de propane / Propane storage
37 Réservoirs de diesel / Fuel storage
38 Atelier mécanique / Mechanical workshop
39 Entrepôt à pièces mécaniques / Mechanical warehouse
40 Chargement de résidus miniers / Tailings loading
41 Route vers l'usine de traitement de l'eau / Water treatment plant road
GALAXY
Mine de lithium Baie-James / James Bay Lithium Mine
Étude d'impact sur l'environnement / Environmental Impact Assessment
Aménagement du secteur industriel et administratif / Industrial and Administrative Area General Arrangement
Sources :
Données du projet / Project data : Galaxy, 2018
No Ref : 171-02562-00_wspT099_EIE_c4-2_processing_181011.mxd
0 17,5 35 m
UTM 18, NAD83
Carte / Map 4-2
wsp

4.4 PREPARATORY WORK

Preparatory work consists of all the activities that precede the mining activities. Map 4-3 shows the site arrangement during construction, while Map 4-4 presents the location of the borrow pits and quarries where construction material (aggregates, gravel, etc.) could be sourced out. The following subsections describe the tasks included in each activity.

4.4.1 TRANSPORTATION

Air travel will be the primary means of transportation for workers as it will save a day in each direction, as well as improve overall security. Galaxy will organize charter flights from major hubs to the Eastmain airport and will provide bus service to and from the site. The Eastmain airport is located 135 km away from the project site.

Equipment and supplies will be trucked to the site. Equipment and supplies will come through Matagami (James Bay road). Minor upgrades to increase safety will be made to the James Bay road at km 382. Turning lanes will be added in to and out of the site at the point of contact between the James Bay road 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.

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 yet. As such, if an agreement is not possible the accommodation camp on-site will house the expected 280 workers.

4.4.3 QUARRY AND BORROW PITS

Due to the limited quantities of construction material available in the project area, a construction quarry will be opened in the near center of the proposed open pit (Map 4-1). The quarry will be in the diabase dyke. The available material from the construction quarry is estimated at 885,000 m^3. Trucks will haul the material along the quarry access road and travel along the James Bay road. Material will then be brought to the concrete batch plant area.

According to a geomorphologic study done by WSP (2018a), there are 15 possible borrow pits close to the project site. The available volume is limited by the abundance of wetlands, mainly peat bogs. The potential volumes are summarized in Table 4-2. Additional quarry sites have also been identified.

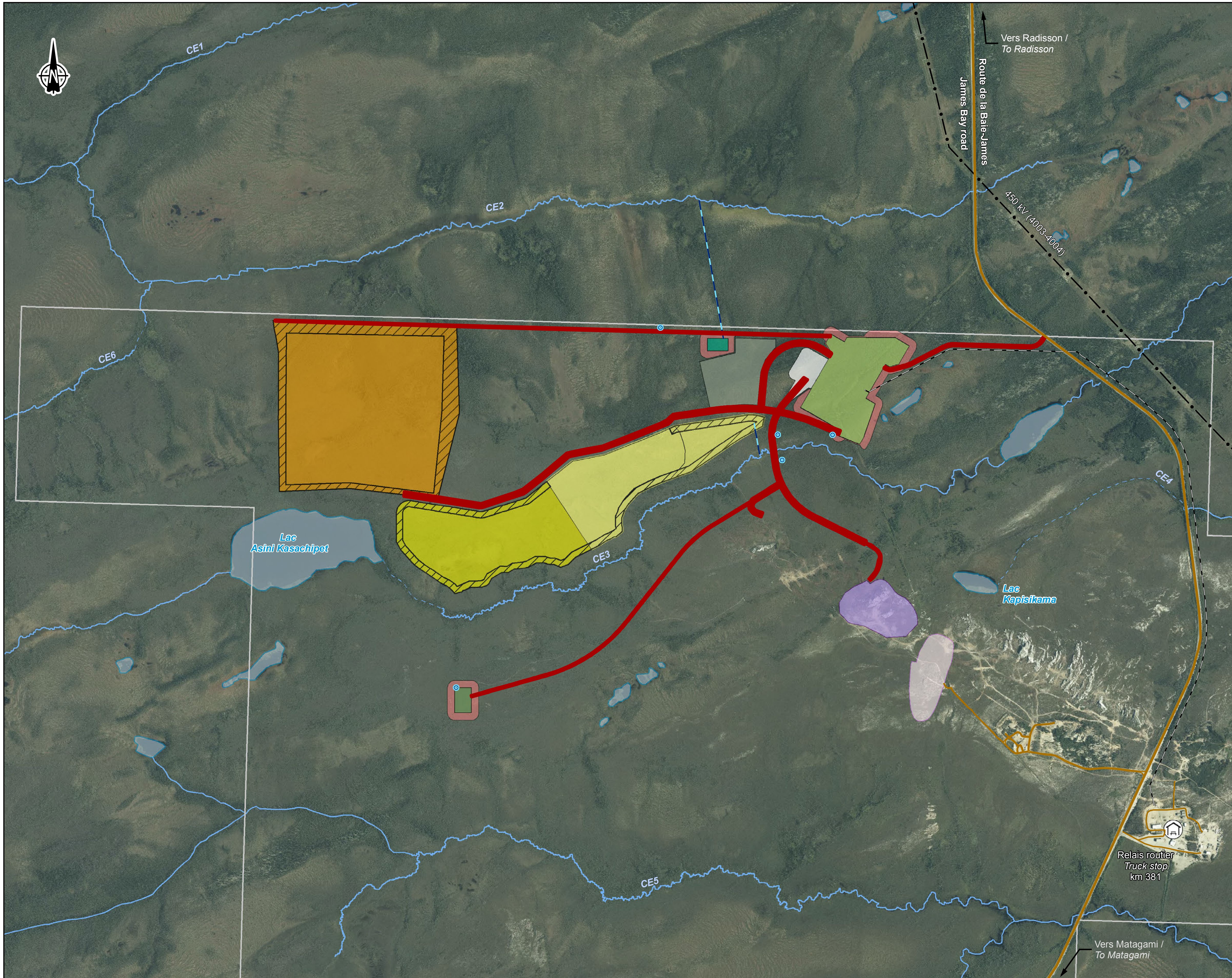
Table 4-2: Summary of earthworks quantities

Site ID	Potential Material(s)	Quantity (m³)
Borrow pit		
BE-01	Sand	315,000
BE-02	Thin till (<2 m) over rock	170,000
BE-03	Till (2 to 6 m) over rock	415,000
BE-04	Thin till (<2 m) over rock	123,000
BE-05	Sand (2 to 6 m) over clay and thin till (<2 m) over rock	343,000
BE-06	Sand	160,000
BE-07	Sand (2 to 6 m) over rock	68,000
BE-08	Sand and thin peat (<2m) on sand	227,000
BE-09	Sand and thin peat (<2m) on sand	169,000
BE-10	Thin peat (<2m) on sand	55,000
BE-11	Thin peat (<2m) on sand	90,000
BE-12	Thin peat (<2m) on till	120,000
BE-13	Thin peat (<2m) on sand	54,000
BE-14	Thin peat (<2m) on sand	56,000
BE-15	Thin peat (<2m) on sand	17,000
Quarry		
CA-01	Rock	270,000
CA-02	Rock	2,505,000
CA-03	Rock with veneer of thin (<2 m) and discontinuous till	185,000
CA-04	Rock	630,000
CA-05	Rock with veneer of thin (<2 m) and discontinuous till	252,000
CA-06	Rock	384,000
CA-07	Rock with veneer of thin (<2 m) and discontinuous till	3,320,000

Source: WSP, 2018a.

4.4.4 LAYDOWN AND CONCRETE BATCH PLANT

A concrete batch plant will be constructed near the WTP. The site will be converted into a dry storage area during the operations phase. The concrete plant will be used to store material issued from the quarry. A mobile crusher and screen will sort rocks by size into different piles. The site will be used to prepare the concrete to be poured for the foundations of buildings and tanks in the industrial and administrative area. The contractors' administrative trailers and equipment will also be in this area.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Station de pompage / *Pumping station*
- 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 matière organique / *Organic matter stockpile*
- Halde à dépôts meubles / *Unconsolidated deposit stockpile*
- Entrepôt à explosifs / *Explosives magazine*
- Cour d'entreposage / *Dry storage area*
- Carrière / *Quarry*
- Zone tampon pour la protection d'incendie / *Buffer area for fire protection*
- Câble de fibre optique / *Optical fiber cable*
- Digue et berme / *Dike and berm*

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
Étude d'impact sur l'environnement /
Environmental Impact Assessment

Aménagement du site minier – Année -1 / *Mine Site General Arrangement – Year -1*

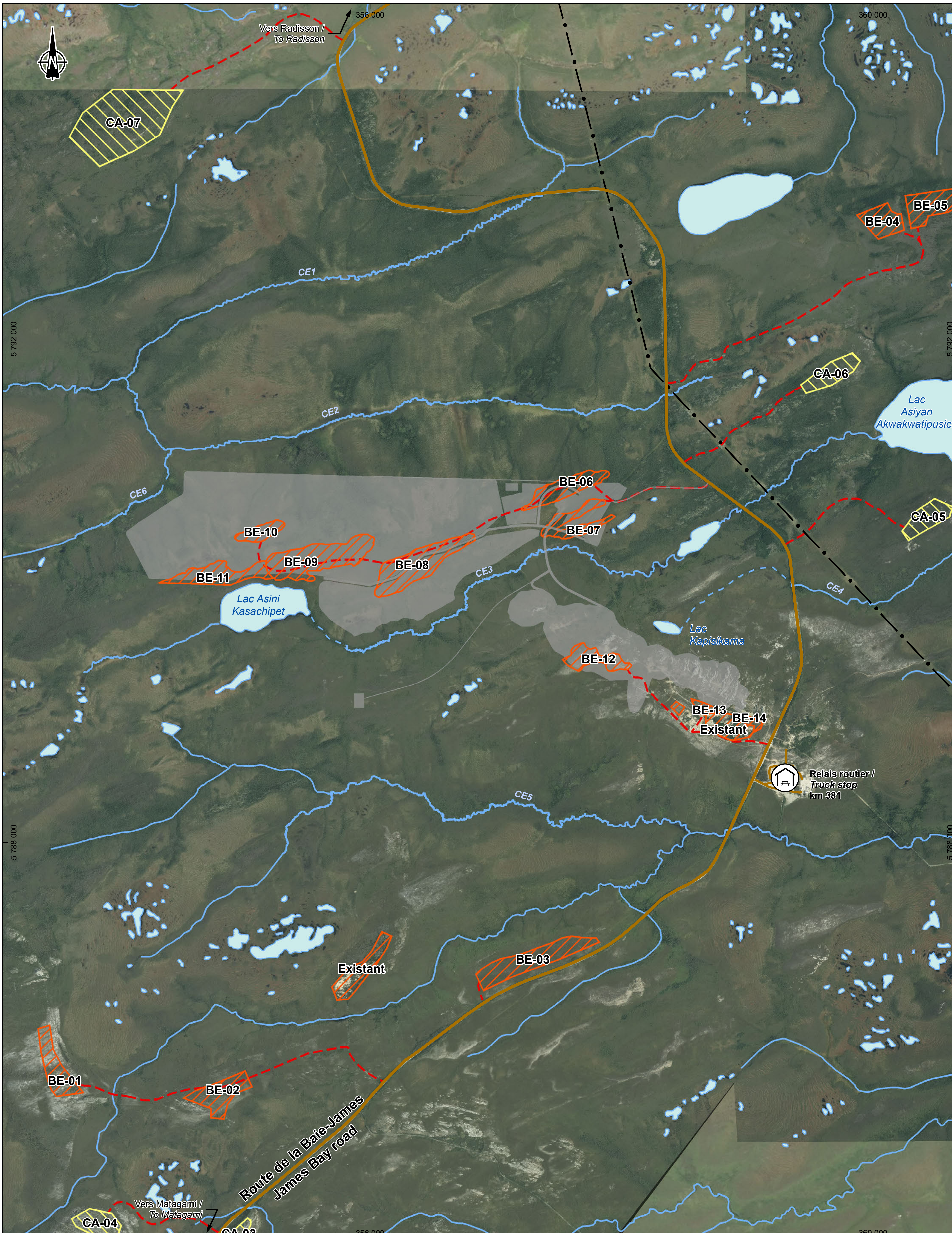
Sources :
Orthoimage : Galaxy, août / august 2017
Fosse et carrière / Pit and quarry : Mining Plus, 2018
Secteur admnistratif et industriel /
Administrative and industrial sector : Primero, 2018

No Ref : 171-02562-00_wspT100_EIE_c4-3_prep_work_180903.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-3

wsp



Composantes du projet / *Project Components*

- Route d'accès potentielle / *Potential access road*
- Source potentielle de matériaux d'emprunt / *Potential borrow sources*
- Carrière potentielle / *Potential quarry*
- Infrastructures minières / *Mining infrastructure*

Infrastructures / *Infrastructure*

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

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
Étude d'impact sur l'environnement / *Environmental Impact Assessment*

Localisation des bancs d'emprunt et des carrières potentiels / *Location of Potential Borrow Pits and Construction Quarries*

Sources :
World Imagery, ESRI, 2017
Photo interpretation : WSP 2018

No Ref : 171-02562-00_wspT102_EIE_c4-4_borrow_pit_180903.mxd

0 300 600 m
UTM 18, NAD83

Carte / *Map* 4-4

wsp

4.4.5 EARTHWORKS

Site earthworks are required before construction and mine operations, to build roads as well as foundations for various infrastructures. Table 4-3 summarizes the quantities for the main earthworks.

Table 4-3: Earthworks quantities

Activity	Unit	Value
Excavation	m^3	7,624,672
Fill	m^3	5,653,652
Cut and fill operations	m^3	148,410
Final trimming, grading, profiling	m^2	3,544,946
Compacting and leveling	m^2	4,117,840
Drainage	m	44,030

Source: Primero, 2018.

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 to approximately ground level, and all fallen timber and rubbish 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 topsoil stockpile. 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 stockpile. 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 borrow pits, 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 pits and construction quarry.

4.4.5.4 *DITCHES*

Ditches consist of open channel ditches and seepage drains. Open ditches will be constructed to the specified cross-sections with tight, sound, uniform surfaces, with positive drainage throughout. 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 packed as the construction progresses, so that the finished surface is tight and uniform and conforms to the design slope.

4.4.6 POWER

An emergency diesel generator will be required as backup for the permanent worker' camp and process plant; this unit will be installed early to provide the power needed for the worker' camp accommodations. A second diesel generator will be required at the mining facilities for fleet assembly and stripping operations. The earthworks contractors will supply their own generators.

4.4.7 COMMUNICATIONS

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 the site access road 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. Galaxy 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 40 Mt of material could be extracted at an average grade of 1.40% Li_2O and the total waste rock excavation required will be approximately 127 million tonnes (Table 4-4). 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 %), banded metasediment (14.0 %), mafic volcanic (0.9 %), feldspar porphyry (0.2%), and non-economical pegmatite (0.1 %). In addition, almost 6 Mt of overburden will be displaced.

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

Category	Volume (m³)	Tonnage (t)
Metasediment (M1)	39,016,815	108,072,889
Banded metasediment (M2)	6,414,440	17,767,391
Mafic volcanic and basalt (V3)	397,650	1,101,452
Feldspar porphyry (FP)	84,304	233,515
Pegmatite (I1G) (non-economical)	62,100	172,011
Total waste rock	**45,975,308**	**127,347,257**
Overburden	**2,956,547**	**5,913,094**
Grand total	**48,931,856**	**133,260,352**

Source: Mining Plus in Primero, 2018.

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 4-4). 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.

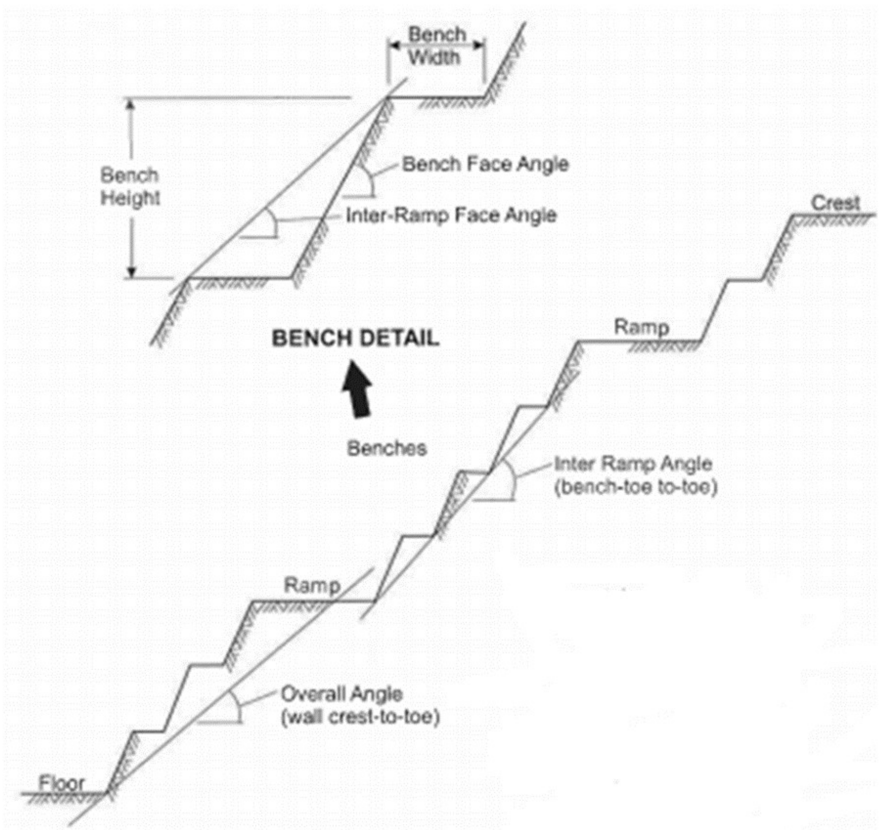


Figure 4-4: Schematic representation of pit geometry

Source: Read and Stacey, 2009.

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.

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 4-5.

Table 4-5: 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
Notes: 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 benches are designed with a 75-degree face angle with 9 m side catch benches. 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 through 4-7 illustrate the evolution of the mine site for Years 3, 5, and 10.

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 shovel 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. Overburden and waste rock materials will be trucked and positioned in their own stockpiles. The waste rock stockpile will be started in the central area and progress towards the east until design limits are reached. The stockpile will then advance to the west.

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).

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 drillhole. 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.

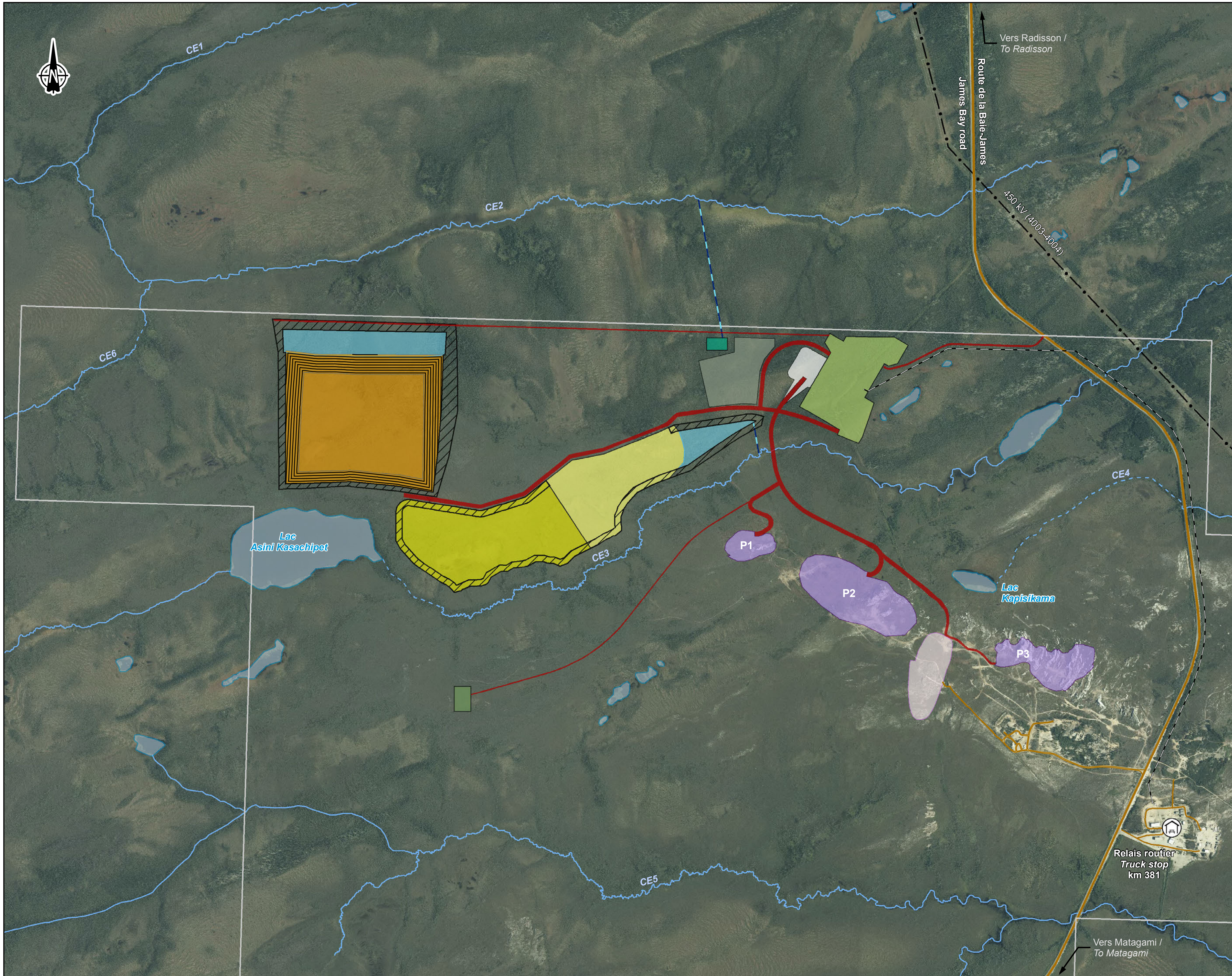
Equipment fleet requirements are based a 140-tonne hydraulic excavator (backhoe) with a 7 m^3, loading a 61.5-tonne rigid frame haul truck. The size selected for the excavator is the largest that still allows the mine to have two excavators, which are required for the multi-pit operations of the project. A 61.5-tonne rigid frame haul truck was selected for the 7 m^3 excavator as it can be loaded with 5 passes based on assumed swelled material densities and bucket fill factors, which is within the optimum range of 3 to 5 passes. Haul trucks are required to transport tailings from the industrial sector to the stockpile. 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.

Secondary equipment will be utilized to directly support the equipment utilized 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.

The secondary equipment selected for this project will consist of:

- Grader: CAT 14M with 4.26m blade;
- Track dozer: CAT D9 with 5 m blade;
- Wheel dozer: CAT 834K with 4.5 m blade;
- Water / snow plow / sander truck: CAT 775 - 61.5 tonne rigid frame truck.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

Route / *Road*

Effluent minier / *Mine effluent*

Station de pompage / *Pumping station*

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 matière organique / *Organic matter stockpile*

Halde à dépôts meubles / *Unconsolidated deposit stockpile*

Entrepôt à explosifs / *Explosive magazine*

Cour d'entreposage / *Dry storage area*

Carrière / *Quarry*

Digue et berme / *Dike and berm*

Bassin de rétention d'eau / *Water retention basin*

Câble de fibre optique / *Optical fiber cable*

Infrastructures / *Infrastructure*

Route principale / *Main road*

Route d'accès / *Access road*

Ligne de transport d'énergie / *Transmission line*

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
Étude d'impact sur l'environnement /
Environmental Impact Assessment

Aménagement du site minier – Année 3 / *Mine Site General Arrangement –Year 3*

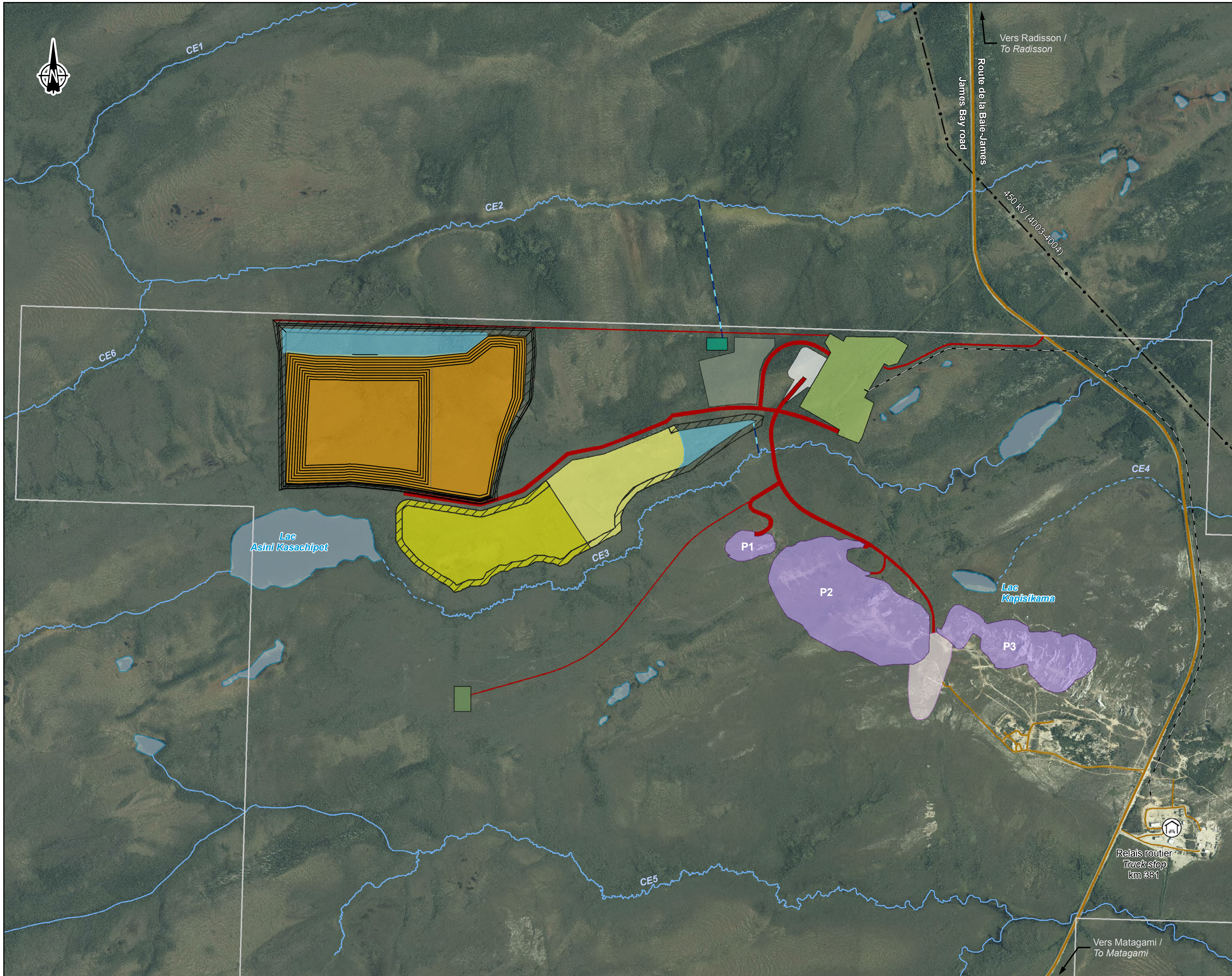
Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018
Fosse, carrière et entreposage d'explosifs /
Pit, quarry and explosives magazine : Mining Plus, 2018
Secteur administratif et industriel et aire de minerai /
Administrative and industrial sector and ROM pad : Primero, 2018

No Ref : 171-02562-00_wspT103_EIE_c4-5_mine_design_yr3_180903.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-5

wsp



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Station de pompage / *Pumping station*
- 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 matière organique / *Organic matter stockpile*
- Halde à dépôts meubles / *Unconsolidated deposit stockpile*
- Entrepôt à explosifs / *Explosives magazine*
- Cour d'entreposage / *Dry storage area*
- Carrière / *Quarry*
- Digue et berme / *Dike and berm*
- Bassin de rétention d'eau / *Water retention basin*
- Câble de fibre optique / *Optical fiber cable*

Infrastructures / *Infrastructure*

- Route principale / *Main road*
- Route d'accès / *Access road*
- Ligne de transport d'énergie / *Transmission line*
- 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
Étude d'impact sur l'environnement /
Environmental Impact Assessment

Aménagement du site minier – Année 5 / *Mine Site General Arrangement – Year 5*

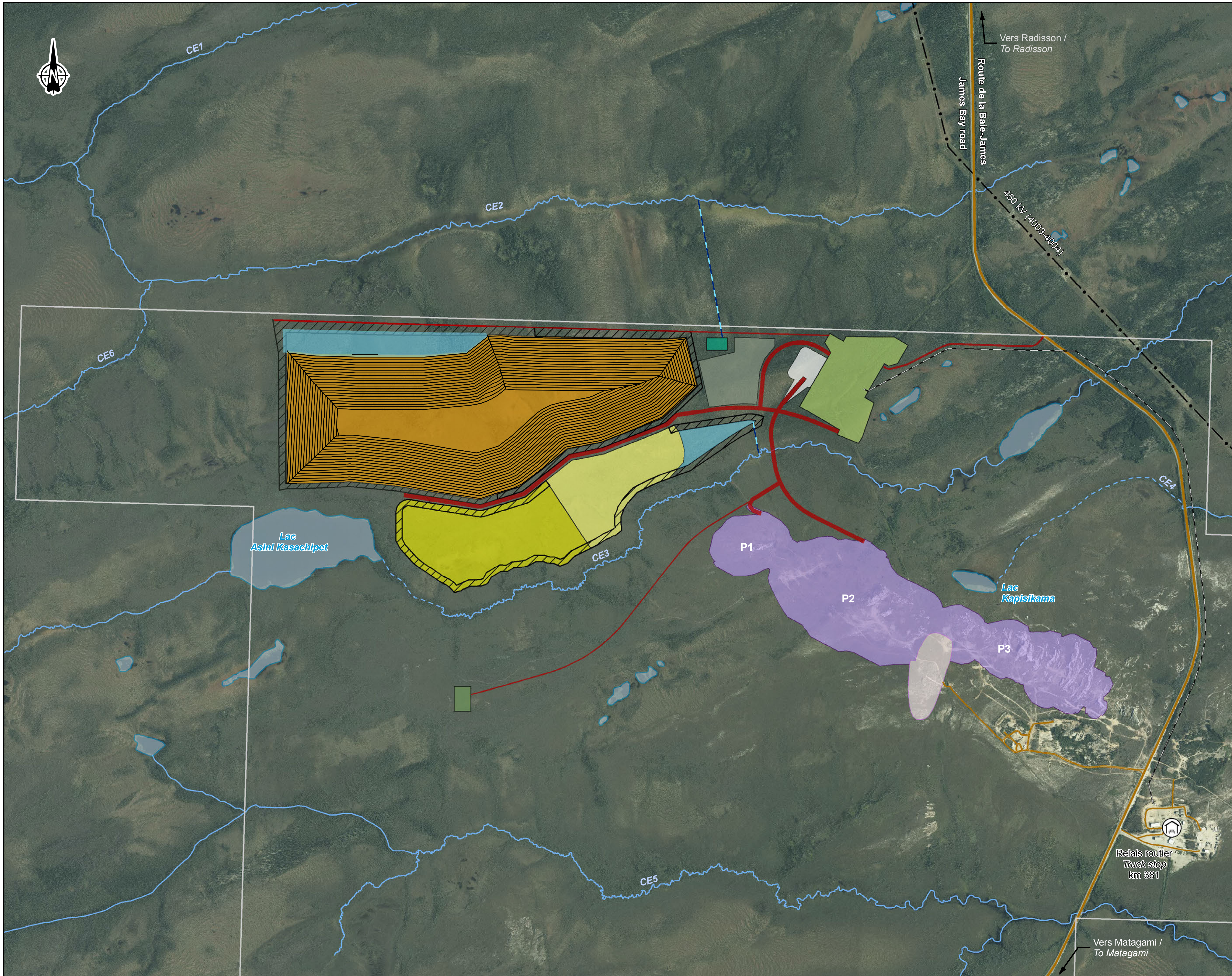
Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018
Fosse, carrière et entreposage des explosifs / Pit, quarry and explosives magazine : Mining Plus, 2018
Secteur administratif et industriel et aire de minerai / Administrative and industrial sector and ROM pad : Primero, 2018

No Ref : 171-02562-00_wspT104_EIE_c4-6_mine_design_yr5_180903.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-6

wsp



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

- Route / *Road*
- Effluent minier / *Mine effluent*
- Station de pompage / *Pumping station*
- 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 matière organique / *Organic matter stockpile*
- Halde à dépôts meubles / *Unconsolidated deposit stockpile*
- Entrepôt à explosifs / *Explosives magazine*
- Cour d'entreposage / *Dry storage area*
- Carrière / *Quarry*
- Digue et berme / *Dike and berm*
- Bassin de rétention d'eau / *Water retention basin*
- Câble de fibre optique / *Optical fiber cable*

Infrastructures / *Infrastructure*

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

Étude d'impact sur l'environnement /
Environmental Impact Assessment

Aménagement su site minier – Année 10 / *Mine Site General Arrangement – Year 10*

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018
Fosse, carrière et entreposage d'explosifs / Pit, quarry and explosives magazine : Mining Plus 2018
Secteur administratif et industriel et aire de minerai / Administrative and industrial sector and ROM pad : Primero, 2018

No Ref : 171-02562-00_wspT105_EIE_c4-7_mine_design_yr10_180903.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-7

wsp

There will also be auxiliary equipment such as pick-up trucks, passenger wagons (busses), dewatering pumps. Table 4-6 summarizes the mining equipment list for both heavy and light mobile equipment at Year 10, when the fleet is at its maximum capacity. The total fuel consumption by the mining equipment will average 15 million litres per year.

Table 4-6: List of mining equipment – Year 10

Equipment	Model / Type	Quantity
Primary equipment		
61.5-tonnes rigid frame haul truck	CAT 775	22
40-tonnes articulated truck	CAT 745C	2
140-tonne hydraulic backhoe	CAT 6015 B	2
Drill	152mm DTH	5
Secondary equipment		
Grader	CAT 14M	3
Track dozer (pit)	CAT D9	2
Wheel dozer (stockpile)	CAT 834H	2
Water / plow / sand truck	CAT 775	1
Auxiliary equipment		
6x4 on-highway service trucks	CAT CT 660	3
35-tons crane	Terex RS7010	1
50-tonnes hydraulic excavator	CAT 320E L	2
Light tower 16 - 20kW		4
15-person wagon		4
Pick-up truck, crew cab	Ford F-250 XL	5
Forklift, 9-tons lift capacity	Kalmar DCE90-6	1
Two low boy (multi-axle) 181-tonnes deck	1998 XL 200T	1
Dewater booster		2
Tow truck	CAT 773G	1
Dewatering pump, self primed	Godwin HL200M	1

Note: The models have been specified for calculation purpose; however, this does not preclude other equivalent equipment suppliers from being utilized and final selection of similar equipment to be selected during the procurement process.

Source: Mining Plus in Primero, 2018.

4.5.3 EXTRACTION SCHEDULE

The pegmatite extraction will follow the concentrator's yearly capacity: 1,000,000 tonnes in year 1, then 2,000,000 tonnes from year 2 to penultimate year. The last year will complete the production. Table 4-7 summarizes the extraction schedule.

The overburden and waste rock extraction schedule follows the mining plan developed. The volume of waste rock excavated averages 2,870,000 m³ per year, with a maximum of 4,868,000 m³ at Year 10 and a minimum of 921,000 m³ at Year 15. The volume of overburden excavated varies between 329,000 to 754,000 m³ per year. No overburden is excavated from Year 10 onward.

Table 4-7: Extraction schedule

Material	m³			'000 tonnes			Ore Grade % Li_2O	Stripping ratio (W:O)
	Ore	Waste Rock	Overburden	Ore	Waste Rock	Overburden		
Y1	370	1,033	233	1,000	2,875	466	1.41	2.88
Y2	741	1,841	346	2,000	5,111	693	1.48	2.56
Y3	741	1,795	172	2,000	4,982	343	1.49	2.49
Y4	741	2,270	754	2,000	6,297	1,508	1.42	3.15
Y5	741	2,850	558	2,000	7,903	1,117	1.44	3.95
Y6	741	4,184	271	2,000	11,599	542	1.44	5.80
Y7	741	4,101	387	2,000	11,369	774	1.42	5.68
Y8	741	4,304	178	2,000	11,932	356	1.50	5.97
Y9	741	4,807	58	2,000	13,325	115	1.39	6.66
Y10	741	4,868	0	2,000	13,494	0	1.34	6.75
Y11	741	4,763	0	2,000	13,202	0	1.46	6.60
Y12	741	3,129	0	2,000	8,677	0	1.47	4.34
Y13	741	1,997	0	2,000	5,542	0	1.44	2.77
Y14	741	1,311	0	2,000	3,641	0	1.45	1.82
Y15	741	921	0	2,000	2,560	0	1.49	1.28
Last year	595	1,744	0	1,607	4,839	0	1.26	3.01
Rest of LOM	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Note: The detailed mine extraction schedule is provided for the first 15 years only.

Source: Mining Plus in Primero, 2018.

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 1.26 % Li_2O, to 1.50% Li_2O for an average of 1.43% Li_2O.

Waste rock tonnage averages 7,959,000 tonnes per year with a maximum of 13,494,265 tonnes at Year 10 and a minimum of 2,560,092 tonnes at Year 15. The LOM's average stripping ratio is 4.16. The overburden and topsoil tonnage averages 657,000 tonnes per year. Table 4-8 presents the explosives yearly consumption schedule with a distinction between the consumption from May to October (inclusively) and November to April.

Table 4-8: Explosives consumption

Year	Explosives Consumption (tonnes)		
	May-Oct.	Nov.-Apr.	Total
Y1	1,014	401	1,415
Y2	1,289	1,276	2,565
Y3	1,218	1,206	2,424
Y4	1,586	1,568	3,154
Y5	1,766	1,745	3,512
Y6	2,229	2,201	4,430
Y7	2,229	2,201	4,431
Y8	2,251	2,223	4,474
Y9	2,422	2,391	4,813
Y10	2,430	2,399	4,829
Y11	2,387	2,356	4,743
Y12	1,715	1,695	3,411
Y13	1,250	1,237	2,488
Y14	968	960	1,928
Y15	808	802	1,610
Last year	1,062	1,050	2,112
Rest of LOM	n.d.	n.d.	n.d.

Note: The detailed mine extraction schedule is provided for the first 15 years only.

Source: Mining Plus in Primero, 2018.

4.5.4 ROCK TRANSPORTATION

The economic and non-economic rock will be transported on a series of haul roads which are shown on Map 4-1. Haul roads will be 20 m wide with a heavy foundation to accommodate the proposed 61.5-tonne off-highway truck. The trucks will exit the pit area from one of the two ramps: JB1 or JB2. Trucks originating from JB3, JB4, or JB5 will travel inside the pits toward the exit point at JB2.

Economic material will be hauled to the ROM pad located at 1,555 m or 1,765 m respectively, from the JB1 and JB2 exit points. The material will be fed to the crusher and screened then sent to the crushed material stockpile (in dome) located in the process plant sector.

Waste rock will be hauled to the waste rock stockpile located 1,000 m or 1,210 m respectively, from the JB1 and JB2 exit points from Years 6 to end of mine life. Waste rock will be unloaded following a pre-established deposition plan and a dozer will profile the material received (Section 4.8).

Since the haulage road crosses creek CE3, a haulage bridge will need to be constructed. The bridge will comply with the norms stated in the *Règlement sur l'aménagement durable des forêts du domaine de l'État*.

4.6 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 spodumenerich material, with a nominal concentrate production of 308,000 tonnes per year (41 t/h). The process design criteria are summarized in Table 4-9. The design criteria were based on industry standards, professional experience, as well as calculations and data provided by Galaxy. The simplified process flow diagram is presented on Figure 4-5, while Figure 4-6 presents a more detailed process flow diagram. The detailed version is subject to change. It is possible that the equipment or the layout within the DMS building be different. The processing method and footprint are not being challenged.

The material is transported from the open pit mine to the ROM pad that has a capacity of 3,800 m³, or 5,550 tonnes (loose), which is equivalent to one day of production. 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.

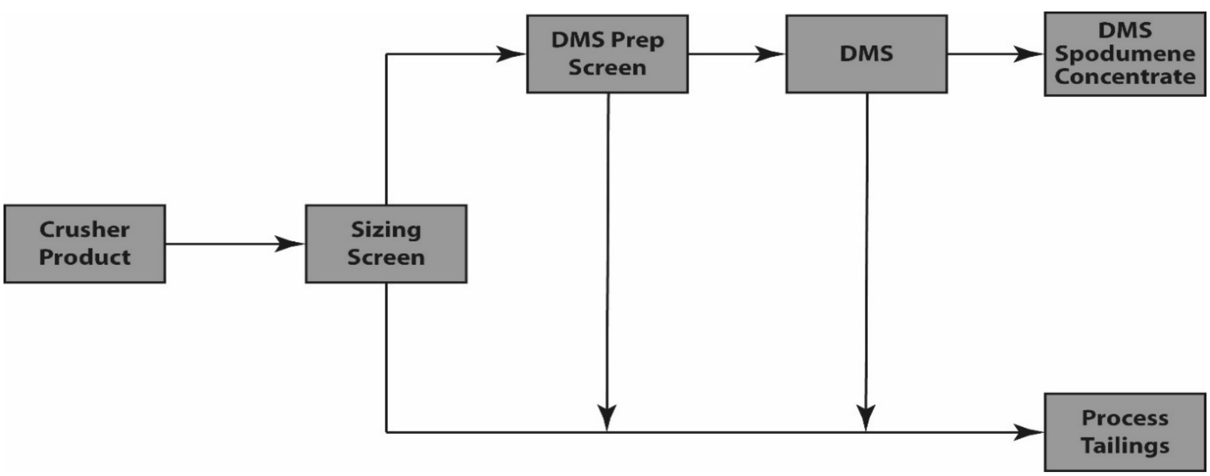


Figure 4-5: Simplified process flow diagram

4.6.1.1 *DENSE MEDIA SEPRATION FEED PREPARATION*

The DMS feed preparation is designed to classify the material into distinct size fractions. The sizing screen sorts the coarser material from the fines (4 mm cut-off). Sizing screen undersize (>1 mm) is sent directly to the tailings. Coarse material goes directly to the DMS for processing while the fines go through additional steps. Process water is added via spray bars to facilitate the material classification as it passes over the wet screen. Fine material (1-4 mm) through a reflux classifier before going for mica removal. Mica removal is done with a screw classifier which is a combination of a fluidised bed separator and a lamella settler. It also uses water as the separating medium to reduce the mica gangue within the fines fraction.

GALAXY

James Bay Lithium Mine

Environmental Impact Assessment

Process Flow Diagram

Sources : *WSP, 2018*

No ref. : 171-02562-00_wspT114_EIE_f4-6_gestion_eau_ANG_181015.ai

Figure 4-6

PRELIMINARY

wsp

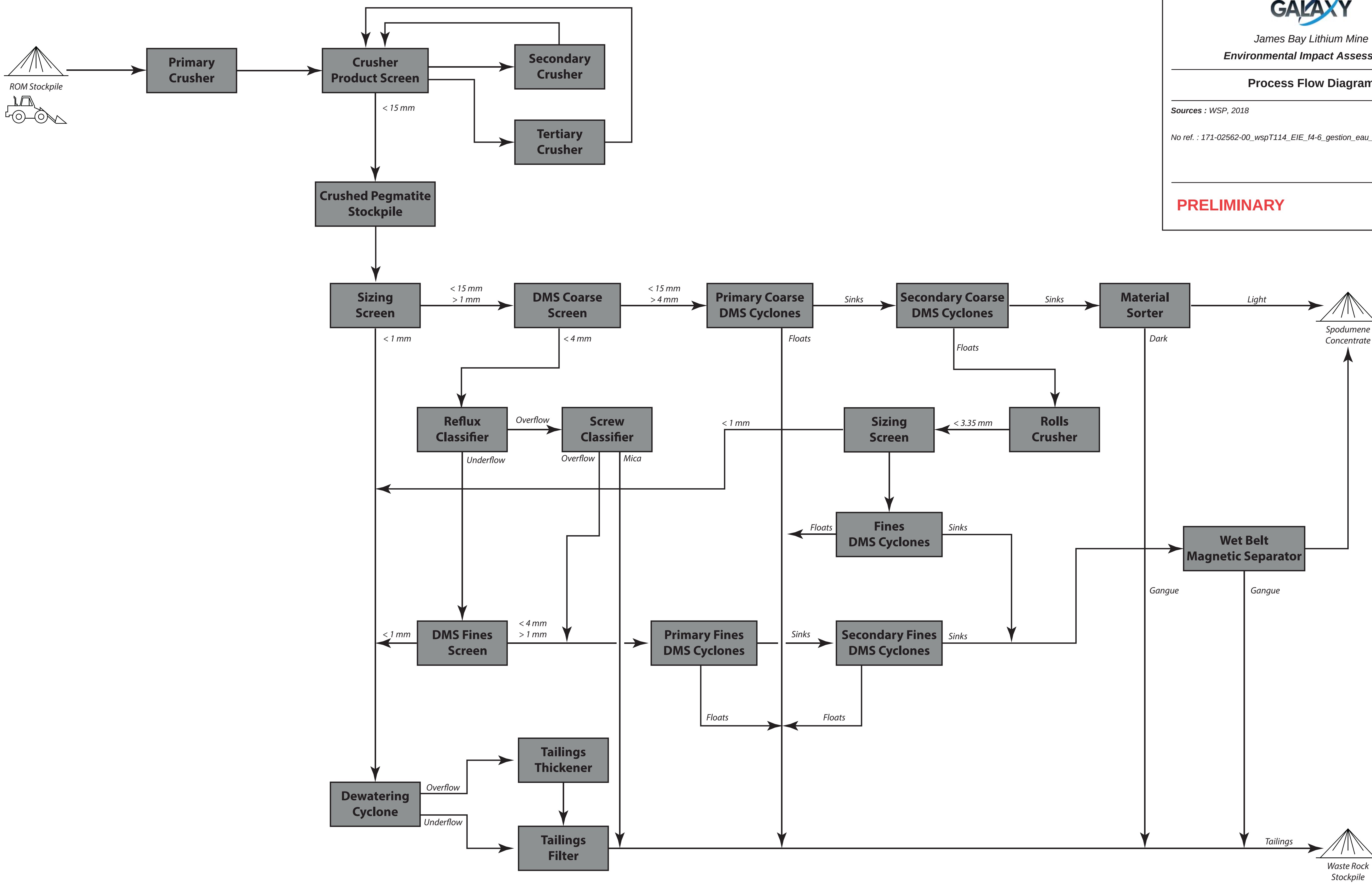


Table 4-9: Process design criteria

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	%	66.7
Crushing circuit utilised hours	h	5,840
Required average crushing rate (dry)	dry t/h	342.5
Required average crushing rate (wet)	wet t/h	360.5
Design surge factor	%	20
Design crushing rate	wet t/h	433
DMS Circuit Operating Schedule		
DMS circuit utilisation	%	85
Effective daily processing hours	h	20.4
Required average DMS	dry t/h	268.6
Feed material Characteristics		
Feed grade[a]	% Li_2O	1.40
Product Characteristics		
Recovery	%	66
Concentrate grade	% Li_2O	6
Nominal lithium production	Li_2O t/a	18,480
Lithium concentrate production @ 6.0% Li_2O	t/a	308,000
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	600
F_{80}[c]	mm	288

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: Primero, 2018.

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 product is the spodumene concentrate that can 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 stockpile.

Dewatered spodumene concentrate travels on the conveyor to the dome where it is loaded into trucks for shipment 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 will be 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.

4.7 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 4-10.

Table 4-10: Test results for waste rock

Unit	Metals>A	TCLP>RES	SPLP>RES	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%)	

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.

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 4-11.

Table 4-11: Test results for pegmatite samples

Metals>A	TCLP>RES	SPLP>RES	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%)				

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.

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 4-12.

Table 4-12: Test results for tailings samples

Metals>A	TCLP>RES	SPLP>RES	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 should be 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 OUTCOME

To more accurately determine the long-term acid generation potential and leachability of waste rock/tailings, kinetic column tests were recommended. These tests are performed on coarse materials like the particle size and the actual composition of waste rock/tailings that will be stored on the site. Kinetic column tests were therefore initiated in May 2018. The kinetic test program was based on recommended waste rock management assumptions, i.e., codisposition and codeposition. The results of these tests will help confirm the appropriate protection measures to take for the storage area. The tests performed on the unconsolidated deposits show that the sand unit is not leachable and that the clay unit leaches barium, copper, lead and zinc.

4.8 STOCKPILES

The waste rock stockpile as well the unconsolidated deposits and organic matter stockpiles are shown on Map 4-1. A multi-criteria decision analysis was carried out to determine the most favourable option and location for the tailings and waste rock disposal with regards to environmental, technical, economic, and socioeconomic impact criteria. The methodology and results of this analysis are presented in Chapter 3.

The stockpile design is supported by stability analyses which include geotechnical investigations. The geotechnical investigations included a total of 53 boreholes, in situ shear strength measurement of cohesive soils (e.g. clays), laboratory assays (e.g. water content, sieve tests, hydrometer tests, plasticity (Atterberg) limits).

Stability analyses (limit equilibrium) were conducted for static and pseudo-static conditions, the latter accounting for seismic hazard in the project area (the project is in a region with low seismic activity). The seismic hazard value was determined by using the 2015 *National Building Code of Canada* seismic hazard calculator (RNCan, 2016). The minimum required FoS was based on the guidelines provided by the D019.

The peak horizontal ground acceleration (PGA) at the site is 0.038g 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 4-13.

A tailings and waste rock deposition strategy was developed based on the planned production (Primero, 2018). This deposition strategy includes the unconsolidated deposit and organic matter. Due to the lack of information on the overburden characteristics in the pit sector, it has been assumed that 10% of the material to be excavated will be organic. A 15% contingency was added to the overburden calculations. Figures 4-7 through 4-10 illustrate various cross-sections of the stockpiles and dikes/berms.

The next subsections present additional details on the overburden stockpiles, the waste rock stockpile, 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.

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 heterogenous properties of the unconsolidated deposit, 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 homogenous material, and will have better frictional property to ensure the slope stability. This protection layer will be compacted to provide the required shear resistance.

Table 4-13: Stockpiles key design criteria

Parameter	Unit	Design Value
Material acid drainage potential		
Waste rock	Yes / no	Yes
Tailings	Yes / no	Yes
Unconsolidated deposit (inorganic)	Yes / no	No
Organic matter	Yes / no	N/A
Material water content		
Waste rock	% w/w	5
Tailings	% w/w	11
Unconsolidated deposit (inorganic)	% w/w	15
Organic matter	% w/w	75
Global slope		
Waste rock	H:1V	2.5 H:1V
Unconsolidated deposit (inorganic)	H:1V	2.5H:1V
Organic matter (drained)	H:1V	8H:1V
Specific dry density (loose)		
Waste rock	t/m^3	1.94
Tailings	t/m^3	1.70
Unconsolidated deposit (inorganic)	t/m^3	1.83
Organic matter	t/m^3	1.22
ROM (pegmatite)	t/m^3	1.89
Storage capacities		
Waste rock tonnage	Mt	233.4
Tailings tonnage	Mt	36.4
Waste rock volume (loose)	Mm^3	100
Tailings volume (loose)	Mm^3	20
Unconsolidated deposit (inorganic) (loose)	Mm^3	3.57
Organic matter (loose)	Mm^3	3.49
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: WSP in Primero, 2018.

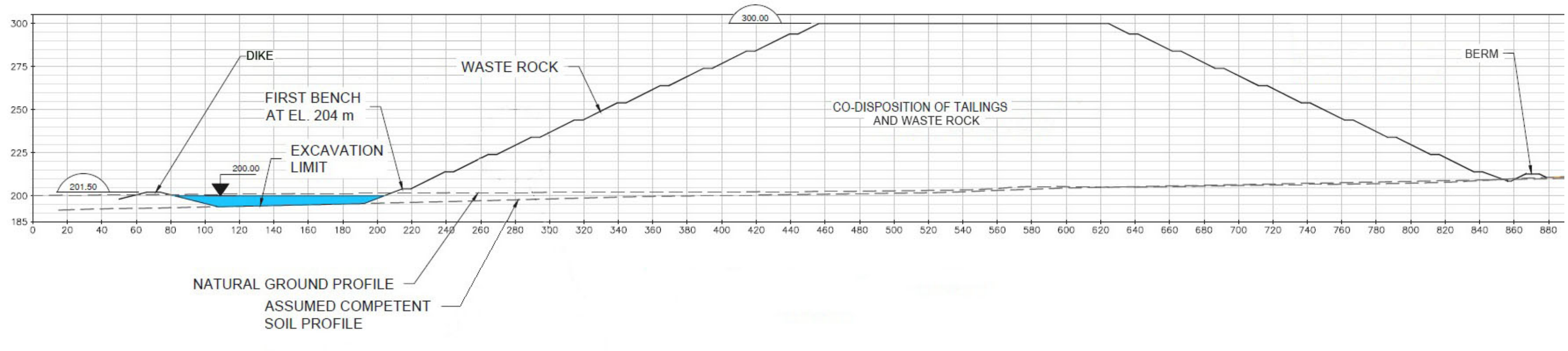
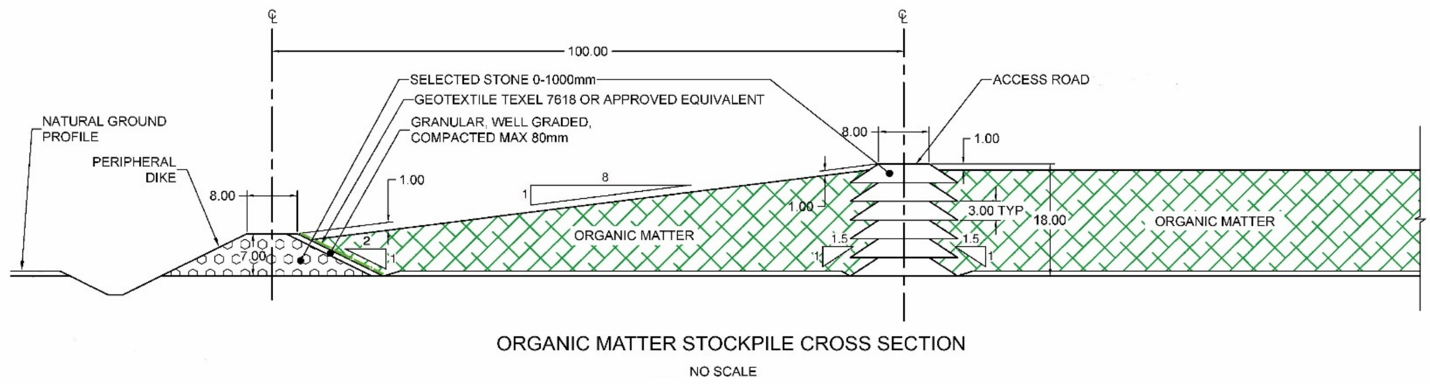


Figure 4-7: Waste rock stockpile cross-section

Source: WSP in Primero, 2018.



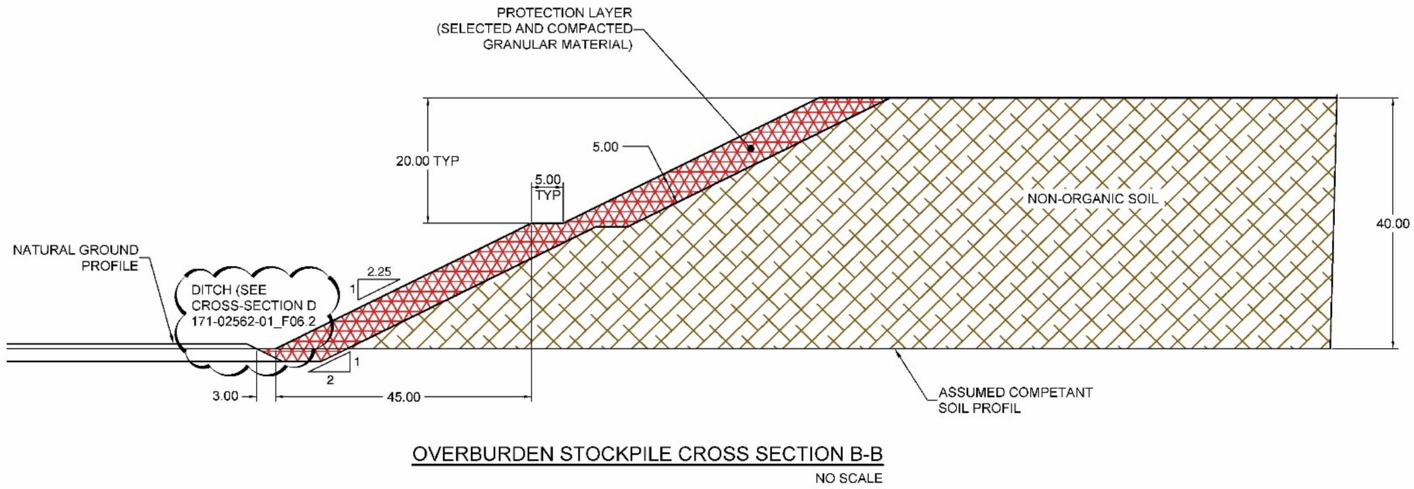


Figure 4-8: Overburden stockpiles cross-sections

Source: WSP in Primero, 2018.

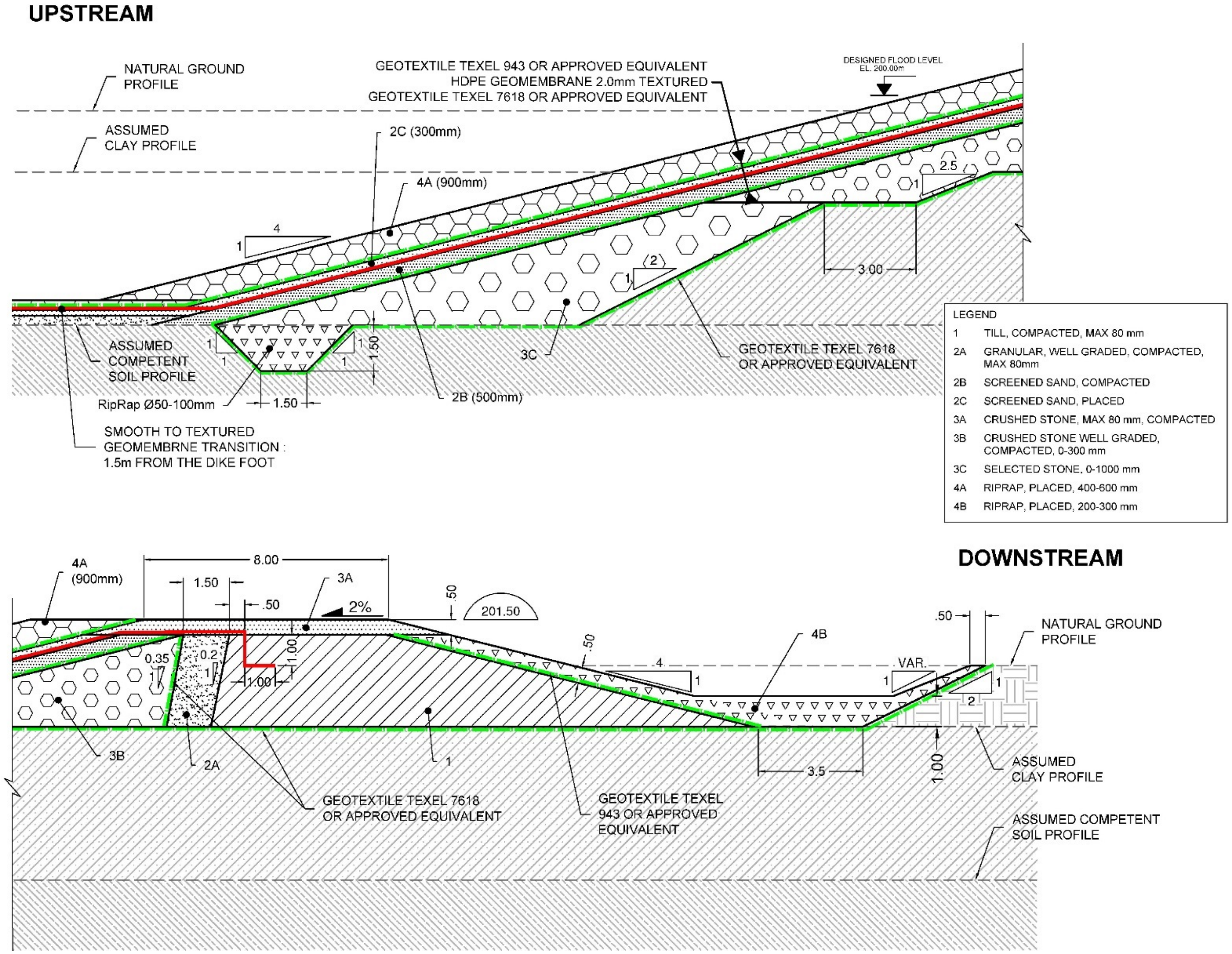


Figure 4-9: Dike cross-sections

Note: Top: Upstream (inside); Bottom: Downstream (outside).

Source: WSP in Primero, 2018.

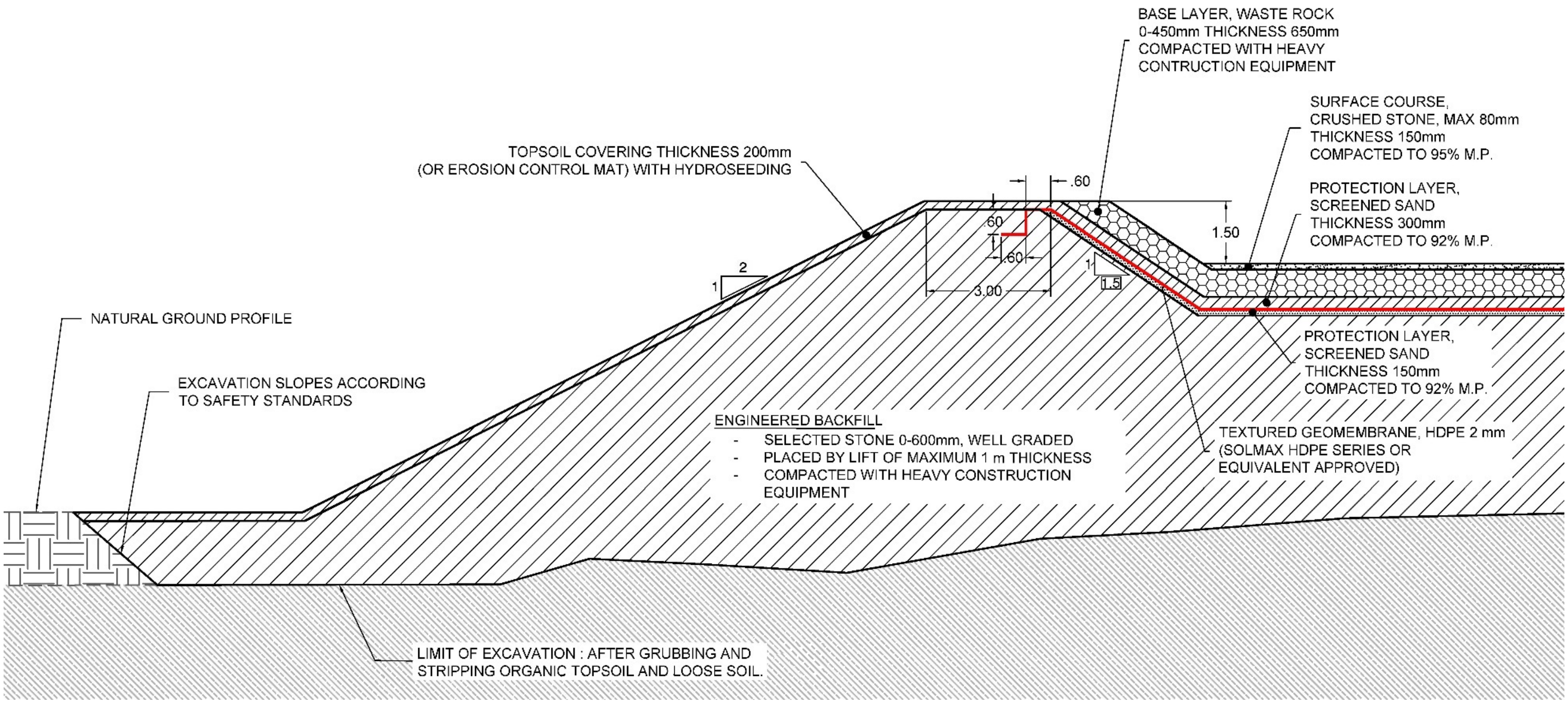


Figure 4-10: Run-of-Mine pad cross-section

Note: Not to scale.

Source: WSP in Primero, 2018.

The proposed unconsolidated deposit stockpile will be a fill with a maximum height (depending on the ground elevation) of approximately 40 m (Figure 4-8). The maximum elevation of the proposed stockpile is 249.5 m. The stockpile will be assembled over the years and its general geometry will be:

- Maximum bench offset: 5 m;
- Maximum bench height: 20 m;
- Local bench slope – 2.25H: 1V.

Organic matter was intercepted at most of the borehole locations and is composed of fibrous peat. This material is known to be saturated, with a high-water content (Mesri and Ajlouni, 2007). It is therefore important to consider water management when designing the stockpile to allow water to drain easily. With that purpose in mind, a peripheral dike composed of stones (0-1,000 mm) will be built around the stockpile. In addition, access roads, spaced at approximately 100 m, will be built to optimize the dozer placement activities. The roads will be used for trucks to circulate across the stockpile safely while unloading the organic matter. A bulldozer can then be used to spread and compact the material. A gentle slope of 8H:1V is recommended on the edge of the stockpile. Figure 4-8 illustrates the organic matter stockpile geometry. The cumulative volumes of the stockpiles are summarized in Table 4-14 for reference Years -1, 1, 3, 5, 10, and rest of LOM.

Table 4-14: Cumulative volumes of overburden stockpiles

Reference Years	Unconsolidated Deposit (Mm^3)	Organic Matter (Mm^3)
Year -1	0.06	0.77
Year 1	0.34	0.83
Year 3	0.95	0.96
Year 5	2.51	1.62
Year 10	3.58	2.55
Rest of LOM	3.58	2.55

Source: WSP in Primero, 2018.

4.8.2 WASTE ROCK AND TAILINGS

The waste rock and the tailings will be placed in the stockpile referred to in this study as the waste rock stockpile. According to the mining plan, the diameter of the blocks will be 900 mm at maximum, with a F50 of 250 mm.

The geological information and the results from the geotechnical study have shown that the northern half of the footprint of the waste rock stockpile contains a significant layer of clay that will need to be managed to assure the integrity of the design. The following design considered stability analyses conducted for the dikes and stockpiles slopes. WSP is currently developing a hydrogeological model to verify the percolation rates below the waste rock stockpile. The results of that study in conjunction with the results of additional geochemical test work in progress, will determine the final design of the infrastructure.

Deposition Plan

The waste rock and tailings will be deposited on an solid foundation. The topsoil and peat will be stripped and stored on the organic matter stockpile. To minimize hauling, unsuitable material such as clayey soil will be stripped from the footprint and stored directly inside the waste rock stockpile footprint.

All contact water with the clay will be managed by the waste rock stockpile water management system, eliminating potential sediment runoff to streams from the clay. The leaching tests performed on the clay have shown that certain metals can leach. Therefore, the water in contact with the clay will be managed within the main water retention basin, treated by the WTP before it is released into the natural environment.

The co-disposal method consists of building a joint stockpile by mixing or layering both types of materials so the tailings and the waste rock are placed at the same location. A provision for clayey soils within the stockpile was made. The design of the interior arrangement concerning the placement of the waste rock, the tailings or the clayey soils will be conducted at later stage (detail engineering).

The slope geometry will consist of 10 m benches with a face slope of 2H:1V with 5 m berms. The top will be sloped gently to prevent water puddling and water erosion. The stockpile will reach an elevation 300 m, representing a height of approximately 100 m above the surrounding natural environment.

The cumulative volumes on the waste rock and tailings stockpile are presented in Table 4-15 for reference Years -1, 1, 3, 5, 10, and rest of LOM.

Table 4-15: Cumulative volumes of material in waste rock stockpile

Reference Year	Waste Rock (m³)	Tailings (m³)	Subtotal (m³)	Excavated Clay (m³)	Total (m³)
Year -1	-	-	0	1,895,000	1,895,000
Year 1	1,403,000	494,100	1,897,100	1,895,000	3,792,100
Year 3	6,328,000	2,450,800	8,778,800	1,895,000	10,673,800
Year 5	13,255,000	4,422,800	17,677,800	3,000,570	20,678,370
Year 10	43,350,000	9,358,200	52,708,200	4,886,450	57,594,650
Rest of LOM	62,114,000	15,075,700	77,189,700	5,399,490	82,589,190

Source: WSP in Primero, 2018.

Dikes

The proposed water retention dike section consists of a zoned till rockfill dike with a textured High-Density PolyEthylene (HDPE) geomembrane to act as an impervious barrier to potentially contaminated water on the upstream side. To accommodate subsurface ground conditions, upstream and downstream slopes of 4H:1V are proposed for stiff to very stiff clay.

This design includes a geotextile liner between coarse and fine materials to prevent migration of particles from one material to another. The dam crest elevation is at 201.5 m. The design flood level of the basin has been fixed to 200.0 m, and the maximum water level has been fixed to 200.0 m. Figure 4-9 illustrates the typical sections of the dike.

The upstream portion of the dike is composed of a clay core, covered (from bottom to top) by the following:

— Geotextile;
— Selected stone 0-1,000 mm in diameter;
— 500 mm thick protection layer composed of screened sand, compacted;
— Geomembrane (smooth on gentle slope and flat surface and textured in slopes);
— 300 mm thick protection layer composed of screened sand, placed;
— Geotextile;
— 900-mm thick of rip rap, 400-600 mm in diameter, placed.

The downstream portion of the dike is composed of a compacted till core with a vertical filter of well-graded material, with a maximal diameter of 80 mm, and compacted on the upstream side. This downstream side is covered (from bottom to top) by the following:

— Geotextile;
— 500 mm thick of rip rap, 200-300 mm in diameter, placed;
— 500 mm of crushed stone, maximum 80 mm in diameter to act as an access road for inspection and monitoring.

Berms

Berms are also required on the southern half of the waste rock stockpile where till-like material was observed. A collection ditch is located between the toe of the stockpile and the berm. These berms will also serve as haulage roads to transport the material to be deposited. They will be constructed with engineered backfill such as compacted till available at the footprint of the stockpile (e.g. through the excavation of ditches) or in a borrow pit. The final layer will consist of a 300 mm layer of granular material with a maximum particle size of 80 mm. For sections of the berm built on clayey material, the top will be 1.5 m above the natural ground profile. For those built on competent soil (compact), they will typically be 2 m high regardless of the natural ground level.

Foundations and Protective Layers

Once the topsoil has been stripped and clayey material excavated, 1 m deep drainage trenches will be dug. These trenches will be 1 m wide and located at every 50 m, or where needed. The trench bottoms and slopes will be covered with a geotextile and filled with rip-rap (particles 50-100 mm in diameter). The rip-rap surface will be covered with geotextile.

4.8.3 ROM PAD

As presented in section 4.6, the blasted material is first stored on the ROM pad. This stockpile has a capacity of 3,800 m³, or 5,550 tonnes (loose), which is equivalent to one day of production. 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 4-10.

Construction Material Selection

For operational purposes, namely the loading of the primary crusher by a front-end loader, it is proposed that the crest of the pad be fixed at an elevation of 225.7 m. This is approximately 17 m above the existing ground. According to the anticipated stockpile volume, an approximate footprint area of 100 m by 100 m is proposed. According to safety regulations, a peripheral berm with a height above the radius of the largest equipment wheel is required at the crest. The proposed berm will be 1.5 m high. A stone (0-600 mm) of adequate material will be used to build the pad to the requested elevation.

The preparation of the subgrade will include excavation and site grading to produce a useable and easily maintainable ground surface which is not subject to flooding or erosion. To prevent erosion of the exterior slopes, a topsoil covering of 200 mm thick (or erosion control mat) with hydroseeding is planned.

For the pad surface course, a 150-mm thick crushed stone (max 80 mm) layer will be built on a 650-mm thick base layer composed of rock (0-450 mm).

Drainage

Final site grading will comply with the following:

- Design an appropriate surface water management system for the platform;
- Provide an appropriate surface sloping for the platform to minimize precipitation runoff over the platform.

The ROM pad will be graded to 2% downslope toward a pumping station, allowing contact water to be evacuated to the settling pond in the industrial and administrative sector. The peripheral berm will be considered all around the ROM pad to separate the clean runoff water from the contact water within the pad. The height of the berm will comply with the requirement for water retention structures as specified in the D019 as well as in the *Safety Code for the Construction Industry* (Gouvernement du Québec, 2018a). Geometry of ditches is discussed in section 4.9.

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 water management infrastructure and watershed delineations are illustrated on Map 4-8. There will be two clean water discharges for the project:

- Creek CE2 (north of the waste rock stockpile);
- Creek CE3 (south of the overburden stockpiles).

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 dike associated with waste rock stockpile water retention basin during the summer of the previous year. This would allow for the accumulation of a few months of rain water prior to winter.
- Mining sites should always have a water reserve (i.e. liquid and accessible) equivalent to at least one month's worth of processing demand during the summer months. For the project, this represents approximately 14,000 m³.
- An additional quantity of water must be kept in the water basin prior to the onset of winter. This volume is needed to account for losses due to surficial ice formation and to a prolonged period (typically from November to May) where precipitations cease. The exact quantity to be reserved will be established during the operations based on empirically-observed trends of ice formation and wintertime loss rates. This amount can also vary with the evolution of the mining site. For year 1, a volume of 167,000 m³ by late November is recommended (equal to 6 months of processing, plus 1 m of ice).

At a later phase (i.e. detail engineering) and in conjunction with further planning for operations and production, the mine operations will prepare an operational water management protocol. The protocol will further analyze the potential risks associated with a prolonged dry season or winter period and prescribe actions and contingencies, if needed, to ensure a constant supply of water for processing.

Depending on the type of water management infrastructure to be built, there are regulatory and general operational criteria for design:

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

Design Flood Management

As specified in the D019, all water retention basins associated with tailings and/or mining waste rock storage facilities must be designed to manage the project 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.

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.

Effluent Water Quality Standards

The mining effluent regulations of D019 and the MDMER apply to both effluent discharge locations.

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.

Extreme Weather Data

The extreme weather data parameters pertinent to the design are: spring melt of 388.5 mm for 100-year, 30-day snowmelt, while 101.6 mm for the 1,000-year, 24-hour rain. This data is sourced from the intensity-duration-frequency tables for the La Grande Rivière weather station. Table 6-3 provides the monthly average precipitation. This data is based on historical daily precipitation records for the La Grande Rivière.

General Assumptions

As specified by Québec regulatory requirements, all infrastructures must be sized and designed to adequately manage peak flood events, i.e. exceptionally rare occurrences of extreme water inflows and surpluses. The following assumptions were used for the sizing of the water infrastructure:

- For the design spring melt water balances, runoff losses such as evapotranspiration and infiltration are assumed negligible due to the frozen ground and the cold weather conditions. Sublimation losses of the snowpack are similarly assumed negligible.
- For the wet year annual water balances, a global runoff coefficient of 0.7 is assumed. This is considered applicable to industrial land-use zones with significant areas attributed to stockpiles.
- The dead storage (volume beneath the pump's intake) of the water retention basin, settling ponds and the various hauling road pumping stations is assumed to be negligible.
- It was assumed that the water demand for dust control would be sourced from the WTP effluent. It was also assumed that spraying volumes are eventually lost to evaporation.
- Twenty-four-hour (24-hour) rain events were distributed using a SCS type II rainfall distribution.

The input data and assumptions specific for each area are presented in the sections below.

4.9.2 INFRASTRUCTURE

This section details how water will be managed in the various project areas:

- Pit;
- Industrial and administrative area;
- Overburden stockpiles;
- Waste rock stockpile;
- ROM pad;
- Roads;
- WTP;
- Effluents;
- Potable water wells.

The water management infrastructures are design based in conjunction with the water balance.

Pit

The monthly inflow of water from the pit to the main water retention basin was estimated for the flood management event (100-year return period wet year) and operational design (10-year return period wet year). Table 4-16 presents the inflow for these two criteria. The year with the highest inflow is expected to be Year 15 of production with an annual volume of 1,945,007 m^3 for flood management and of 1,549,688 m^3 for operational design. Pumps will be installed to manage the yearly demand. The pumped water will travel in pipes to the main water retention basin.

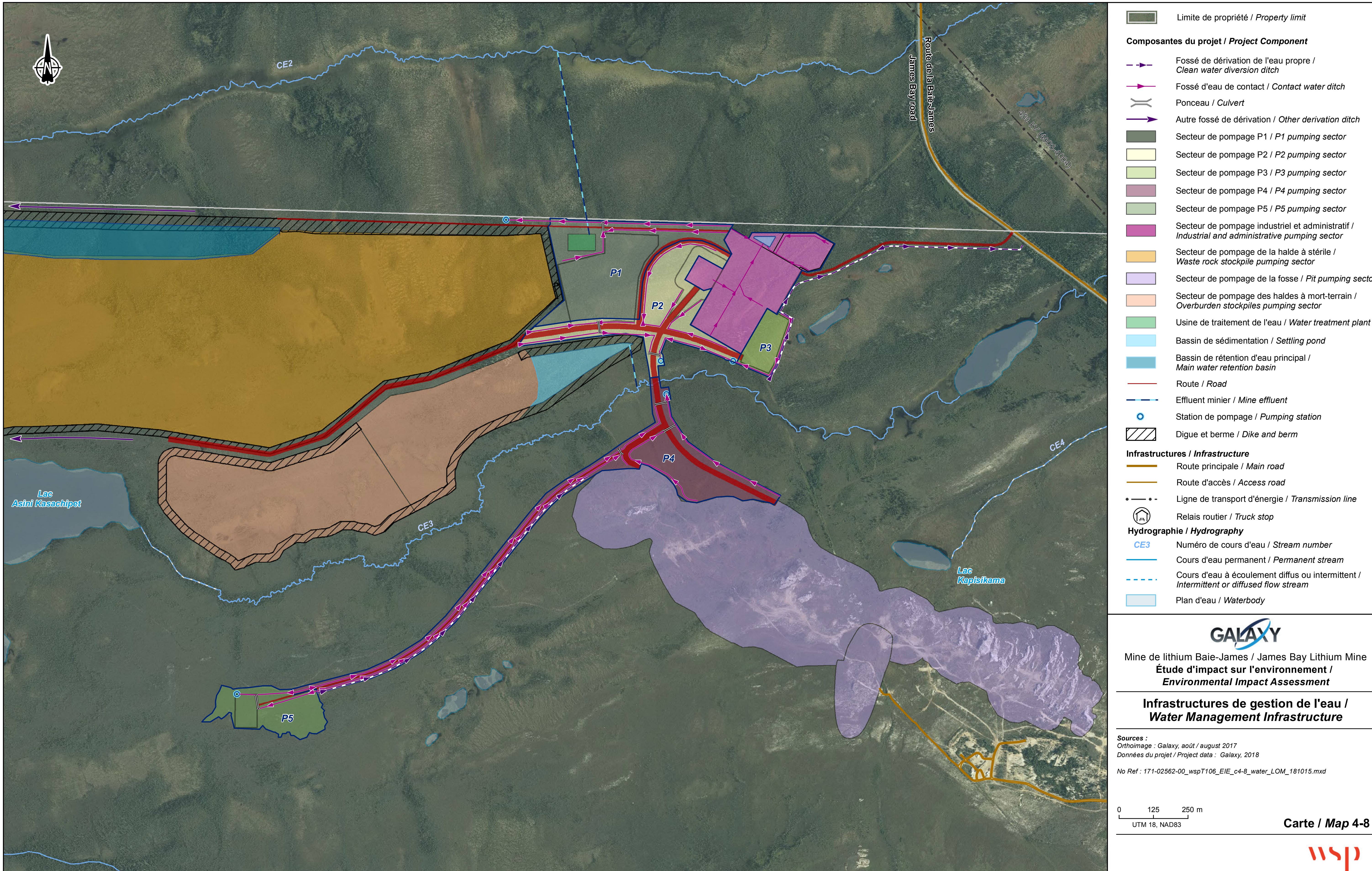

CE2
CE3
CE4
P1
P2
P3
P4
P5
Lac Asini Kasachipet
Lac Kapisikama
James Bay road
Route de la Baie-James
Limite de propriété / Property limit
Composantes du projet / Project Component
Fossé de dérivation de l'eau propre / Clean water diversion ditch
Fossé d'eau de contact / Contact water ditch
Ponceau / Culvert
Autre fossé de dérivation / Other derivation ditch
Secteur de pompage P1 / P1 pumping sector
Secteur de pompage P2 / P2 pumping sector
Secteur de pompage P3 / P3 pumping sector
Secteur de pompage P4 / P4 pumping sector
Secteur de pompage P5 / P5 pumping sector
Secteur de pompage industriel et administratif / Industrial and administrative pumping sector
Secteur de pompage de la halde à stérile / Waste rock stockpile pumping sector
Secteur de pompage de la fosse / Pit pumping sector
Secteur de pompage des haldes à mort-terrain / Overburden stockpiles pumping sector
Usine de traitement de l'eau / Water treatment plant
Bassin de sédimentation / Settling pond
Bassin de rétention d'eau principal / Main water retention basin
Route / Road
Effluent minier / Mine effluent
Station de pompage / Pumping station
Digue et berme / Dike and berm
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
Étude d'impact sur l'environnement / Environmental Impact Assessment
Infrastructures de gestion de l'eau / Water Management Infrastructure
Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018
No Ref : 171-02562-00_wspT106_EIE_c4-8_water_LOM_181015.mxd
0 125 250 m
UTM 18, NAD83
Carte / Map 4-8
wsp

Table 4-16: Annual inflow of water from the pit

Year	Flood Management (m^3)	Operations (m^3)
1	125,998	100,389
2	180,459	143,781
3	0 [a]	0 [a]
4	786,868	626,939
5	1,361,511	1,084,786
6	1,226,341	977,089
7	1,866,282	1,486,964
8	1,618,076	1,289,205
9	1,904,212	1,517,185
10	1,842,521	1,468,032
11	1,228,372	978,708
12	1,472,505	1,173,221
13	1,504,023	1,198,333
14	1,736,877	1,383,860
15	1,945,007	1,549,688
Last year	709,881	565,599
Rest of LOM[b]	n.d.	n.d.

a During this timeframe, the water is pumped from an active pit to an unmined pit.
b The detailed mine extraction schedule is provided for the first 15 years only.

Source: Mining Plus in Primero, 2018.

Industrial and Administrative Area

The water management infrastructure associated with the industrial and administrative area includes a system of contact water collection ditches and culverts, as well as a settling pond (Map 4-8). The designed pumping rate of the settling pond is estimated at 900 m^3 per hour. The trapezoid shaped settling pond has a capacity of 9,932 m^3. The total depth (from crest to bottom) is 5.6 m. The water from the pond will be pumped to the main water retention basin.

Overburden Stockpiles

The runoff waters from the overburden stockpiles (organic matter and unconsolidated deposit) will naturally make their way to the settling pond in their eastern tip. Since the settling pond is not associated with an area used for the permanent storage of mining wastes as defined by D019, no volumetric flood storage requirements are imposed. The mining effluent criteria of the D019 and the MDMER will still apply to the water decanted out of the pond released back to the natural environment. The pond is therefore regarded as a type of water treatment facility. As such, it must be dimensioned so its effluent will meet water quality requirements.

It is assumed that 50% of the water content of the material will exfiltrate toward the water basin. When the basin is fully saturated, it is assumed that the water content of the organic matter (peat) will be 90% v/v while the water content of the unconsolidated deposits (sand and other materials) will be 25% v/v.

The maximum water level is 209.5 masl. The dike crest would therefore be at 211.0 masl (1.5 m of freeboard). Considering the dike height and layout, the basin would have a storage volume of approximately 50,000 m^3. A basin volume of that order would allow for a hydraulic retention time of 5 days, considering the average inflow from a rain event with a 50-year return period of a similar 5-day duration. The basin's surface length also imposes a minimum horizontal travel distance of 400 m (distance between where a particle enters the pond and the decantation structure) which will further promote the settling of suspended particles.

The settling pond, with its proposed volume and surface length, will be adequate to have an effluent that meets discharge criteria. This will be validated at a later stage with a particle sedimentation model, when more information regarding the particle properties of the stockpile materials becomes available. In addition, if any non-compliances are measured at the outflow of the settling pond, water will be redirected to the main water retention basin.

Waste Rock Stockpile

This section provides the basis for the sizing of the following water management infrastructure: main water retention basin associated with the waste rock stockpile and the WTP. The watersheds of interest for the main water basin include:

- Waste rock stockpile;
- Industrial and administrative area;
- Pit;
- ROM pad;
- Haul roads and access roads.

Due to constraints imposed by the natural terrain, the maximum water level in the water retention basin is to be 200 masl. To meet the freeboard requirement criterion, the crest of the dike will be at 201.5 masl. The storage capacities of the basin vary between 0.415 Mm^3 to 0.900 Mm^3. For the ditches around the stockpile, a trapezoidal cross-section with a 1-m wide invert and side slopes of 2.0H: 1V is to be built to convey design rain events while ensuring an adequate freeboard above peak water levels. Riprap will be sized to D_{50} = 200 mm for erosion protection purposes.

ROM Pad

The surface of the ROM Pad will have a gentle slope and drain water towards the northeastern corner where a waterproof sump and pump will be installed. The water will be pumped to the settling pond in the industrial and administrative sector. The pumping station and the water pipe will be sized to accommodate the designed rates.

Roads

The proposed layout and nomenclature of the water management infrastructure for the access and hauling roads are located on Map 4-8. The infrastructure presented in this section include:

- Hauling roads from the pit to the ROM pad and to the waste rock stockpile;
- Hauling roads to the overburden stockpiles;
- Main access roads and other access roads on the site;
- Drainage ditches and pumping stations.

The contact water will be managed through a series of ditches and pumping stations installed in small water basins at various locations. For all contact water and clean water diversion ditches, a trapezoidal cross-section with a 1-m wide invert and side slopes of 2.5H:1V is to be built to convey design rain events while ensuring an adequate freeboard above peak water levels. Riprap sized to D_{50} = 100 mm is to be used for erosion protection purposes. These ditches are designed and planned to divert water from the environment and keep it away from contact water or any water that could potentially be contaminated by mining activities. The design event (24-hour rain, 100-year return period, SCS type II rain distribution), was simulated using a HEC-HMS 4.1 hydrologic model. Table 4-17 documents watershed areas, the pumping capacity and the dimensions of the associated basins for each pumping station.

Table 4-17: Roads contact water and pumping infrastructure

Parameter	Unit	P1	P2	P3	P4	P5
Watershed	ha	14.2	11.0	3.2	14.6	5.8
Required pump flow rate	m^3/min	800	540	150	800	290
Basin dimensions (width x length x depth)	m	15 x 60 x 3	20 x 45 x 2	10 x 30 x 2	20 x 45 x 3	20 x 20 x 2

Source: WSP in Primero (2018).

Water Treatment Plant

The WTP is designed to treat the water from the water retention basin and the occasional inflow from the overburden stockpiles' settling pond (if any non-compliances are measured). The water inflow from the water retention basin is estimated using the highest of the design flood management (100-year return period wet years) or operational summer dewatering (10-year return period wet years). The design considers two implementation stages:

— Phase 1: Years 1 through 9 and Year 11 onward; 500 m^3/hr capacity;

— Phase 2: Year 10: 1,500 m^3/hr capacity.

For phase 1, the WTP will consist of:

— Pumping (from the basin to the treatment plant);

— Sand and solids separation (capacity of 1,500 m^3/hr);

— Physicochemical stage consisting of coagulation-flocculation (with coagulant, flocculant and possibly lime);

— Lamellar settling;

— pH adjustment;

— Treated water reserve;

— Sludge basin;

— Sludge dehydration through a press filter (capacity of 1,500 m^3/hr).

For phase 2, the WTP will consist of:

— Pumping (from the basin to the treatment plant);

— Sand and solids separation (same as previous phase);

— Physicochemical stage consisting of coagulation-flocculation (with coagulant, flocculant and possibly lime);

— Mobile lamellar settling unit;

— pH adjustment;

— Treated water reserve;

— Sludge basin (same as previous phase);

— Sludge dehydration through a press filter (same as previous phase).

The reagents will be shipped from the distributor to the site in drums, totes, supersacks or bags depending on the product manufacturing. The reagents and the empty media will be stored at the DMS and WTP products warehouse. Appendix C presents the preliminary layout of the WTP. The design components as presented above could be altered to comply with the effluent discharge objectives (EDO). As such, the quantities needed for various products in operations are either estimates or not provided.

Effluents

The effluents at creeks CE2 and CE3, will consist of:

— A built weir or canal to allow flow measurement (e.g.: Parshall Canal);

— Monitoring instruments for pH, temperature and outflow;

— Energy dissipation measures to reduce water speed and minimize sediments disturbance.

These items will be installed upstream of the discharge point in the creek and their design will be conducted at a later stage (i.e.: detail engineering). Appendix D provides photos of the actual conditions at the effluent discharge locations.

Potable Water Wells

During the construction phase, the potable water will be supplied by water trucks while the water wells and water treatment infrastructure is being built. The potable water requirement is estimated to 63 m³ per day for a peak of 280 workers. The water will be stored into a 400-500 m³ capacity water tank which will be insulated and heat traced.

During the operations, either two or three wells will be needed to satisfy the potable water requirement of 41 m³ per day of 150 workers. The potable water supply will include a treatment station and insulation or heat trace of the piping to the camp and the treatment site. The location of the wells has not been determined and work on this project component is going.

4.9.3 WATER BALANCE

The water balance is presented for the entire site with specific focus on the clean water discharges is presented on Figure 4-11. The specific water balance for each discharge is presented in the sections below.

Creek CE2

The water management system respects the design flood water balances for all staging intervals. The most critical year in terms of inflow for each the staging interval was selected based on the inflow from the pit. The change in storage of the main water retention basins, resulting from the difference in the sum of the inflows and outflows from the system, is equal to the storage capacity of the basin for all staging years. The required water treatment rate of the WTP for the spring melt period is provided in Table 4-18.

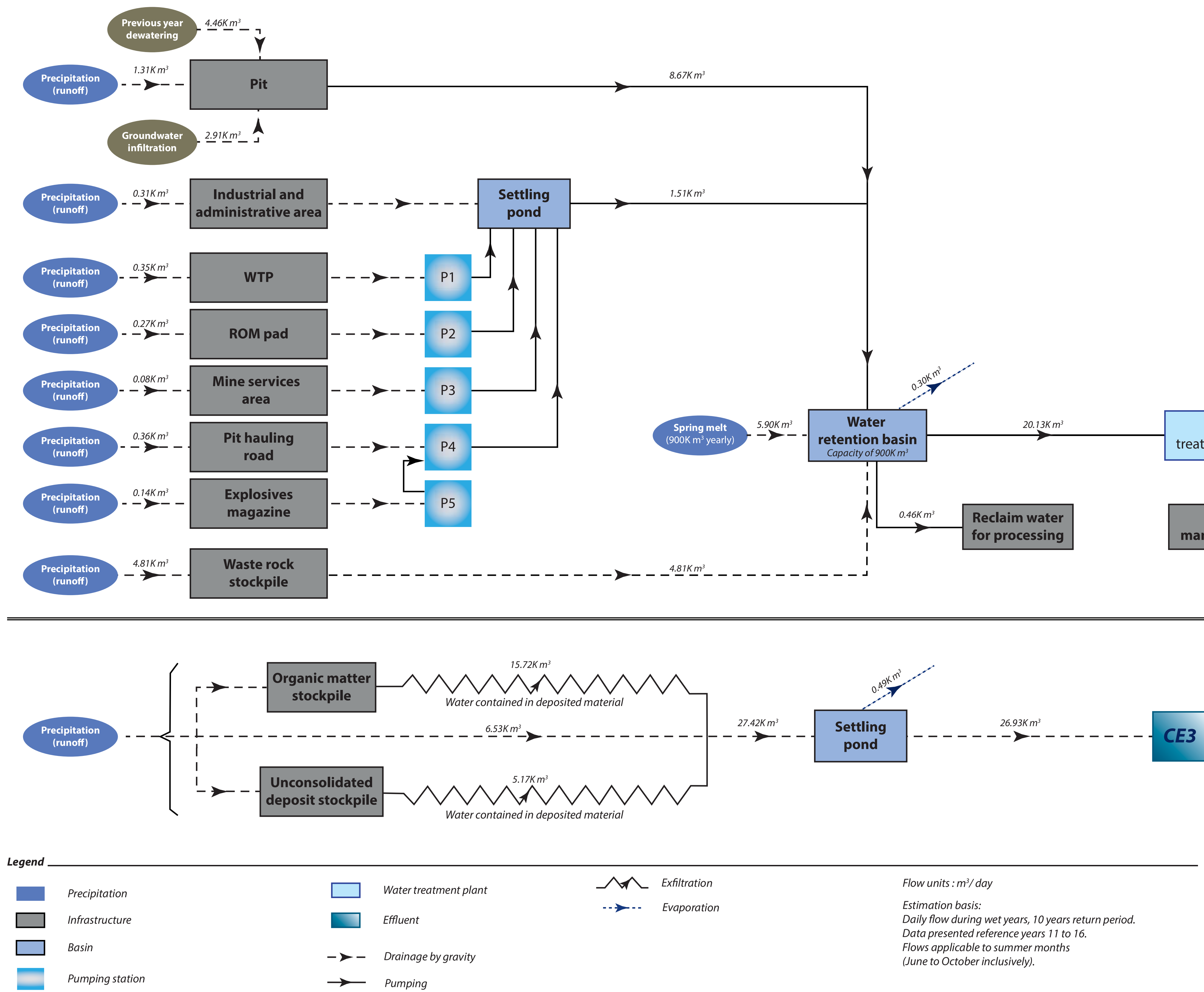
Table 4-18: Water balance summary for the main water retention basin

Parameter	Unit	Years -1 and 1	Years 2 and 3	Years 4 and 5	Years 6 to 10	Years 11 to rest of LOM
Pit dewatering – spring melt	Mm³/30d	0.000	0.088	0.138	0.485	0.321
Basin capacity	Mm³	0.415	0.415	0.500	0.500	0.900
Required WTP treatment rate during the spring melt	Mm³/30d	**0.149**	**0.237**	**0.342**	**0.912**	**0.661**
	m³/d	4,953	7,895	11,392	30,411	22,022
	m³/h	206	329	475	1267	918
	m³/s	0.057	0.091	0.132	0.352	0.255
Required WTP treatment rate to dewater the basin during the summer	Mm³/30d	**0.171**	**0.187**	**0.379**	**0.445**	**0.576**
	m³/d	5,687	6,220	12,630	14,830	19,197
	m³/h	237	259	526	618	800
	m³/s	0.066	4.319	8.771	10.299	13.331

Source: WSP in Primero, 2018.

To calculate the WTP rate required to dewater surplus volumes of water generated by wet year scenarios, annual water balances were developed at all staging intervals. The most critical year in terms of inflow for each the staging interval was selected based on the inflow from the pit.

It can be assumed that the clean water discharge volumes will be equivalent to the pumping requirement for the summer dewatering. These volumes vary from 0,171 to 0.576 Mm³ per 30 days depending on the reference year.



Flow units : m³/ day

Estimation basis:
Daily flow during wet years, 10 years return period.
Data presented reference years 11 to 16.
Flows applicable to summer months
(June to October inclusively).

GALAXY

James Bay Lithium Mine

Environmental Impact Assessment

Site Water Balance

Sources : WSP, 2018

No ref. : 171-02562-00_wspT108_EIE_f4-11_gestion_eau_ANG_181015.ai

Figure 4-11

wsp

Creek CE3

The expected clean water effluent flows into creek CE3 are presented in Table 4-19 These volumes vary from 90.2 to 153.8 m³ per 30 days depending of the years of reference.

Table 4-19: Water balance summary for the overburden stockpiles settling pond

Parameter	Unit	Years -1 and 1	Years 2 and 3	Years 4 and 5	Years 6 to 10	Years 11 to rest of LOM
Exfiltration from organic matter stockpile	Km³/d	1.02	1.18	2.00	3.14	3.14
Exfiltration from unconsolidated deposit stockpile	Km³/d	1.03	1.03	1.03	1.03	1.03
Basin capacity	Km³	50.0	50.0	50.0	50.0	50.0
Annual outflow during wet years (1 in 10)	m³/30d	90.2	95.0	119.4	153.8	153.8
	m³/d	3.01	3.17	3.98	5.13	5.13
	L/h	125	132	166	214	214
	L/s	0.035	0.037	0.046	0.059	0.059

Source: WSP in Primero, 2018.

In the unlikely event that the water quality of the effluent decanted out of the settling pond does not meet regulatory limits, the excess volume will be pumped to the main water retention for storage and treatment. A pumping capacity of 700 m³/hour is recommended for this purpose.

4.9.4 CONSTRUCTION PHASE

During construction, the water demand will consist of:

- Potable water for 280 persons: 63 m³/day.
- Non-potable water:
  - Dust control;
  - Concrete batch;
  - Soil (e.g.: till) and/or aggregate (gravel) conditioning (rewatering);
  - Water reserve for the DMS plant commissioning: 167,000 m³ by the end of year -1 (before the end of November).

During the construction of the access roads with material from borrow pits and/or quarries, water will be managed through the ditch system contiguous to the roads. Mitigation measures to limit the environmental effects during this stage are presented in Chapter 7.

The overburden settling pond will be built early in the construction schedule. During the stripping of the topsoil at the settling pond footprint, water will be pumped out of the excavation and send to the road ditches where sediment barrier will be installed. Water quality will be monitored following applicable regulations. The waste rock stockpile footprint will also be stripped early on and the water basin at that location will gradually be built as the dikes are being construction.

The water management plan for the phase will be under the responsibility of the contractor in charge of the construction works and will be revised and approved by Galaxy's environmental manager prior to the start of construction.

4.9.5 OPERATIONS PHASE

The water management plan for this phase includes all the infrastructure presented in section 4.8.2 and shown on Map 4-8. The site wide water balance for the operation phase is presented on Figure 4-11. The water outflows, which vary with the mining schedule, are summarised in Tables 4-18 and 4-19 for the clean water discharge in Creek CE2 and Creek CE3. The potable water requirement for the operation phase is estimated to 41 m³ per day for a peak of 150 personnel at the worker' camp.

4.9.6 REHABILITATION PHASE

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

- Construction of an overflow in the pit;
- Breach of the dike of the main water retention basin;
- Breach of the dike of the overburden stockpiles settling pond;
- 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).

The pit overflow will be constructed with a low permeability core covered in compacted granular material and rip rap. The invert of the overflow will be protected with rip-rap 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 stage of the permitting process. A preliminary ground water flow model has indicated that the pit would fill with water in between 120 to 170 years.

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 4-20, while those of the industrial and administrative sector are presented in Table 4-21. 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 4-21. A dust management plan for the handling of waste rock and tailings was prepared for the project (Primero, 2018). 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 20-m³ 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 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, in operations water needs will total 500 m³ per day.

The project's GHG emissions have also been estimated. Table 4-22 presents the total direct emissions as estimated. Appendix E details the GHG calculation methods.

The quantity of GHG emissions caused by all direct activities during the construction, operation and rehabilitation phases is 1,029,312 tCO_2eq. During the life of the project, the average annual emissions will be 57,184 tCO_2eq. During the operation phase, the average annual emissions will be 61,232 tCO_2eq. Indirect project emissions have been estimated at 9,962 tCO_2eq.

Table 4-20: Mining air emissions – Types and locations

Emission Type	Location	Project Phase
Blast gases	Pit	Operation
	Quarry	Construction / Operation
	Off-site quarries (if any)	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 stockpile	Construction / Operation / Rehabilitation
	Overburden stockpiles	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 stockpile	Construction / Operation / Rehabilitation
	Overburden stockpiles	Construction / Operation / Rehabilitation
	Concrete batch plant / Dry storage area	Construction / Operation
Ventilation	Industrial area	Construction / Operation / Rehabilitation
	Workers' camp	Construction / Operation / Rehabilitation

Source: Primero, 2018.

Table 4-21: Air emissions in industrial and administrative area – Types and locations

Emission Type	Area	ID [a]	Source	Project Phase
Dust	Crushing and screening	1	Crusher dust collector	Operation
		2	Screen dust collector	Operation
		4	Screen feed conveyor	Operation
		5	Secondary crushing conveyor	Operation
		6	Tertiary crushing conveyor	Operation
		7	Crushed feed material stockpile conveyor	Operation
	Crushed feed material dome	3	Dust collector	Operation
		8	DMS sizing feed conveyor	Operation
Noise	Crushing and screening	9	Vibrating grizzly	Operation
		10	Primary crusher	Operation
		11	Secondary crusher	Operation
		12	Tertiary crusher	Operation
		13	Sizing screen	Operation
Noise / Exhaust gas	Crushing and screening	14	Diesel generator	Operation
	DMS building	15	Diesel generator #1	Operation
		16	Diesel generator #2	Operation
	Administration building	17	Diesel generator	Operation
	Mining service area	18	Diesel generator	Operation
	Workers' camp	19	Diesel generator	Construction / Operation / Rehabilitation
Exhaust gas	Crushing and screening	20	Crushing building make-up air heater	Operation
		21	Crushing building ventilation fan discharge	Operation
		22	Screening building make-up air heater	Operation
	DMS building	24	Make-up air heater	Operation
	Spodument concentrate dome and loading bay	26	Concentrate building make-up air heater	Operation
	Tailings stacking	27	Tailings loadout make-up air heater	Operation
	Workshop and warehouse	28	Warehouse make-up air heater	Operation
		30	Workshop make-up air heater	Operation
	Mine services area	32	Mine service building make-up air heater	Operation
	Workers' camp	34	Construction camp dormitory #1, heating furnace and water heater	Construction
		35	Construction camp dormitory #2, heating furnace and water heater	Construction

Table 4-21: Air emissions in industrial and administrative area – Types and locations (cont.)

Emission Type	Area	ID [a]	Source	Project Phase
Exhaust gas (cont.)	Workers' camp (cont.)	36	Camp dormitory #1, heating furnace and water heater	Operation / Rehabilitation
		37	Camp dormitory #2, heating furnace and water heater	Operation / Rehabilitation
		38	Camp dormitory #3, heating furnace and water heater	Operation / Rehabilitation
		39	Camp dormitory #4, heating furnace and water heater	Operation / Rehabilitation
		40	Camp dormitory #5, heating furnace and water heater	Operation / Rehabilitation
		41	Camp kitchen heating furnace, water heater, appliances and make-up air heater	Operation / Rehabilitation
		42	Camp offices heating furnace	Operation / Rehabilitation
		43	Camp laundry heating furnace and water heater	Operation / Rehabilitation
		44	Camp medical heating furnace	Operation / Rehabilitation
	Administration building	45	Heating furnace	Operation / Rehabilitation
	Laboratory	46	Heating furnace	Operation
Ventilation	Crushing and screening	23	Screening building ventilation fan discharge	Operation
	DMS building	25	Ventilation fan discharge	Operation
	Workshop and warehouse	29	Warehouse ventilation fan discharge	Operation
		31	Workshop ventilation fan discharge	Operation
	Mining services area	33	Mine service building ventilation fan discharge	Operation

a ID: Refer to Map 4-9 for locations of sources.

Source: Primero, 2018.

Table 4-22: Annual and period GHG emissions

Period/Year	CO_2 Emissions (tonnes)	CH_4 Emissions (tonnes)	N_2O Emissions (tonnes)	CO_2eq Emissions (tonnes)
Construction	23,595	0.7	4.6	24,969
Year 1	47,033	2.0	13.1	50,986
Year 2	49,576	2.2	14.0	53,785
Year 3	49,549	2.2	14.0	53,758
Year 4	53,562	2.4	15.4	58,199
Year 5	55,180	2.5	16.0	59,988
Year 6	58,453	2.6	17.1	63,602
Year 7	60,777	2.8	17.9	66,184
Year 8	64,661	3.0	19.4	70,495
Year 9	66,275	3.1	19.9	72,280
Year 10	66,278	3.1	19.9	72,283
Year 11	66,261	3.1	19.9	72,266
Year 12	58,261	2.6	17.1	63,410
Year 13	53,436	2.4	15.4	58,073
Year 14	51,005	2.3	14.5	55,385
Year 15	50,170	2.2	14.3	54,465
Las year	50,265	2.2	14.3	54,560
Rest of LOM	n.d.	n.d.	n.d.	n.d.
Rehabilitation	23 250	0.7	4.6	24,624

Note: The detailed mine extraction schedule is provided for the first 15 years only.

4.10.2 WASTE WATER DISCHARGE

The worker' camp will be serviced by a domestic wastewater treatment system with an expected capacity of 280 people during the construction phase and 150 people during the operation phase. The treated water requirements are estimated to 56 m³ per day and 30 m³ per day, respectively for the construction and operation phases.

As discussed in Chapter 3, 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 in a receiving watercourse must be considered.

To that end, the supplier of the Ecoprocess MBBR treatment train will also provide a tertiary treatment train to meet the disinfection and phosphorus removal objectives required for discharges into 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 towards 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 discharge location of the waste water has yet to be determined. It is likely to be either into overburden stockpiles' settling pond or into creek CE3 directly.

GALAXY

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

Étude d'impact sur l'environnement /
Environmental Impact Assessment

Sources d'émissions atmosphériques / *Air Emission Sources*

Sources : *WSP, 2018*
Primero, May 2018

No ref. : 171-02562-00_wspT155_EIE_c4-9_air_181012.ai

Carte / Map 4-9

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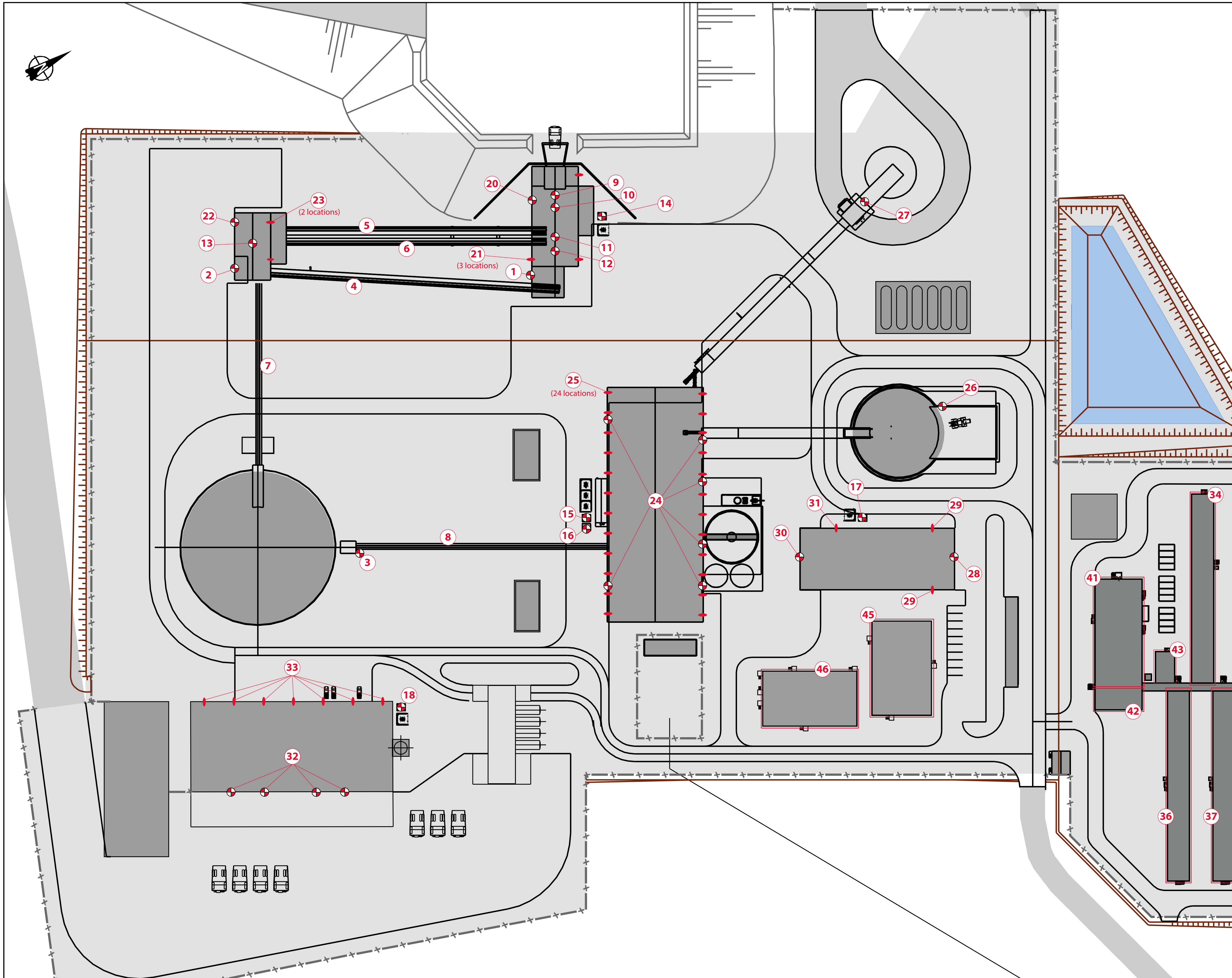
*** Le détail des sources d'émissions est présenté au tableau 4-21.**

**** Emission source details are outlined in Table 4-21.***



4.10.3 RESIDUAL MATERIALS

As a rule, Galaxy will work to minimise the production of waste. 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. The estimated quantities of domestic residual material by category are listed in Table 4-23. 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 an authorized sanitary landfill site. This container is ready for road transport without any waste handling on-site.
- 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 4-23: Estimated quantity of residual materials

		Tonnage (Mt)	
Category	Description	Construction (18 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	Bulky waste, polystyrene foam, packaging, composite objects, etc.	220	480
Total		**715.6**	**992.0**

Source: WSP in Primero, 2018.

4.10.4 HAZARDOUS WASTE

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 4-24. 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 center 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 waste can be stored in proper double floored containers or in a dry area with a containment pad and ventilation. 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 4-24: Estimated annual quantity of hazardous waste

		Tonnage (Mt)	
Category	**Description**	**Construction**	**Operation**
Hazardous household waste	Antifreeze, solvents, aerosols, carboys, paints, fluorescents, lamps, etc.	8	16
Waste oil, grease and oily water	Various from mechanical workshop	0.8	4
Residual hazardous materials	Empty adjuvant vessels for concrete batching and other construction consumables	0.6	0
	Empty chemical vessels for processing and WTP	0	3
Total		**9.4**	**23**

Source: WSP in Primero, 2018.

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, contaminated soils to be managed 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. This will be used for the laboratory, administration, and medical services buildings. Storage warehouses and the like will be site assembled from light steel sections and metal cladding. Verandas, shade areas, and the like will be site constructed from lightweight components.

Larger facilities such as the mechanical workshop, various warehouses, and the concentrator building will be constructed utilizing 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. Switch rooms (housing the various motor control centers) will be pre-fabricated and pre-wired, with the wiring tested in the factory before dispatch, to minimize site work.

4.11.2 SITE ACCESS ROAD

The proposed 10 m wide site access road (Map 4-1) will be 810 m long and composed (from surface to base) of:

- 300 mm of road base typically 0-20 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, James Bay road will be widened with the addition of turning lanes (slip lanes) into and out of the site at the point of contact between James Bay road and the site access road.

4.11.3 SERVICE ACCESS ROADS

There will be two services access roads on the site:

- WTP and waste rock stockpile and dike: 1,650 m long;
- Explosives magazine: 1,690 m long.

The proposed 6 m wide road will be composed (from surface to base) of:

- 300 mm of road base typically 0-20 mm crushed stone, compacted;
- 200 mm of road sub-base typically 0-112 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.

4.11.4 ACCOMMODATION

The typical arrangement of the proposed workers camp is illustrated on Figure 4-12. The design can house up to 280 workers in construction and 150 workers in operations. Accommodations include the following:

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

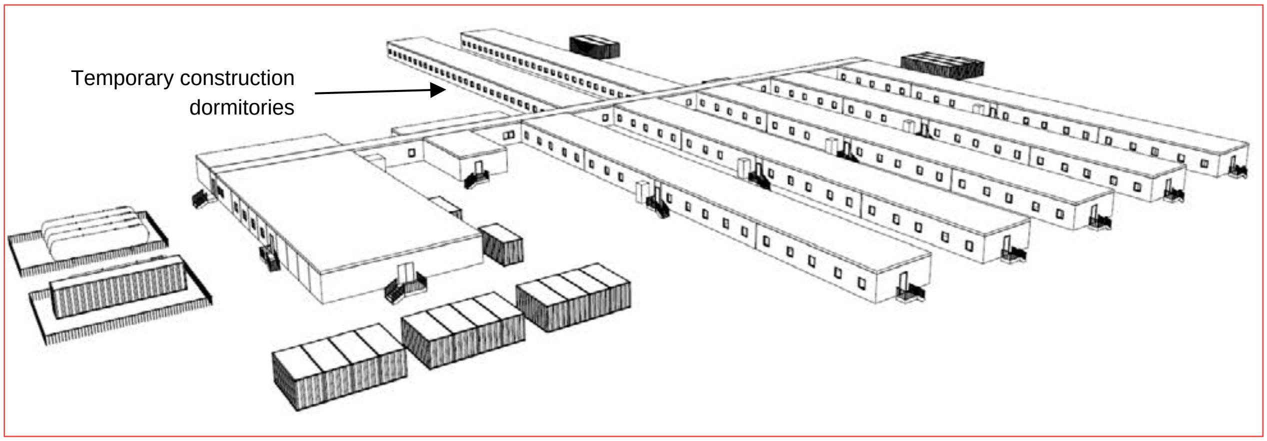


Figure 4-12: Oblique view of the workers' camp

Source: Outland (2018)

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).

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:

— Three double-walled 80 kilolitres diesel tanks;
— Light vehicles fueling station which will also serve as the tank refill area;
— Heavy vehicle fueling station.

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

4.11.7 POWER LINE

Total consumption is estimated at 782 kW in the industrial area, and 432 kW at the workers' camp with a peak demand of 8.3 MW. Hydro-Québec is responsible for the permitting of the power line that will bring the 69 kV transmission line (L-614) located 7 km south the project site the high-voltage switchyard on 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.

4.11.8 HIGH VOLTAGE SWITCHYARD

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

- One substation transformer: 69/4.16kV, 10MVA, oil filled, auto tap changer;
- Five plant transformers: 4.16/0.6kV, 2.5MVA, oil filled, offload tap changer, pad mounted.

All transformers will use the ONAN cooling system with provision for fans in the future. ONAN refers to the cooling system used in the transformer, in this case:

- Internal cooling:
  - **O**: Liquid with flash point less than or equal to 300°C;
  - **N**: Natural convection through cooling equipment and windings.
- External cooling:
  - **A**: Air;
  - **N**: Natural convection.

The oil type is to be confirmed at a later stage but will most likely be Envirotemp ™ FR3™ fluid, a natural ester derived from renewable vegetable oils. All transformers will be "sealed tank" type and will not require top up. Transformers are located on the industrial and administrative area general arrangement (Map 4-2).

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 500 kVA standby diesel generators located in each switch room. The workers' camp will have its own set of redundant 1.5 MVA standby diesel generators.

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 4-25.

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.

Table 4-25: 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: Mining Plus in Primero (2018)

The magazine area dimension is estimated at 170 m x 80 m, which includes (Primero, 2018):

- ANFO shed;
- Stand-off distance between different classes of explosive;
- Soil barrier;
- Access road;
- Perimeter fence;
- Buffer clearing of 35 m (for forest fire safety).

Galaxy will comply with Québec 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

A 3.7 km long optical fiber cable will be installed from the km 381 truck stop to the project site for communications and internet connections (see Map 4-2). 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.

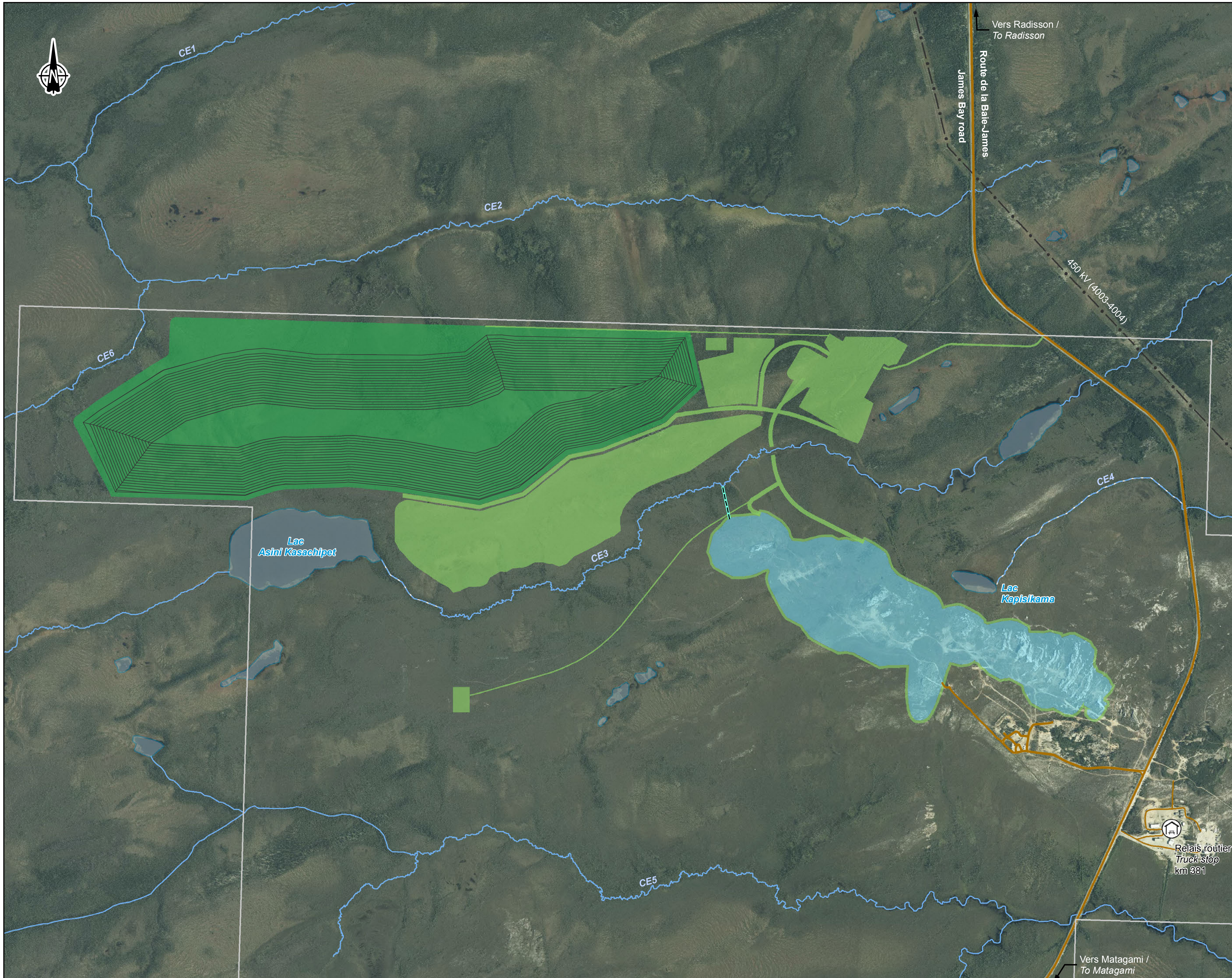
4.12 CONCENTRATE TRANSPORT TO MATAGAMI

The spodumene concentrate will be hauled to the Canadian National's transhipment terminal in Matagami, Québec. There, it will be transferred to trains (Map 1-1). Approximately 22 truckloads per day will be required to haul the daily concentrate production. Transportation will be done during the day with minor exceptions.

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 REHABILITATION

A conceptual mine closure and rehabilitation plan was completed (Gouvernement du Québec, 2017; Sanexen, 2018). The planned state of the site after closure and the mine rehabilitation are presented on Map 4-10.



Limite de propriété / *Property limit*

Composantes du projet / *Project Component*

Halde à stériles revégétalisée / *Revegetated waste rock stockpile*

Infrastructures revégétalisées / *Revegetated infrastructure*

Écoulement vers le réseau hydrographique existant / *Outflow into the existing hydrographic network*

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

Étude d'impact sur l'environnement /
Environmental Impact Assessment

Aménagement du site minier après la restauration /
Mine Site After Rehabilitation

Sources :
Orthoimage : Galaxy, août / august 2017
Données du projet / Project data : Galaxy, 2018

No Ref : 171-02562-00_wspT107_EIE_c4-10_mine_rehabilit_180903.mxd

0 185 370 m
UTM 18, NAD83

Carte / *Map* 4-10

wsp

4.13.1 CONTAMINATED SOILS

Following a definitive cessation of activities, Galaxy 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 settling pond will be drained, sludge will be removed and sent to an authorized disposal facility. Eventually, the settling pond 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 STOCKPILE

Benches slopes will be softened down to 2.5H:1V and covered with overburden and topsoil to improve revegetation. The water basin will be breached by removing a part of a dike. The excavated granular and till-like material will be placed inside the water basin and profiled to allow smooth surface water flow. The patches of liners removed from the dike breach will be disposed with other residual material during the closure and rehabilitation activities.

4.13.5 OVERBURDEN STOCKPILES

Benches slopes will be softened down to 2.5H:1V and covered with overburden and topsoil to improve revegetation. The sedimentation basin will be breached by removing a part of a dike. The excavated granular and till-like material will be placed inside the water basin and profiled to allow smooth surface water flow.

If topsoil is excavated for rehabilitation purposes (e.g. revegetation), the excavation geometry will allow water flow towards the existing ditches 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 (Map 4-1) and then, revegetated.

4.13.7 PIT

A preliminary cost-benefit analysis of pit backfilling was carried out and the results showed that backfilling is unlikely since the entire resource will not be extracted in the current LOM. Thus, an embankment with a perimeter ditch will be built around the pit. The embankment must be 2 m high and have an equivalent crest line, and it must be made of unconsolidated deposits or inert mineral substances. It must be located at a sufficient distance from the pit, include a perimeter ditch and be designed based on geotechnical considerations.

The pit will gradually fill with water and eventually overflow. An outflow will need to be designed and built to control the drainage from the pit lake. A short series of dikes north of JB1 and JB2 as well as a rip-rap spillway northwest of JB1 pit is expected. The outflow will be directed toward creek CE3 instead of overflowing anywhere around the pit and potentially damaging the environment.

4.13.8 REVEGETATION

The industrial and administrative area, WTP area, waste rock stockpile and the overburden 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. Then, they will be seeded with indigenous herbaceous plants and controls necessary to promote plant growth will be added. 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, which means that once in place, the plants must be hardy, provide long-term viability, and not require other care to ensure their sustainability.

4.14 PROJECT EXECUTION

Figure 4-13 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: 18 months;
- Operations: 15 to 20 years;
- Rehabilitation: 1 year;
- Post-rehabilitation: 5 years.

Most of the workers employed at the mine will work in 12-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 will have a 4-day in followed by 3-day off schedule or a typical 5-2 schedule (Monday to Friday).

Air travel will be the primary means of transportation for workers. Galaxy 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 135 km away from the project site.

The construction phase will employ 210 workers on average during the 18 months required to build the infrastructure. As illustrated in Figure 4-14, 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.

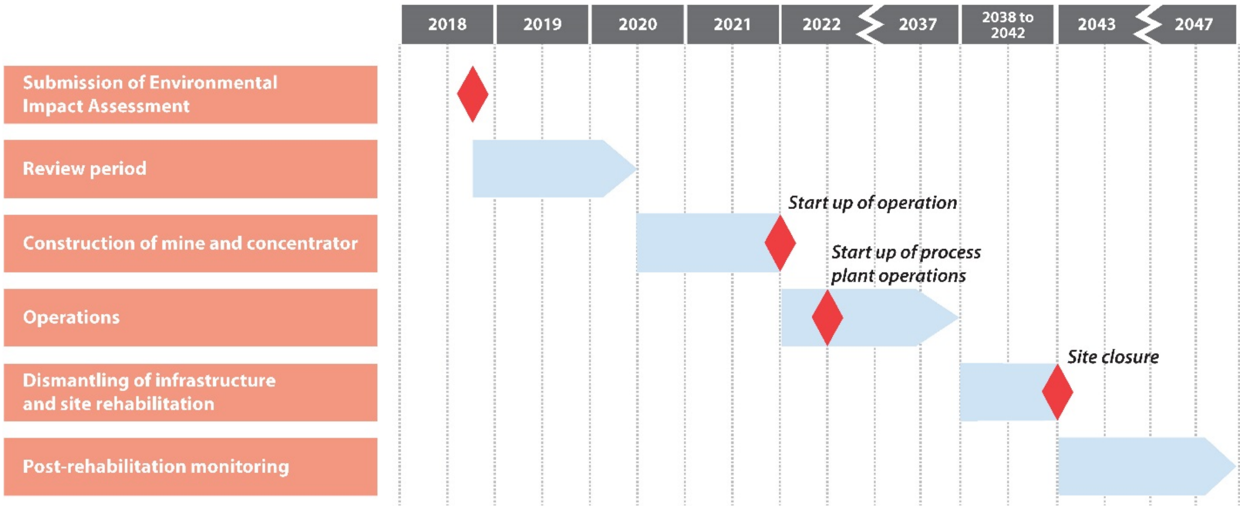


Figure 4-13: Timeline

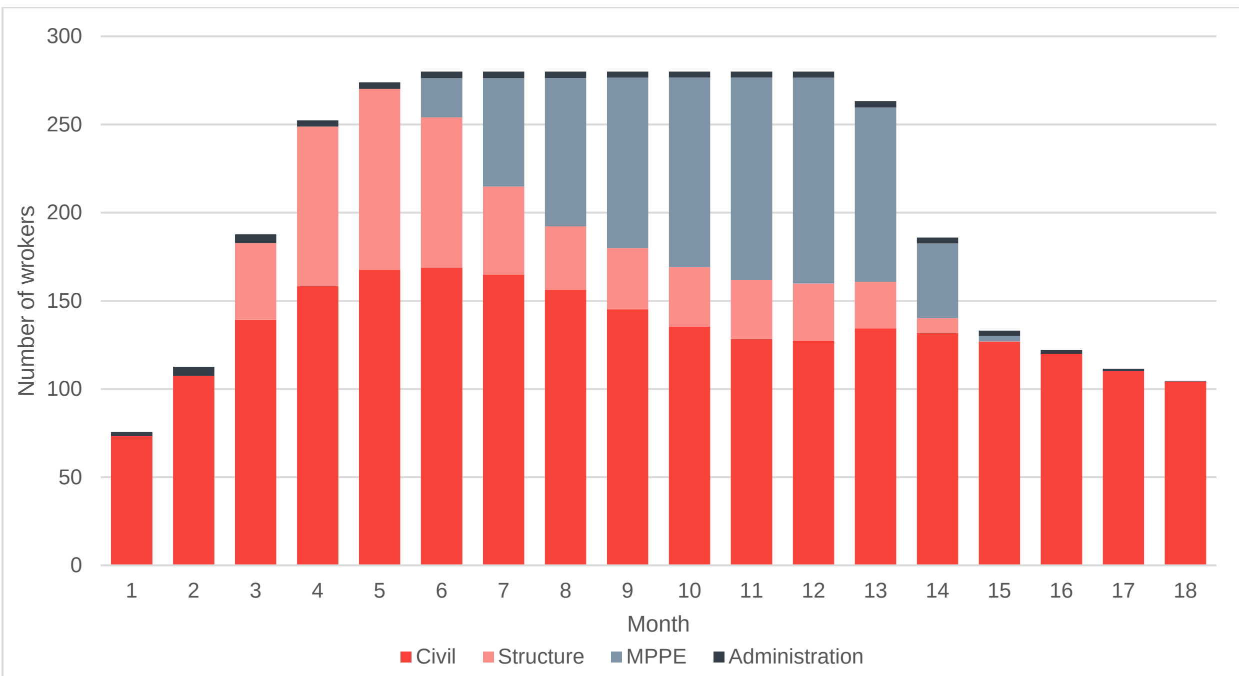


Figure 4-14: Estimated workforce during the construction phase

Note: MPPE refers to mechanical, piping, platework and electrical.

Source: Primero, 2018.

The estimated project costs that include the initial mining equipment purchases are 507 M$. The cost breakdown is shown in Table 4-26. Detailed information is available in the economic spinoffs study (WSP, 2018*d*). Galaxy is currently working on the project's optimization to reduce its costs. Optimization opportunities are detailed in section 4.15. As such, the final project costs and employment numbers could vary from those presented in this study.

Table 4-26: Estimated CAPEX

Activity	Expenses ($)	Labour ($)	Total ($)
Administration	97,968,959	19,348,708	117,317,667
Construction, reparation and maintenance	11,020,303	2,176,492	13,196,795
Non-residential construction	103,416,394	62,148,801	123,840,961
Engineering services	35,056,399	n.a.	41,979,980
Mining equipment manufacturing	88,211,491	n.a.	105,633,115
Structure and carpentry manufacturing	22,916,980	n.a.	27,443,046
Electric equipment manufacturing	46,669,481	n.a.	55,886,626
Concrete and cement products	11,510,865	n.a.	13,784,242
Steel product manufacturing	6,898,491	n.a.	8,260,932
Total	**423,669,363**	**83,674,000**	**507,343,363**

n.a. = not available.

Note: This is the present evaluation, depending on the result of the value engineering studies (section 4.15), it is possible the total should therefore adjusted downwards.

Source: WSP, 2018d.

As for the mining operations, the annual evolution of the estimated workforce is shown in Figure 4-15. Most of the jobs available will be associated to the extraction operations. Since the workers on site will be on shifts, the total number of employees is higher than the camp's capacity. Also, as indicated previously, Galaxy is considering ways to reduce its operation costs. If the worker' camp's capacity needs to be increased, Galaxy will develop its it in later years. Table 4-27 presents the operation costs by category.

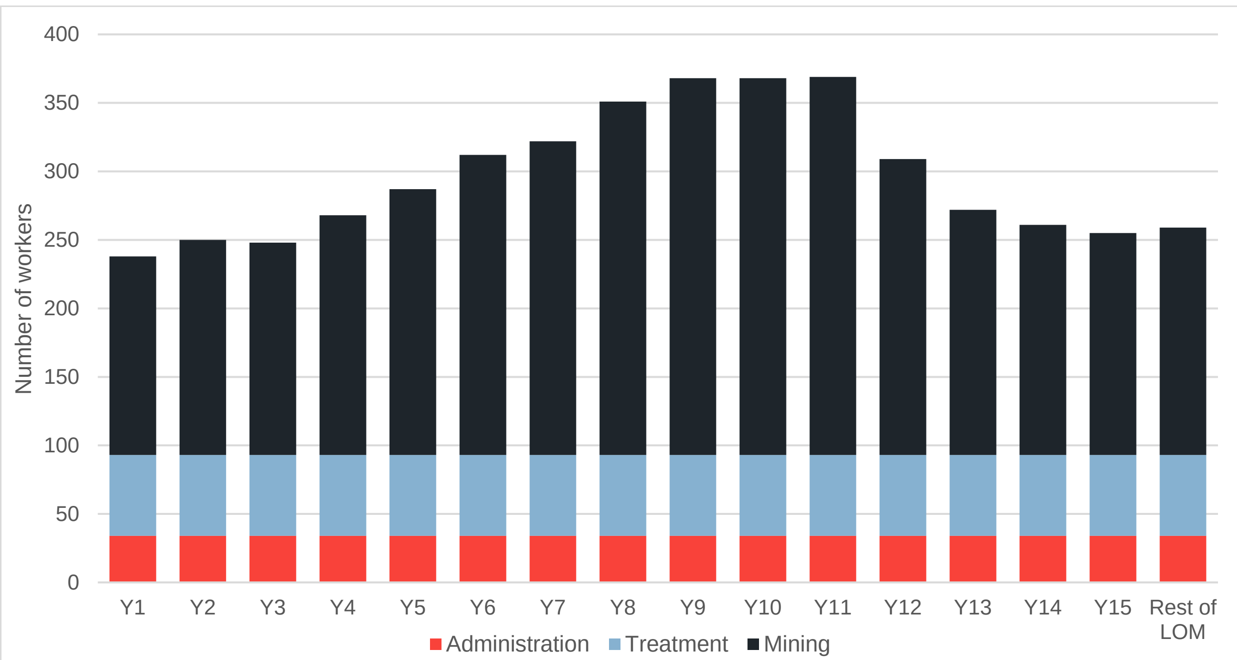


Figure 4-15: Estimated workforce during the operation phase

Source: Primero, 2018.

Table 4-27: Estimated annual average OPEX

Activity	Expenses ($)	Labour ($)	Total ($)
Mining and processing	50,051,605	46,162,146	96,213,751
Electricity	7,084,909	n.a.	7,084,909
Site maintenance	2,127,771	n.a.	2,127,771
Administration	6,100,616	5,887,468	11,988,084
Non-residential construction	7,839,965	n.a.	7,839,965
Mining equipment manufacturing	3,276,202	n.a.	3,276,202
Environmental work	582,188	n.a.	582,188
Camp maintenance	3,506,671	n.a.	3,506,671
Other employee services	1,502,859	n.a.	1,502,859
Total	**82,072,785**	**52,049,615**	**134,122,400**
n.a. = not available.			

Source: WSP, 2018d.

4.15 OPPORTUNITIES FOR PROJECT OPTIMIZATION

4.15.1 AIR TRANSPORT

As currently defined, the project will use the Eastmain airport to transport workers from southern Québec. Located 155 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 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.

A study is currently underway to evaluate the two air transport solutions. In this regard, the tallyman of the land on which the Opinaca airport runway is located will be consulted.

4.15.2 USE OF LNG TRUCKS TO TRANSPORT CONCENTRATE TO MATAGAMI

As mentioned previously, reducing GHG emissions is an inherent priority for Galaxy, 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. When purchasing trucks to transport the concentrate, the evaluation of alternatives on fuel types will be updated.

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

To reduce GHG and dust emissions, the installation of a conveyor to transport extracted rock to the concentrator and waste rock stockpile is being considered. At the present time, energy supply is limited by the power supplied by Hydro-Québec.

After the plant's break-in period, it is possible that demand for energy will drop and leave a surplus that could be used to operate the conveyors. Also, Hydro-Quebec is progressing with a study that could make additional power available This would reduce the number of employees on site. The pros and cons of this situation merit evaluation.

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. No ideal site was found. The selected site has construction constraints that significantly increase costs.

To reduce construction and operating costs, technical solutions other than those presented in the project description are being studied. The site and the footprint are not called into question.

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 150 workers. More rooms will be added for the construction period.

Additional workers will be lodged at the km 381 truck stop. The km 381 truck stop has 40 rooms; another 130 rooms will be required during the construction phase. Setting up additional rooms at the km 381 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 Galaxy'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 km 381 truck stop is that it is a public facility and alcohol is permitted whereas the worker' camp on the project site will be dry. Galaxy is looking at how to manage the different conditions for employees at the km 381 truck stop and at the site.

4.15.6 PRE-SELECTION AT DMS

A pre-selection system is a pre-concentration technology in which large volumes of waste are separated from a conveyor belt using sensor measurement. With sensor bulk material sorting, the material is better evaluated for its qualification to be processed resulting of the processing plant treating less tons at higher feed grade or allow to transform non-economic material into economic material. The discarded waste contains less economic material; it improves the resource utilization.

This system would likely reduce energy consumption, greenhouse gas emissions and water losses per ton of product.

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) (Gouvernement du Québec, 2018b) 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, 2015).

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

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

Galaxy 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 proponents, 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, Galaxy 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, for examples:

- Moving the waste rock stockpile to the north to minimize nuisance to Cree users and km 381 truck stop users;
- 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.

Concerning the project's impact on quality of life, Galaxy 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, Galaxy will indirectly contribute to improving the local population's quality of life. Galaxy also intends to award contracts to qualified local entrepreneurs, which will drive job creation and economic development in the region.

Galaxy 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 Galaxy 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, Galaxy 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 sourcing 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. Galaxy 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.

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.

A critical analysis of this project was carried out to determine the effects on the physical, biological and social environments. Galaxy and its 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. 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.

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

Galaxy'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.

Galaxy 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.

Galaxy intends to form a committee to maintain open dialogue with stakeholders and the public. Moreover, Galaxy 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."*

Galaxy 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 measures have been incorporated into industrial developments and processes to reduce, at the source, the environmental risks associated with the storage and use of hazardous materials, 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 Galaxy'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 Galaxy 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 and 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, Galaxy undertakes to carry out a complementary archaeological study of sites with archaeological potential near the project infrastructure to ensure the heritage is preserved.

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.

Despite this effort, the waste rock stockpile will encroach on the site of a valued species *(Carex sterilis).* In this regard, Galaxy will implement a relocation program to preserve the species.

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. During the construction phase, 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.

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. Galaxy 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 ecoefficient approach that avoids waste and optimizes the use of resources."*

Throughout the design stage, Galaxy chose to optimize its project by implementing measures to reduce resource consumption. Galaxy 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 stockpile 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, some of 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.

Galaxy 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."*

Galaxy 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.

5 PUBLIC HEARINGS

5.1 CONTEXT

To garner as much social approval as possible to its James Bay Lithium Mine project, Galaxy established a stakeholder consultation and engagement process. This initiative made it possible to gather the concerns, views and expectations of local communities concerned by the James Bay Lithium Mine project.

The consultation process was primarily conducted among the James Bay and Eastmain Cree communities, whose territory hosts the proposed project.

The first round of consultation activities was conducted in 2011–2012. This chapter covers both the results obtained during this first series of meetings and the outcomes of the 2017–2018 consultations, in addition to presenting the:

- consultation process objectives and means used;
- stakeholders consulted;
- summary of activities and consultations conducted by the promoter and the key items in their information program and public consultation program;
- compilation of concerns, expectations and recommendations toward the project;
- Galaxy’s response to concerns and continuation of the consultation process.

5.2 PROCESS OBJECTIVES

The consultation and stakeholder engagement process established by Galaxy is intended to be transparent and respectful. Its engagement advocates open communication and sustainable business practices in view of sharing values and benefits with the local communities, significantly investing themselves among the latter and building productive relationships with the representatives at all levels of government. Galaxy aims to be an exemplary and outstanding corporate citizen with local communities, in Québec and at the federal level.

More specifically, the stakeholder consultation and engagement approach favoured by Galaxy has several objectives, namely to:

- complete the description of the social environment using information stemming from the populations on the territory concerned by the James Bay Lithium Mine project (gathering of information from primary sources);
- identify the concerns and expectations of the James Bay and Cree communities toward the project and on mining development in general on the territory;
- limit potential environmental impacts;
- ensure the health and safety of employees and contractors;
- gather mitigation measure suggestions from the concerned populations or organizations;
- ensure follow-up of Galaxy’s engagements toward the stakeholders;
- maximize the socioeconomic spin-offs and limit the project’s impacts on the local communities;
- maximize employment opportunities and prioritize the hiring of local workers;
- develop training initiatives and contribute to improving the skills of the local workers;
- assess and support community development initiatives;
- provide local communities and stakeholders with consistent, timely and accurate information.

5.3 METHODS USED

As part of the consultation process held by Galaxy, several communication methods and tools were put in place and used to inform, consult and ensure proper follow-up of engagements with communities and concerned stakeholders. The list of the methods used is presented in this section.

5.3.1 STAKEHOLDER REGISTER

A register of stakeholders and consultation activities has been established so that Galaxy can track and follow up on communications, concerns, past activities and future actions with those organizations or communities. The section of the register concerning stakeholder engagement includes the following information: name and contact details of the person, type of stakeholder, agency they represent, consultation activities they have participated in, archiving of e-mails concerning said person and follow-up of actions required by Galaxy toward the person. With regard to the data compiled on the consultation activities, the items considered were the following: type of activity held, stakeholder consulted, date of the event, names of the participants, material used, aim of the activity, activity report, actions required by Galaxy following the activity and date of completion of said actions.

The register is also considered a tool for archiving e-mails exchanged with the stakeholders, reports of meetings held and material used during consultations (presentations, posters, maps, announcements, etc.).

5.3.2 PUBLIC PRESENTATIONS

To inform and consult the Cree Nation of Eastmain community, two public consultation presentations were offered. The first of such events was held on February 22, 2018. Through this initiative, Galaxy sought to present the James Bay Lithium Mine project to the public and to initiate an open and respectful dialogue with the Eastmain Cree community. The second public presentation took place on July 16, 2018, in the form of an open house, thus encouraging members of the community to meet Galaxy representatives and learn more about the project. The mining company initiated the meeting largely to present the environmental impact assessment results to members of the community. Each of these activities was highlighted by a PowerPoint presentation and posters presenting the salient features of the project or the key aspects of the EIA. The second public presentation provided information on the project's impact and mitigation measures.

5.3.3 INTERVIEWS

One-on-one interviews were also scheduled with socioeconomic stakeholders from the James Bay and Eastmain community. These meetings, either by telephone or in presence of the person concerned, were conducted in the manner of a structured interview aimed at surveying their knowledge of the project, obtaining information on their organization, learning the known effects of other mining projects on the EIJB territory, taking into account the potential positive and negative impacts from the proposed mining development, determining whether any cumulative impacts need to be considered and collecting all of the mitigation measures, expectations or concerns recommended by the stakeholders.

5.3.4 GROUP INTERVIEWS

Group interviews with the trapline tallymen and their families were organized during consultations for the EIA. The goal was to know how trapline (RE2) users in the study area use the territory and to know the practices of users on nearby traplines (VC33 and VC35), who also felt concerned. Maps of the traplines were provided to participants so that they could mark up their activities and camps, the drinking water supplies, transportation links and enhancement and preservation sectors. The following information was also gathered: their knowledge of the project, known effects of mining projects on the Cree territory, positive or negative impacts apprehended, impact on the traditional use of the territory, recommended mitigation measures and concerns or expectations voiced by users.

A group interview was also conducted during the consultation of the Cree Board of Health and Social Services of James Bay (CBHSSJB) and of the James Bay Cree School Board (JBCSB). All the stakeholders from these two bodies were invited to the meeting. This approach made it possible to canvass the views of each area of intervention within these organizations.

5.3.5 FOCUS GROUPS

During the consultation activities held as part of the ESIA, certain members of the Eastmain community were asked to participate in focus group discussions, formed based on the age or gender of participants. At Galaxy's request, these meetings were publicized by the municipal administration and the agencies concerned. Three focus groups were formed, in total, for the following population categories: youths (7 participants), women (2 participants) and seniors (7 participants). These groups were targeted due to their low turnout to other consultation activities, hence providing a more accurate picture of the concerns and expectations of the Eastmain community. These meetings addressed the participants' knowledge of the James Bay Lithium Mine project; their views on the proposed project; its potential positive and negative impacts; its potential cumulative impacts; the mitigation measures to consider; and any other expectations, concerns or queries members of the community wished to voice.

5.3.6 APPROVAL OF MINUTES

Minutes were drafted following each of the meetings, interviews, presentations or other consultation activities to report on the themes covered and on the discussions between Galaxy and respective stakeholders. Reports of the one-on-one interviews and focus groups were sent for approval to the concerned stakeholders.

5.4 INFORMATION AND CONSULTATION ACTIVITIES OF THE STAKEHOLDERS

In its stakeholder consultation process, Galaxy focused on two groups in particular:

- the Cree stakeholders, more specifically, those from the Eastmain Cree community;
- the James Bay stakeholders.

5.4.1 CREE STAKEHOLDERS

5.4.1.1 2011–2012 PERIOD

In 2011, the first James Bay Lithium Mine project presentation and information session was held in Eastmain. It should be noted that the Eastmain Band Council had been notified of the project. Following this meeting, Galaxy met with the Grand Council of the Crees (GCC) and the Cree Regional Authority (CRA) to initiate the discussion process under the Cree National Mining Policy (GCC and ARC, 2010). This policy requires negotiations with the mining companies to allow for a Cree-integrated approach to mining. At this meeting, the Cree representatives for mining development were identified. In addition, Galaxy advised then-chief Edward Gilpin that the proposed environmental baseline sampling program activities would take place on the project site in 2011–2012.

In 2012, a meeting was held between the GCC-ARC representatives and Galaxy. Although a Pre-Development Agreement (PDA) was prepared and negotiated and was ready for signature, the project was put on hold due to a collapse in the market price of lithium.

In parallel with the activities undertaken at government and administrative levels, interviews were held as part of the ESIA process with the tallymen of the potentially impacted traplines in Eastmain to document the traditional use of the territory:

- RE2 trapline: Most activities are located along the James Bay road. They include moose and goose hunting, beaver trapping, fishing, wood cutting and blueberry picking. Drinking water supplies, snowmobile trails and goose ponds established by the tallyman were identified in this area.
- VC33 trapline: Along the Eastmain River, valued wildlife areas used for moose hunting, beaver trapping and fishing.
- VC35 trapline: The tallyman needs to pass by km 381 to access his trapline and does not want blasting to block off road traffic on the James Bay road. He is also worried about cumulative environmental impacts and the use of the trapline by mine workers.
- RE1 trapline: This project area is not used by the tallyman.

Moreover, from February to April 2012, several interviews were conducted in Eastmain with stakeholders from various sectors relating to the economy, the sociocultural world, health, hunting, fishing, trapping, the environment and from focus groups (Table 5-1).

5.4.1.2 *2017–2018 PERIOD*

In 2017, Galaxy's James Bay Lithium Mine project was relaunched. A second series of meetings were organized with the Eastmain Cree community to inform and consult the stakeholders involved in this mining development. It is primarily aimed at socioeconomic stakeholders, RE2, VC33 and VC35 tallymen[2], the users of the territory of these traplines and members of the Eastmain community. The meetings held are summarized below and the schedule of these meetings is presented more generally in Table 5-2.

COUNCIL OF THE CREE NATION OF EASTMAIN

The Council of the Cree Nation of Eastmain met several times during the consultation process. An introductory meeting, at which Galaxy representatives presented the company and the James Bay Lithium Mine project, was held on May 23, 2017. Following this presentation, a discussion was held between the nation's council members and mining delegates about the environmental impacts, project schedule, the hiring priority for Cree workers in Eastmain, communication measures put in place by Galaxy to inform the community and the possibility of a possible partnership. Galaxy suggested setting up a meeting schedule and scheduling four meetings per year between the nation's council and the mining company.

A new meeting was organized on November 15, 2017. Its purpose was to present the entire project to the members of the nation's council in more depth using PowerPoint. Concerns were raised during this meeting, including the presence of tributaries near the planned mining site, the project's impact on groundwater and the importance of training Cree workers.

On April 3, 2018, Galaxy had a third meeting with the Eastmain nation's council to discuss the Cree community's expectations with regard to the mining project and to pass on the latest updates using PowerPoint. During the discussion period, the members of the nation's council mentioned their lack of knowledge about the mining industry. Galaxy offered to arrange a visit to a mining site of a similar size so they could get have better understanding of what this entails, as well offering to facilite a Mining 101 course in the community.

Members of the nation's council are interested in learning and working with Galaxy, but before that, they feel the need to develop a relationship of trust. They also feel some pressure with the established schedule.

They also address the concern that the community will not receive due benefits if the mine is developed. Galaxy tries to reassure them by stating that it is important for the mining industry to offer the community most of the job opportunities and possible benefits and that, to do so, it will put a lot of effort into training.

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[2] It was determined during the exchanges held in 2011–2012 with the RE1 trapline tallyman that they did not feel concerned about the Galaxy project.

Table 5-1: Calendar of information and consultation activities held with the Cree - 2011–2012

Date	Activity	Stakeholder(s)*
February 2011	Public presentation	Cree Nation of Eastmain
August 2011	Meeting to initiate the discussion process under the Cree Nation Mining Policy	GCC-CRA
November 2011	Meeting for a general presentation of the project	Council of the Cree Nation of Eastmain
February 22, 2012	Group interviews with users of the territory	RE1 – Trapline tallyman, his family and other users of the territory
		RE2 – Trapline tallyman, his family and other users of the territory
		VC33 – Trapline tallyman, his family and other users of the territory
February 22, 2012	Discussion group	Cree Nation of Eastmain – Youth
February 23, 2012	Group interview with users of the territory	VC35 – Trapline tallyman, his family and other users of the territory
February 23, 2012	Discussion groups	Cree Nation of Eastmain – Men
February 24, 2012		Cree Nation of Eastmain – women
February 27, 2012	Interviews with Eastmain socioeconomic stakeholders	Wabannutao Eeyou Development Corporation (WEDC), Eastmain
February 28, 2012		Economic development services Eastmain
February 28, 2012		Eastmain Nation Youth Council
February 28, 2012		Eastmain Human Resources Development
February 28, 2012		Eastmain housing services
February 29, 2012		Eastmain elders council
February 29, 2012		Eastmain special projects services
March 1, 2012		Eastmain public health services
March 2, 2012		Eastmain police services
April 3, 2012		Cree Board of Health and Social Services of James Bay (CBHSSJB) – national program on alcohol and drug abuse among Indigenous peoples
April 3, 2012	Group interview to validate the meeting minutes on February 22	RE2 – Trapline tallyman, his family and other users of the territory
April 4, 2012	Group interview to validate the meeting minutes on February 23	VC35 – Trapline tallyman, his family and other users of the territory
April 4, 2012	Interviews with Eastmain socioeconomic stakeholders	Eastmain Environmental Health Department
May 8, 2012	Group interview to validate the meeting minutes on February 22	VC33 – Trapline tallyman, his family and other users of the territory

* A calendar of information and consultation activities with the names of the stakeholders met during each activity is provided in Appendix F.

Table 5-2: Calendar of information and consultation activities with the Cree - 2017–2018

Date	Activity	Stakeholder(s)*
May 23, 2017	Introductory meeting	Council of the Cree Nation of Eastmain
November 15, 2017	Description or project and overview of environmental assessment	Council of the Cree Nation of Eastmain
February 19, 2018	Introductory meeting and key project updates	CSB and CHRD
February 20, 2018	Introductory meeting	COMEX
February 22, 2018	Public presentation	Cree Nation of Eastmain
April 3, 2018	Meeting	Council of the Cree Nation of Eastmain
April 16, 2018	Group interviews with users of the territory	RE2 – Trapline tallyman, his family and other users of the territory
June 11, 2018		RE2 – Trapline tallyman, his family and other users of the territory
June 12, 2018		VC33 – Trapline tallyman, his family and other users of the territory
June 12, 2018		VC35 – Trapline tallyman, his family and other users of the territory
June 13, 2018	Focus groups with young people and women of the Cree Nation of Eastmain	Cree Nation of Eastmain – young people
June 13, 2018		Cree Nation of Eastmain – women
June 13, 2018	Interviews with Eastmain socioeconomic stakeholders	WEDC
June 13, 2018		CHRD
June 14, 2018		CBHSSJB and CSB
June 14, 2018	Focus groups with elders of the Cree Nation of Eastmain	Cree Nation of Eastmain – elders
July 3, 2018	Interview with regional authority representatives	CBHSSJB
July 16, 2018	Public presentation	Cree Nation of Eastmain

* A calendar of information and consultation activities with the names of stakeholders met for each is provided in Appendix F.

CREE SCHOOL BOARD, CREE HUMAN RESOURCES DEPARTMENT AND CREE BOARD OF HEALTH AND SOCIAL SERVICES OF JAMES BAY

On February 19, 2018, Galaxy met with the adult vocational training coordinator for the JBCSB and a representative from the Cree Human Resources Department (CHRD) to present the project and its updates. The meeting ends with a commitment from Galaxy. The mining company will work with these stakeholders to organize training and professional development workshops.

A second meeting with the Cree Human Resources Department took place on June 13, 2018. The mining project is perceived by CHRD as being positive for the community. Topics discussed at the time of this discussion were training, employment and the quality of life for workers.

A meeting was held on June 14, 2018, with CSB staff during consultations for the EIA. The CBHSSJB represented by stakeholders from the Community Miyupimaatisiiun Centre (CMC) was also present. Maps of the study area as well as the project's general arrangement were presented. Some JBCSB members felt that the proposed mining project by Galaxy was an opportunity for them to demonstrate to their students that there is the prospect of a future after graduation; that there are jobs waiting for them. However, most of the stakeholders met also feel that there may be significant adverse effects on the environment as well as on traditional Cree activities and that it is important to ensure that solutions are provided to all the problems before the project moves forward. Questions were also raised about the influence of the market on mining operations, the on-site rehabilitation process, the use of traplines by non-Indigenous workers and the effect of the project at the km 381 truck stop. A major point raised during discussions was the importance of continuing the consultation process. People in the community need to be more informed to be able to understand the scope of the project and understand the impacts that it could have.

An introductory meeting held on July 3, 2018, with the CBHSSJB Assistant Director of Public Health aimed at clarifying the issues associated with health and mining development in Cree territory. Discussions on the mitigation measures that Galaxy wanted to put forward were initiated to verify their validity, confirm that they will be relevant and add more as needed.

The concerns put forward by the CBHSSJB revolve mainly around topics related to health, social problems, services offered by their institution and environment. Concerns were felt about the pressure that the mine project could place on community services if Galaxy would require their use and the social and health problems that would be created or intensified by this project (alcoholism, drug addiction, removal of children from their family, elderly people left to fend for themselves, etc.). The CMC is also concerned with the potential increase in cancer rates in the community due to the presence of contaminants in the food chain.

MEMBERS OF THE CREE NATION OF EASTMAIN

The Eastmain Cree community was consulted both through public presentations and group discussions organized by age and gender.

To date, two public presentations have taken place. On February 22, 2018, Galaxy publicly presented its project to the Eastmain Cree community and began a first honest and respectful dialogue with its population. Other than the presentation of the planned project, information was passed on about the mining company and its ongoing projects, about the latest updates regarding the engineering progress and impact studies on the environment and about the benefits and potential impacts if the project is approved. A list of job and training opportunities was also presented. During the discussion period, Galaxy discussed its schedule, the number of estimated jobs for the construction and operation phases, the priority given to the Eastmain community for job opportunities and the use of lithium on the market. The 18 participants at this meeting expressed concern about the presence of watercourses near the project, the impact of pollution (noise, light, dust), the air quality, the effect of the project on road traffic as well as the km 381 truck stop. Users of the RE2 trapline also expressed their concerns about the proximity of the waste rock stockpile to the creek CE5 used. Following this meeting, Galaxy took into account the concerns encountered by users and modified the design of its project to minimize the impacts on the creek CE5 by moving the waste rock stockpile to a less frequented area.

Another public presentation was held on July 16, 2018, to present the results of an EIA to the Eastmain Cree community. For the occasion, a series of twelve posters and a PowerPoint presentation were prepared by Galaxy. The event was as an open house where community members were invited to learn more about the mining project and its impacts. It was also possible for participants to discuss their concerns, their expectations for Galaxy representatives and make their recommendations. In total, 44 people attended this day of information and consultation. The main concerns addressed by the participants were related to the following topics: the quality of drinking water in the study area, more specifically to the km 381 truck stop; wastewater treatment; impact of the project on fauna and flora; potential relocation of the km 381 truck stop; mining development in the James Bay region (especially with respect to lithium); increased traffic on the road network and effects of the project on traffic; employment opportunities; training; waste management; organization of emergency services; lifetime of the mine; operations and processes at the mine site; facilities at the mine site; work camp; work schedules; risks of contamination; taxes on Cree workers at the mine; site rehabilitation plan; effects of the project on fishing and hunting; agreement regarding repercussions and benefits; peat management; and commuting.

As for the discussion groups, three meetings were held on July 13 and 14, 2018, each focusing on a category of the Eastmain population based on the gender or age of the participants. The main concerns mentioned by community members during these interviews were the environment; Galaxy’s schedule; job opportunities; training; cultural and professional issues for Cree workers; sexual harassment; traditional use of the territory; health; benefits for community members; impact follow-up and rehabilitation process.

CREE USERS OF THE TERRITORY

In summary, three tallymen were consulted in 2018 as part of the James Bay Lithium Mine project. These are the RE2, VC33 and VC35 tallymen. Their families and other users of the territory concerned were also present.

The James Bay Lithium Mine project is located on the RE2 trapline. The tallyman of this sector and their family were formally met on two occasions. A meeting took place on April 16, 2018, to update the data collected in 2012, learn about the new use of territory areas for traditional purposes as well as gather user concerns, recommendations and expectations. They are worried about the environmental impacts on fauna and flora. They have the impression that the projected effects of the mine are being minimized. They are concerned about various issues such as the rehabilitation process, the risks of water contamination, the impact of the project on the sturgeon and the extraction process.

A second meeting was organized on June 11, 2018, to validate the information collected during the session that took place in April. New data, recommendations and uses were noted. Other concerns were also raised such as the location of the waste rock stockpile near watercourses, the risk of contamination by the dust generated by blasting activities, the footprint of the mine on the RE2 trapline, the wastewater treatment process and the presence of other types of minerals that could be harmful to the environment.

It should be noted that several other informal meetings were held between Galaxy and the cree users of the RE2 trapline to keep them informed of the project' progress and activities held on their territory.

With respect to the VC33 and VC35 tallymen and their families, they were met on two separate meetings on June 12, 2018. The objectives of these interviews were the same as the meetings held with RE2, in other words, to update the data collected in 2012, learn about new areas of use for traditional purposes on the trapline as well as gather the concerns, recommendations and expectations of the users of the territory. Their concerns echo those stated by users of trapline RE2. Other concerns have been added including the impact of the proposed mining operations on regenerating vegetation due to the 2013 fire, the effects on hunting and fishing areas, the challenges associated with the location of the mine on a peatland, the impact of lithium on the environment, the road conditions, territory safety, the priority of indigenous people for job opportunities and the air quality.

WABANNUTAO EEYOU DEVELOPMENT CORPORATION

The Wabannutao Eeyou Development Corporation (WEDC) is an organization owned by the Eastmain community that promotes and improves the economic development of the Eastmain community. The WEDC Executive Director was consulted as part of the environmental impact assessment during an interview held on June 13, 2018. The topics covered by the organization include training and professional development, job and contract opportunities, the James Bay road, the environment and traditional use of the territory and the local economy. It is important for WEDC that training be developed within the community, that a partnership be established between Eastmain, the other Cree communities and Galaxy to meet the needs of the mining company and that fair trade respects their values and culture be established. From a cultural perspective, WEDC believes it is necessary to train workers on Indigenous cultures, include a cultural village within worker camps and schedule breaks for goose hunting and autumn hunting, two traditional Cree activities.

5.4.2 JAMES BAY STAKEHOLDERS

5.4.2.1 *2012 PERIOD*

In James Bay communities, interviews were conducted in Matagami in May 2012 with stakeholders from a number of sectors of the municipal government, economic development, territorial management and planning and natural resources (Table 5-3). These meetings identified the concerns and expectations of James Bay stakeholders regarding the project and on mining development in the territory. The stakeholders expressed their support for mining development in their region, but all underscored the importance of establishing conditions to ensure and maximize socioeconomic spin-offs for the region.

Table 5-3: Calendar of information and consultation activities with James Bay stakeholders – 2012

Date	Activity	Stakeholder(s)*
May 14, 2012	Interviews with socioeconomic stakeholders	James Bay regional conference of elected officers (CRÉ), James Bay Local Development Centre (CLDBJ), Regional Commission on Natural Resources and the James Bay Territory (CRRNTBJ)
May 14, 2012		Committee to maximize economic spin-off (COMAX Nord)
May 15, 2012		Municipality of Baie-James
May 15, 2012		James Bay Development Corporation

* A calendar of information and consultation activities (with the names of stakeholders met for each activity) is provided in Appendix F.

5.4.2.2 *2017–2018 PERIOD*

Consultations have been conducted since December 2017 with stakeholders from the James Bay community (Table 5-4). The objectives of these ongoing consultations are to meet with the regional organizations concerned to present the project to them and receive the concerns, expectations and recommendations of these stakeholders as well as information useful to the development of the EIA. Details of the meetings and discussions are summarized below.

Table 5-4: Calendar of information and consultation activities held with James Bay stakeholders - 2017–2018

Date	Activity	Stakeholder(s)*
December 19, 2017	Meetings to unveil the project to the various stakeholders	EIJBRG
December 19, 2017		City of Matagami
December 19, 2017		SDBJ
February 5, 2018	Interviews with socioeconomic stakeholders from James Bay	Direction régionale de Services Québec du Nord-du-Québec
February 12, 2018		CFPBJ
February 22, 2018		SDBJ
February 23, 2018		City of Matagami
April 3, 2018		ARBJ
May 23, 2018	Meeting	SDBJ
May 30, 2018	Interview with socioeconomic stakeholders from James Bay	TJCM
July 23, 2018	Meeting	SDBJ
July 23, 2018	Information session	EIJBRG
July 24, 2018	Meeting	City of Matagami

* A calendar of information and consultation activities with the names of the stakeholders met during each activity is provided in Appendix F.

EEYOU ISTCHEE JAMES BAY REGIONAL GOVERNMENT

Galaxy representatives met with the Eeyou Istchee James Bay Regional Government (EIJBRG) on December 19, 2017, to present both the mining company and the James Bay Lithium Mine project. During the discussion period, members of the EIJBRG asked for information about the criteria for determining the profitability of a mine as well as about the state of exploration work and of the proposed mining project. The EIJBRG was also interested in learning Galaxy's intentions regarding processing, in finding out if the business planned to process the economic material within the territory and whether the process will be as polluting as that seen in China. The EIJBRG wanted assurance at this meeting that the new regulation to protect peatland, in force since June 2017, would be respected. The regional government also asked questions about the community's receptiveness to the lithium mine project, about use of the Matagami transshipment yard and about the estimated number of jobs during the construction and operation phases.

From January to September, numerous exchanges (23) and concrete actions were carried out in order to present the project to the members of the EIJBRG Board and, at the same time, to collect and respond to their comments, concerns, and recommendations. Galaxy is currently awaiting confirmation; therefore, at the time this report was published, this meeting had not been held. It should be noted that all requested documentation has been sent to the EIJBRG.

CITY OF MATAGAMI

The city of Matagami was consulted twice about the James Bay Lithium Mine project. A meeting was held on December 19, 2017, with the mayor, councillors and director of economic development. The meeting was held to present the mining company and the project. Topics addressed following the presentation were processing, infrastructure present on the mining site, the amount of concentrate to be transshipped, the lifespan of the mine, the project schedule, the economic spin-offs and the environmental impacts. The city of Matagami presented the social and economic benefits the municipality offers for a mining project of Galaxy's scale. These included the transshipment yard, the various services the city could offer the company (lodging, workers, administration, training for non-Indigenous and Indigenous people, etc.), the advantages of the James Bay road and airport service.

A telephone interview also took place with the municipality on February 23, 2018; it was represented this time by the mayor of Matagami and its director of economic development. The city of Matagami reiterated that it possessed several socioeconomic features attractive for mining development and said that it wished to participate in the James Bay mining project as a partner. The municipality addressed problems associated with development of the Nord-du-Québec and the mining sector, such as the province-wide scarcity of labour, problems with transportation and logistics and land-use issues. Regarding this last matter, the main concern is that, for logistical reasons, Galaxy will establish its administrative headquarters in an urban centre outside the Nord-du-Québec region, such as Val-d'Or or Rouyn Noranda, and that the organization of transportation for its employees would entice residents of Matagami to move south to one of these two cities in order to go work further north for the mine. Commuting is very present in the concerns of the municipality, which indicated that this phenomenon would minimize economic spin-offs for the region, limit job opportunities for the people of James Bay and would not encourage the retention of residents in the territory. The distance of the mining project from the city of Matagami could also have an impact on the community, since workers would have to remain on the mine site during their shift. Furthermore, the city of Matagami would like Galaxy to take a firm position prioritizing local labour and service businesses.

An information meeting was also held on July 24, 2018. The city of Matagami took the opportunity to discuss the municipality's transshipment yard and its benefits; the advantages of the James Bay road were also put forward. Documents were submitted to Galaxy representatives concerning the laboratory project, the transshipment yard and the recent mining symposium. A tour of the transshipment yard took place after the meeting.

JAMES BAY DEVELOPMENT CORPORATION

The SDBJ was also met on December 19, 2017. At this meeting, Galaxy representatives presented the mining company and the James Bay Lithium Mine project, which is located near the Km 381 truck stop, an infrastructure owned by the SDBJ. During the discussion period, the matter of the remote landfill used by the SDBJ near the projected mine site was raised. Several concerns were also expressed about the km 381 truck stop, which was recently renovated at a cost of $3 million, especially the impact of noise and dust on the operation of this business. The SDBJ also reminded the mining company of the suggestion made in 2010 regarding a partnership to relocate the km 381 truck stop if the project were approved. Concerning the James Bay road, maintenance of which is part of the SDBJ's mandate, the corporation underscored that it receives financial contributions from the Ministère des Transports, de la Mobilité durable et de l'Électrification des transports (MTMDET) and from Hydro-Québec and that, given Galaxy's activities and needs which could increase expenses, the SDBJ might ask the mining company for compensation.

A few months later, on February 22, 2018, a telephone interview was conducted with the SDBJ. The corporation presented its various mandates as well as work and projects underway or planned. It underscored that the development of multiple projects at the same time could greatly drain contractors in the region, resulting in increased costs to maintain the James Bay road and other outlying infrastructure. It added that establishment of a mine near the km 381 truck stop could lead to problems for the SDBJ concerning the remote landfill, employee recruitment, potable water (risk of contamination) and reconstruction of the James Bay road. The SDBJ also mentioned that the traffic created by this mine, if the project is approved, could encourage the development of a cellular network if demand were significant.

Galaxy met with the corporation again on May 23, 2018. At this meeting, the SDBJ presented the main features of the km 381 truck stop in terms of lodging capacity as well as the various services available. The attractions of the James Bay road were also mentioned. Topics covered at this meeting were Galaxy's proposed agreement to share nursing services, the procedure for temporary Galaxy workers staying at the km 381 truck stop, measures that would be put forward for the remote landfill and the possibility of an agreement for organization of the worker camp.

An information meeting was held on July 23, 2018. Galaxy representatives presented a recent map of the project to the SDBJ as well as the results of an EIA, supported by posters prepared for the open house held in Eastmain on July 16, 2018. During this meeting, the SDBJ was informed of the potential impact that dewatering of the pit could have on the level and quality of potable water in the wells of the km 381 truck stop. For their part, Galaxy members asked the corporation about the depth of these wells, about reconstruction work on the James Bay road and about hunting and fishing activities in the area. Regarding this last question, the SDBJ invited the mining company to consult the EIJBRG, which has information on the topic. Sharing of emergency services and procurement were also discussed at this meeting. The SDBJ also mentioned the existence of a GCC budget to develop entrepreneurship among the Cree.

DIRECTION RÉGIONALE DE SERVICES QUÉBEC DU NORD-DU-QUÉBEC

A discussion took place by telephone with the Direction régionale de Services Québec du Nord-du-Québec on February 5, 2018. Two main concerns were voiced by the organization. One was regarding land use. For the Direction régionale de Services Québec, it is important that people who work in the region also live there. There is concern about the impact that commuting could have on municipalities and communities in the Nord-du-Québec, namely the absence of economic spin-offs and the loss of job opportunities. The second concern raised was the prioritization of local labour, which, according to the representative consulted, is an essential measure.

JAMES BAY VOCATIONAL TRAINING CENTRE

The James Bay Vocational Training Centre (CFPBJ) was consulted via telephone interview on February 12. During this meeting, information was obtained about specific mining-sector or applicable training offered by the institution; about partnerships between the CFPBJ and mining companies to provide classes in the mine industry; about the shortage of labour and the difficulty of recruiting both instructors and students; about the impact of the sector on other types of industries; and about vocational training for Indigenous people. For the CFPBJ, it is important that mining companies in the territory and entrepreneurs can contact them if they need training, so the institution can meet these requirements without the workers having to go to Montréal, Québec City or Saguenay for training. The main concern voiced by the CFPBJ was land use. According to the institution, the people of James Bay must be able to remain in the territory and see their numbers grow. The CFPBJ mentioned that Cree labour should not be overlooked and that it is important to consider workers from Indigenous communities. It also suggested that Galaxy design its schedules so that workers would move to the region with their family.

JAMES BAY REGIONAL AUTHORITY (ARBJ)

The James Bay Regional Authority was consulted via telephone interview on April 3, 2018. In particular, information was obtained about the state of the construction and mining sectors in James Bay, about mining development initiatives undertaken by the ARBJ and about the concerns of the Authority. In terms of problems for the mining sector, the ARBJ identified a current labour shortage. For the region, it underscored that there are not always spin-offs from mining development and that, despite their contribution to the regional economy, these projects do not encourage residence in the territory due to the work schedules set, which entice commuting. Besides the beneficial economic spin-offs such a project could have on the region and its municipalities, the ARBJ highlighted that the increased road traffic and the impact of the mine on the environment and the integrity of the territory were factors to take into consideration. The ARBJ invited Galaxy to participate in a committee to maximize economic benefits (COMAX), an initiative it had implemented and for which it already coordinates many projects in the territory. The Authority also encouraged Galaxy to contact the James Bay Mining Roundtable for its EIA, which was done in May 2018.

JAMES BAY MINING ROUNDTABLE

On May 30, 2018, the *Table Jamésienne de concertation minière* (TJCM) was consulted. Several issues associated with mining development in James Bay were addressed by the organization. The TJCM discussed transportation issues as well as the importance of social acceptability of the project – not only within the territory of the EIJB, but across Québec as well. Concerning labour within the administrative region of Nord-du-Québec, the main issue cited by the TJCM was turnover: the organization said that prioritizing the hiring of local workers is the solution to reducing this phenomenon and that this initiative would make it possible to retain more workers. During the meeting, the TJCM also shared that current elected officials and James Bay residents would like to encourage processing of metals in the James Bay territory and that a project is underway to economically measure and quantify the competitive benefits that James Bay could offer so as to entice projects such as Galaxy's to process their concentrate into finished products within the territory. The organization also clearly expressed its expectations of Galaxy. The TJCM would like the mining company to collaborate in the northern development process, for it to assume its leadership role, take the time to meet with elected officials of the city of Matagami to evaluate the competitive benefits of the municipality and for its project to contribute to the development of the James Bay territory.

5.5 CONCERNS, EXPECTATIONS AND RECOMMENDATIONS REGARDING THE PROJECT

Stakeholders' concerns, expectations and recommendations with regard to the James Bay Lithium Mine project were recorded throughout the consultation process. This section summarizes the information gathered during the consultations held in 2011, 2012, 2017 and 2018.

5.5.1 CREE STAKEHOLDERS

5.5.1.1 2011-2012 PERIOD

As mentioned, information and consultation activities with representatives of various administrative or public service organizations were held in Eastmain in 2012. In addition, three discussion groups were organized with participants chosen on the basis of age and gender. The main concerns and expectations expressed by the Cree community revolved around the sharing of revenue from mining activities, the project's impacts on water quality and territory resources, training, the effectiveness of the information and consultation process, the effect of mining activities on traditional use of the territory, the rehabilitation and rehabilitation of the mining site and the alcohol problem at the worker camp (Table G-1 in Appendix G).

5.5.1.2 2017-2018 PERIOD

During the second series of consultation meetings held in 2017–2018, stakeholders again expressed their concerns regarding the planned project, along with their expectations and recommendations. This information is summarized in the following paragraphs as well as in Table G-2 (in Appendix G).

In terms of the environment, several stakeholders asked questions regarding the impact of disruptive elements (dust, noise, vibrations, odours, etc.) on wildlife, plant life and water and air quality. Of these disturbances, dust from mining activities appears to be the primary concern. The people met with enquired as to the area within the territory that would be affected or contaminated by this nuisance. The mining project's location near watercourses and peatland led certain Eastmain community members to doubt Galaxy's ability to control the risk of contamination. Various other mining processes or activities raised concerns, notably wastewater treatment and drilling and blasting activities. The mining site's rehabilitation and rehabilitation was also a topic that elicited numerous issues. Certain stakeholders also voiced their hope that the mining company would consider the cumulative effects of hydroelectric and mining projects on the Eastmain territory.

A significant number of the concerns that were raised addressed training and employment; granting priority to Cree workers is a major issue in agreements of this type. Some of the stakeholders met with expressed a concern that the mining project might, by hiring numerous workers from the community, bring about the closure of other businesses due to a lack of manpower. Regarding vocational training, members of the Eastmain community asked the mining company to notify them of available jobs and to cooperate with the Cree School Board and HRDC to develop and offer training sessions designed to prepare the community for future employment opportunities in the mining sector. This fear that Cree labour would not be adequately prepared at the time of the project's implementation was repeatedly voiced. In addition, stakeholders noted that some obstacles might prove detrimental to Cree workers, among them requirements regarding the French language, tensions with other Indigenous and non-Indigenous workers and Galaxy's expectations concerning professionalism and ethical standards.

As for economic development, the stakeholders brought up the possibility of a partnership with Galaxy, questioning the type of business model most likely to favour fair trade and support community development while respecting the region's culture and values. Concerns over economic spin-offs were also expressed. During the consultations with community members, participants shared their worries that the region would not enjoy any of the promised benefits and that none of Galaxy's profits would be reinvested in the community.

The stakeholders also had issues regarding the mining project's impacts on the community's health and social environment. People from the health sector who were consulted expressed a fear that certain problems might be exacerbated, among them the prevalence of emergency cases, the alcohol and drug addiction rate and the number of cancer cases due to environmental contaminants. The majority of them were particularly interested in learning how Galaxy planned to manage problems linked to alcohol and drugs. Adequate budgeting in the event of an increase in disposable income was also a key concern, as participants spoke of how certain community members found it difficult to spend their earnings wisely. This specific issue could also trigger other social problems. Stakeholders also expressed a fear that Eastmain health services would be affected by increased demand due to Galaxy's activities in the region. In addition, the people consulted were concerned by the effects of Cree employees' work schedules on their families and on community values. Worries were voiced regarding a possible rise in the number of children placed in foster or other care and seniors left to their own devices due to their loved ones being absent.

As for traditional activities, concerns over the impact of mining activities on hunting, fishing and gathering were shared. Concerns as to the effects of mining operations on traditional Cree activities and the resources thus obtained were also voiced during the community consultations. Stakeholders were also curious as to whether Galaxy planned to give Cree workers time off so they could hunt geese and moose. The people consulted also wondered how Galaxy would deal with any cultural problems at the mine itself.

They also apprehended the possible effects of increased traffic on the road's condition and highway safety (mainly James Bay road). Questions as to monitoring truck transport of chemicals and the impact of a future spill due to a highway accident were also raised.

Lastly, commuting is another issue that raises concerns among the elected officials of Eastmain's Cree community. Members of the Eastmain Cree First Nation are also talking about leaving the community to go live in an urban centre such as Ottawa or Montréal. Increased income (due to the mining project) would provide more people with just this type of an opportunity.

5.5.2 JAMES BAY STAKEHOLDERS

5.5.2.1 *2012*

During the first series of information and consultation activities held in 2012, the main concerns of James Bay stakeholders revolved around several elements: the environment, employment and services, use of the territory, communications, economic spin-offs, training and air transport. Table G-3 (Appendix G) presents a summary of the concerns recorded.

5.5.2.2 *2017-2018 PERIOD*

During the meetings and exchanges held as part of the 2017 and 2018 consultation of James Bay stakeholders, a number of the concerns raised in 2012 were reiterated, along with new issues and problems regarding lithium processing and road infrastructure.

The stakeholders specifically shared worries regarding the environment and the integrity of the territory. Compliance with the new regulation to protect peatland, the impact of the disturbances due to mining activities and the risk of drinking water contamination during the construction and operations phases were all brought up.

As for the job sector, the stakeholders consulted brought up employee retention problems in the administrative region of Nord-du-Québec. Priority being given to the region's workers, enterprises and services is thus a key issue for James Bay stakeholders. Giving due consideration to Cree workers and their importance was also discussed. Furthermore, worries were voiced that in the event of a mining project, small entrepreneurs or service providers from the region might be unable to retain their employees, who would seek out work with the mining companies.

Numerous other concerns involved issues regarding land or territory use. Commuting and the associated impacts (fewer economic spin-offs, loss of job opportunities for James Bay residents, possible increase in the number of residents remaining in the Nord-du-Québec region, etc.) are one of the regional stakeholders' greatest fears. The site of the mine's administrative and operating hub, along with the logistics of worker transportation, will be critical issues with a potentially major impact.

Worries were also voiced regarding the lack of economic spin-offs for the region. The urban centres of Val-d'Or and Rouyn-Noranda are two hubs often preferred due to their year-round air service. Obtaining such year-round air service is thus a preoccupation for James Bay stakeholders, as well as a priority to ensure the region's ongoing development.

With regards to workforce training, regional stakeholders are calling for Galaxy to reveal whether or not it plans to rely on regional vocational training centres/establishments. They would also like to know more about the organization's interest in eventually partnering with the CFPBJ.

On another note, the processing of metals was also discussed, with the people met asking whether the method used would have an impact on the nearby environment and whether any thought had been given to the EIBJ as the site of a future processing plant.

Lastly, concerns were raised regarding the James Bay road, its weight-bearing capacity and other capacities as well as the potential impact of the Galaxy mining project and the associated increase in traffic on the road's integrity.

Table G-4 (Appendix G) summarizes the concerns of the James Bay stakeholders for the period from 2017 to 2018.

5.6 GALAXY'S RESPONSE TO CONCERNS, EXPECTATIONS AND RECOMMENDATIONS ABOUT THE PROJECT

Galaxy has already responded to many concerns, expectations and recommendations voiced by James Bay and Cree stakeholders.

Many steps have been taken to address some of the issues raised by the Eastmain Cree population following regional consultations. Table 5-5 presents the initiatives implemented thus far regarding Cree stakeholders.

Table 5-5: Steps taken to address the Eastmain Cree's concerns

Concerns	Steps taken by Galaxy
Lack of stakeholder knowledge of the various aspects of mining operations. Difficulty taking a stance vis-à-vis the project.	• Galaxy invited stakeholders from the Eastmain Cree community and the local tallyman to an organized visit of the Stornoway diamond mine. The visit had to be cancelled on two occasions, due to cancellations by the Cree participants. • An introductory course about lithium and mining operations was offered in Eastmain on July 11, 12 and 13, 2018 (18 participants).
Waste rock stockpile located near a watercourse used by the trapline RE2 (creek CE5) tallyman.	• Following consultations and after several options were considered, the waste rock stockpile was relocated north of Asini Kasachipet Lake and south of creek CE2 (Map 3-1). This new site not only addresses the issue raised regarding creek CE5 (watercourse used by inhabitants of the region), namely by moving the waste rock stockpile further away from this watercourse to a watershed not as favoured by users of trapline RE2, but it also moved this mining infrastructure further from the km 381 truck stop.
Presence of Galaxy consultants or workers in trapline RE2 without the tallyman's permission.	• Galaxy agreed and has given the trapline RE2 tallyman advance notice of each activity planned on the land.
Training support for Cree workers.	• The mining company agreed to work in conjunction with the Cree School Board and HRDC to develop community training designed to prepare the Cree workforce for future job opportunities at the mine.
Impact on the quality of life of Cree workers and their families (problems due to being far from their community).	• Work schedules for Cree employees will be tailored to their particular reality. One option would be 7 work days followed by 7 days off.
Impact on traditional activities.	• The noise level of certain activities, such as upkeep of the industrial facility, will be diminished during the goose-hunting season, so as to limit impacts on hunting activities. • Cree workers will also receive days off during the goose-hunting season.
Exacerbation of alcohol and gambling problems among workers.	• The worker camp will be alcohol-free ("dry") during the construction and operations phases. • Video poker machines, regardless of type, will be strictly forbidden at the mining site.

The main steps taken regarding the James Bay communities involve the SDBJ and the km 381 truck stop. Galaxy agreed to erect a fence around the remote landfill of the SDBJ as well as along the northern side of the road to get there, so that the site will not be impacted by mining activities. The relocation of the waste rock stockpile, mentioned previously, is also a positive means of limiting the mining activities' impacts on the km 381 truck stop. On another note, agreements for worker housing and shared emergency medical services are presently being discussed. These potential collaborative efforts constitute actions that would help increase economic spin-offs and better meet the SDBJ's expectations.

Galaxy also responded to the ARBJ's suggestion that it consult the TJCM as part of the EIA.

5.7 ONGOING CONSULTATION INITIATIVE AND COMMITMENT TO STAKEHOLDERS

Galaxy has agreed to develop sustainable relationships with stakeholders, to maximize the social and economic benefits of the project while minimizing its environmental impacts. The mining company also is sharing information on the project, specifically by holding open houses, committing to having Galaxy's community relations manager spend one week per month in the community, organizing sessions with stakeholders, posting updates on the website, and maintaining direct links with employees. With these commitments, Galaxy aims to offer timely and relevant responses to all the comments and concerns voiced with regard to the James Bay Lithium Mine project.

The relationship and exchanges between Galaxy and stakeholders will be maintained throughout the life of the project.

5.7.1 IMPACT BENEFIT AGREEMENT

Discussions have been initiated with Cree and Eastmain stakeholders to reach sign an impact benefit agreement. No agreement has been reached thus far, as exchanges are still underway.

However, Galaxy has agreed to abide by certain principles, namely to:

- implement sustainable infrastructure projects;
- provide education and training opportunities;
- promote the importance of proper money management to the population;
- favour projects focused education, health and infrastructure;
- make business opportunities available to local entrepreneurs.

5.7.2 MONITORING COMMITTEE

As required under *An Act to amend the Mining Act* (section 101.0.3), Galaxy will establish a monitoring committee to foster the participation of the communities involved in the project's execution. This committee will be created prior to the mine's construction and will remain active throughout its life, until the works provided for in the mining site rehabilitation and rehabilitation plan are fully completed.

The committee's membership will be determined as per the regulations established under the Act, and it will comprise at least one representative from the Eastmain Band Council, one from the business community, one from the city of Eastmain and one from the EIJBRG. Galaxy would also like to include either the RE2 tallyman or one of his family members to the monitoring committee.