



**NI 43-101 Technical Report  
Report on the Estimate to Complete for the Whabouchi Lithium Mine  
and Shawinigan Electrochemical Plant  
Nemaska Project**



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## LIST OF APPENDICES

Appendix A – *Mining Lease Letter*

## 1 SUMMARY

### 1.1 Introduction

This Technical Report, on the estimate to complete of the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, has been prepared for Nemaska Lithium Inc. ("**Nemaska**"), in compliance with the provisions of National Instrument 43-101 Standards of Disclosure for Mineral Projects. The Whabouchi Property is located in the Eeyou Istchee / James Bay area of the Province of Quebec and the Shawinigan Property, is located in Shawinigan, Quebec.

The Whabouchi Property comprises the mining operations and the crushing and concentrating of the ore to produce spodumene concentrate. The concentrator is designed to nominally produce 215,000 tonnes of spodumene concentrate which is then transported by truck transport to Shawinigan. At Shawinigan, the spodumene concentrate is transformed into 37,000 t/y of lithium hydroxide monohydrate crystals (LHM), assuming Nemaska Lithium will purchase lithium sulfate monohydrate (LSM) and/or concentrate when needed to achieve nameplate capacity.

Met-Chem, a division of DRA Americas Inc. ("DRA/Met-Chem") has provided engineering and integration services for all aspects of the Technical Report ("The Report") on the Whabouchi Lithium Mine with the participation of other companies. The Report includes the Resource Estimation (by SGS Geostat "SGS"), Reserve Estimation, Open Pit Mine Design and Mineral Reserve Estimation (by BBA Inc. "BBA") concentrator (by DRA/Met-Chem), and Electrochemical plant (by Hatch and NORAM), infrastructure (Hatch for Shawinigan and DRA/Met-Chem elsewhere), waste rock and tailings disposal and water management (by SNC-Lavalin "SNC"), capital and operating costs (DRA/Met-Chem for Whabouchi and Hatch for Shawinigan), and economic analysis by DRA/Met-Chem.

The responsibilities for each section of the Report is shown in Section 2 and identifies the Qualified Person ("**QP**") responsible for their section or sub-section.

This Report follows the guidelines as outlined with the provisions of National Instrument 43-101 Standards of Disclosure for Mineral Projects. This Report has also been prepared using the Technical Report on the Feasibility Study for the Project dated February 2018 produced for Nemaska as a guideline and each section updated, as required.

Since the design and construction activities have been on-going since 2016 on the properties with special emphasis on the Whabouchi Property, this capital cost impact only focuses on the work to complete each of the two (2) projects to their operational phases.

The purpose of this Report is to update the Reader as to the status of the Project the capital and operating cost estimates and show the current financial picture of the Project.

Work has been on-going on the two (2) projects and as of May 31, 2019, the overall status of the Project's activities is shown in Table 1.1.

**Table 1.1 – Project Completion Status (May 31, 2019)**

Description	Status
<b>Whabouchi</b>	
Design	75%
Procurement	90%
Construction	39%
<b>Shawinigan</b>	
Design	45%
Procurement	20%
Construction	4%

It should be noted that this NI 43-101 Technical Report supersedes all previous NI 43-101 Technical Reports.

## 1.2 Property Description and Location

The Whabouchi Property is located in the James Bay area of the Province of Quebec, approximately 30 km East of the Nemaska community and 300 km north-northwest of the town of Chibougamau. The center of the Property is situated at about UTM 5,725,750 mN, 441,000 mE, NAD83 Zone 18 (Figure 1.1). The Property is accessible by the Route du Nord, the main all-season gravel road linking Chibougamau and Nemaska. The road crosses the Property near its center. The Nemiscau airport is 18 km west of the Property.

The Property is composed of one (1) block containing 35 map-designated claims covering a total of 1,632.24 ha. and one (1) Mining Lease by the *Ministère de l'Énergie et des Ressources naturelles*. Nemaska owns 100% interest in the Property.

On October 26, 2017, Nemaska Lithium Inc. ("Nemaska"), obtained Mining Lease number 1022, under the conditions provided for in the Mining Act and those prescribes by regulation. The surface of the Mining Lease totals 138.106 ha, consisting of lot 4,994,037 of the Quebec cadastre, registration division of Lac-Saint-Jean-Ouest. This lease gives the tenant the right to extract all mineral substances owned by the Crown in the above-named land, but it does not give entitlement to surface mineral substances, petroleum, natural gas, or brine. This lease is for a period of 20 years from the date of the landlord's signature on October 26, 2017 and will end on October 25, 2037 (see Appendix A – Mining Lease Letter).

Nemaska owns 100% interest in the Property. Sixteen (16) claims were acquired from Victor Cantore Group ("Cantore claims") on September 17, 2009, ten (10) claims were acquired from Golden Goose Resources Inc. ("Golden Goose") on January 15, 2010 as part of a larger mining titles purchase agreement (594 claims forming the Lac Levac and Lac des Montagnes properties), and seven (7) claims were acquired by map designation directly by Nemaska. All the claims are registered in the



name of Nemaska. As of the effective date of this Report, all 35 claims are in good standing. The Whabouchi deposit is located on the Cantore claims. The expiry dates for the claims range from November 2, 2019 to January 24, 2020.

### **1.3 Accessibility, Climate, Local Resources, Infrastructure and Physiography**

#### **1.3.1 WHABOUCHI SITE**

##### **1.3.1.1 Accessibility**

The Property is easily accessible via the *Route du Nord* road that crosses the Property near its center. This road links the town of Matagami, via the Route de la Baie-James road, approximately 390 km to the SSW. The Route du Nord also links the town of Chibougamau, located approximately 300 km to the SSE, and leads to the community of Nemaska.

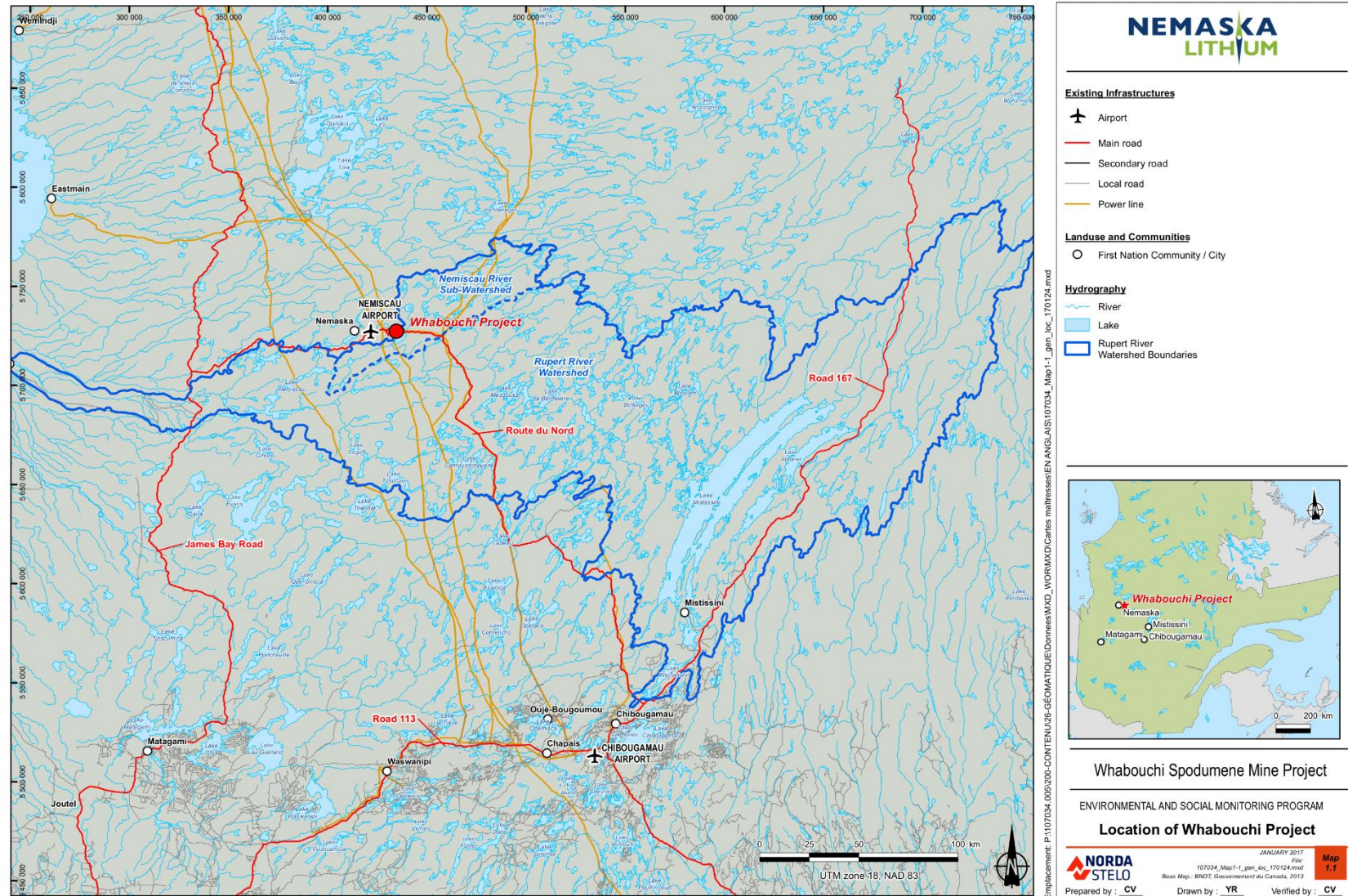
##### **1.3.1.2 Physiography and Climate**

The Property is characterized by a relatively flat topography with the exception of the local ridge where the more competent pegmatites occur, forming the surface expression of the deposit. The elevation above sea level ranges from 275 m to 325 m with an average elevation of 300 m. Lakes and rivers cover approximately 15% of the Property area. The flora in the area is typical of the taiga environment observed in the region with a mix of black spruce forest and peat moss-covered swamps. A vast portion of the Property was devastated by forest fires less than 15 years ago.

There is no permafrost at this latitude and the overburden cover ranges in depth from 0 m near the ridge to 25 m in the south part of the Property. The climate in the region is sub-arctic. This climate zone is characterized by long, cold winters and short, cool summers. Daily average temperature ranges from -20°C in January to +17°C in July. Break-up usually occurs in early June, and freeze-up in early November.

The annual precipitation averages 479 mm of rain mostly from March to November and 117 cm of snow from September to May. Averages are based on data from 2009 to 2016 (<https://www.worldweatheronline.com/nemiscau-weather-averages/quebec/ca.aspx>)

Figure 1.1 – Property General Location



#### 1.3.1.3 Local Resources and Infrastructure

The nearest infrastructure with general services is the *Relais Routier Nemiscau* Camp, located 12 km west of the Property, where Nemaska has access to lodging facilities, if needs exceed the capacity of the camp installed on the property. The community of Nemaska, located 30 km west of the Property, can also provide accommodation and general services. The area is serviced by the Nemiscau airport, serviced by regular Air Creebec flights and charter flights, and by mobile phone network from the main Canadian service providers.

Hydro-Québec owns several infrastructure and facilities in the area including the *Poste Albanel* and *Poste Nemiscau* electrical stations located approximately 20 km east and 12 km west from the Property, respectively. Electrical (735 kV) transmission lines connecting both stations run alongside the Route du Nord road and cross the Property near its center. As well, a 69 kV power line connecting the Poste Nemiscau electrical station to the mine has been put in service and is supplying power to the facilities.

#### 1.3.1.4 Surface Rights

All claims comprising the Property are located on Crown Lands. Nemaska secured, in October 2017, all surface rights to construct and operate the projected infrastructure.

### 1.3.2 SHAWINIGAN SITE

The Shawinigan site is located in a sector of the city identified as *Grand-Mère*, adjacent to the St-Maurice River between the *Grand-Mère* Bridge and 8<sup>th</sup> street south.

#### 1.3.2.1 Accessibility

The site is easily accessible via Highway 40 or Highway 20 and Highway 55. It is located about 40 km north of *Trois-Rivières*; 140 km west of Quebec City; and 170 km east of Montreal.

#### 1.3.2.2 Physiography and Climate

The Shawinigan area is located at the transition from the St-Lawrence River Lowlands to the Canadian Shield (Grenville; Laurentides Geologic Province). Landscape is mainly composed of rounded hills surrounded by small river valleys, with the large St-Maurice River valley acting as a central element and is located in the Laurentian Mixed Forest region. The main physiographic regional element is the St-Maurice River (watershed of 42,651 km<sup>2</sup>) which is the 4<sup>th</sup> largest river flowing towards the St-Lawrence River, representing from 6 to 15% of its flow depending on time of the year.

Mean annual flow is estimated to be about 755 m<sup>3</sup>/s near Shawinigan, i.e. about 40 km upstream of its mouth in the St-Lawrence River. Climate is cold and temperate. The average annual temperature in Shawinigan is 4.7°C. About 1,063 mm of precipitation falls annually. Daily average temperature ranges from -12.7°C in January to +19.5°C in July.



### 1.3.2.3 Local Resources and Infrastructure

Shawinigan has access to the CN rail network, is located less than 45 km from two (2) ports: *Trois-Rivières* and *Bécancour*. A regional airport accessible to regional jets is located in *Trois-Rivières*, approximately 20 minutes from Shawinigan. The Montreal and Quebec international airports are both less than two (2) hours away from Shawinigan.

For international oversea shipments, the port of Montreal, open year-round, is only about 90 minutes from the plant and is connected to the Montreal highway network.

The site is supplied with a high-pressure natural gas line, city water and effluent system. It is also located near the *Grand Mère* Hydro-Québec hydroelectric dam.

## 1.4 History

Numerous geological surveys and geoscientific studies have been conducted by the Quebec Government in the Eeyou Istchee / James Bay area. Geological surveys in the 1960s (Valiquette 1964, 1965, and 1975) cover the entire property area. In 1998, the MRNF released the results of a regional lake bottom sediment survey completed in 1997. The first exploration work reported in the area, dates back to 1962 by Canico and included the discovery of a lithium-bearing pegmatite by the geologists of the Quebec Bureau of Mines. That same year, Canico drilled two (2) packsack drill holes on the pegmatite, followed by three (3) diamond drill holes on the same pegmatite ridge in 1963. A total of 462.99 m was drilled. The best result obtained was 1.44% Li<sub>2</sub>O over 83.2 m (Elgiring 1962).

No exploration was reported for the next ten (10) years. From 1974 to 1982, the exploration work was exclusively reported by the *Société de Développement de la Baie James* ("SDBJ"), which mainly executed large scale geochemical surveys, followed by geological reconnaissance of the anomalies (Pride 1974, Gleeson 1975 and 1976). Two (2) exploration programs, one in 1978 and the other in 1980 were aimed at lithium exploration, with the evaluation of the Whabouchi spodumene-bearing pegmatite (Goyer et al. 1978, Bertrand 1978, Otis 1980, Fortin 1981, and Charbonneau 1982).

In 1987, Westmin Resources completed an airborne Dighem III survey. In 1987-1988, Muscocho Exploration also completed ground magnetic and VLF surveys that covered a major part of the Property.

In 2002, while exploring for tantalum, Inco re-sampled the spodumene-bearing pegmatite, taking 11 channel samples and seven (7) grab samples. The best value obtained by Inco was 0.026% Ta, and Li<sub>2</sub>O values ranging from 0.3% to 3.72% (Babineau 2002). Nemaska initiated its exploration work on the Property during the fall of 2009. A mechanical stripping and trenching program was conducted to expose and sample the main spodumene-bearing pegmatite along with a small drilling program designed to validate the historical results.

During 2010 and 2011, exploration work completed by Nemaska on the Property included three (3) drilling campaigns, mechanical stripping, ground and airborne geophysics, a 50-tonne bulk sample

and metallurgical testing. An initial Mineral Resource was estimated in May 2010 by SGS and was followed by an initial preliminary economic assessment of the Project completed in March 2011 by Equapolar in collaboration with BBA.

The initial Mineral Resource estimate of the Whabouchi Property, effective May 28, 2010, totaled 9.78 Mt grading 1.63%  $\text{Li}_2\text{O}$  in the Measured and Indicated Resources categories, with an additional 15.40 Mt grading 1.57%  $\text{Li}_2\text{O}$  in the Inferred Resources category.

Following further drilling in 2011, SGS provided Nemaska with an updated Mineral Resource (effective June 6, 2011) to be included in the Preliminary Economic Assessment (prepared by Met-Chem Canada Inc. and dated October 2, 2012). This updated Mineral Resources comprised 11.294 Mt of Measured resources with an average grade of 1.58%  $\text{Li}_2\text{O}$ , 13.785 Mt of Indicated resources with an average grade of 1.50%  $\text{Li}_2\text{O}$  and 4.401 Mt of Inferred Resources with an average grade of 1.54%  $\text{Li}_2\text{O}$ . The Mineral Resources were reported within an optimized pit shell and a cut-off grade of 0.43%  $\text{Li}_2\text{O}$ .

From 2012 to 2013, Nemaska conducted further drilling in order to measure the geotechnical properties of the rocks, condemn certain sector of the Property for construction and increase the level of confidence on the 2011 in-pit resources. Nemaska drilled 14 holes for a total of 1,815 m in 2013.

During 2016, Nemaska conducted a definition drilling program highlighting a new mineralization zone named Doris. Nemaska started a bulk sampling program in order to extract and pilot test up to 60,000 tonnes of mineralized material.

During 2017, Nemaska conducted a definition drilling program on Whabouchi focussing on the better definition of measured areas based on the first five (5) years of mining. The program also enabled to add knowledge and resources to the Doris zone.

In 2018, Nemaska conducted a drilling program in order to increase the level of confidence on the shallow, eastern extension part of the measured category mineral resources.

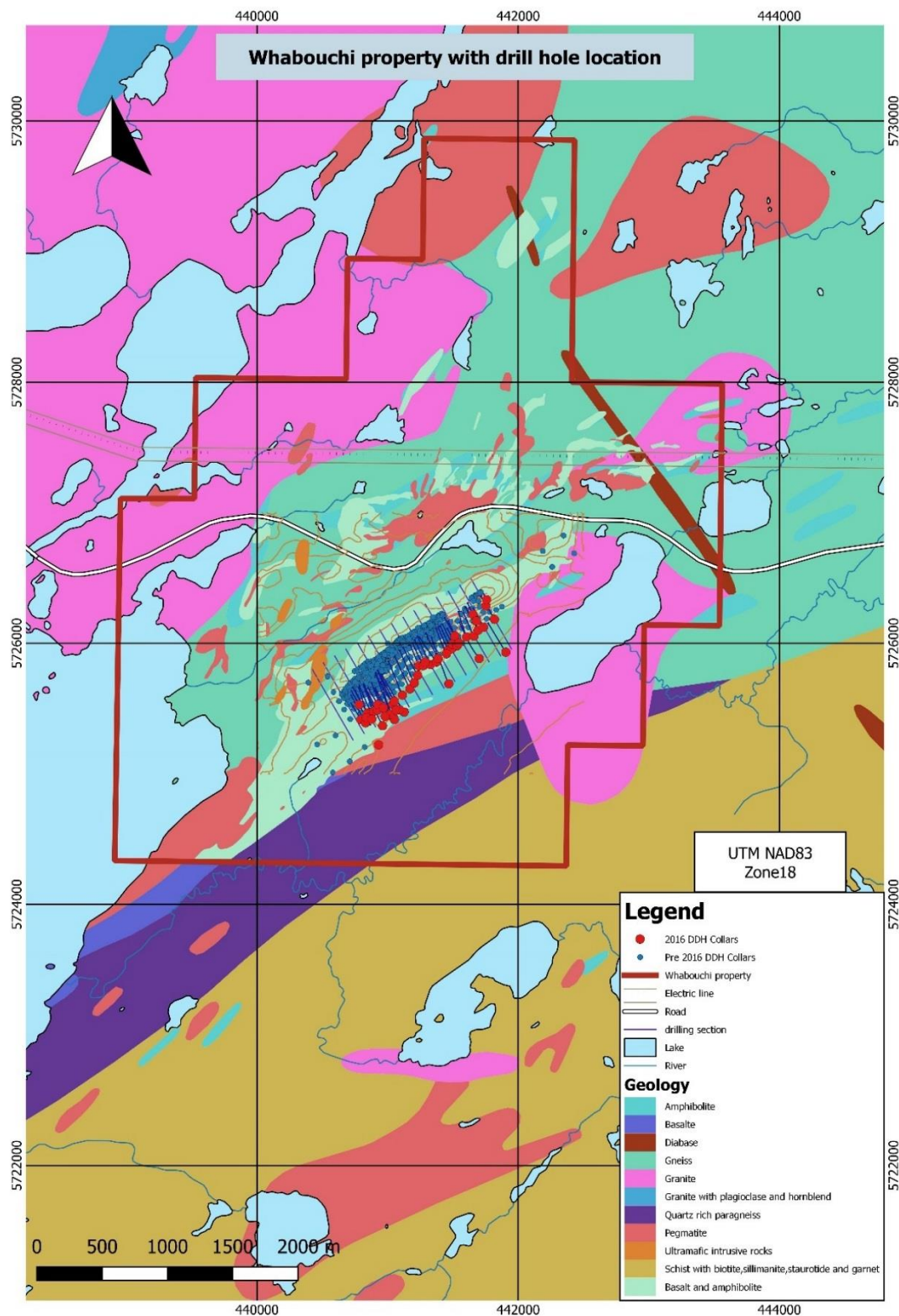
## 1.5 Geological Setting and Mineralization

The Whabouchi Property is located in the northeast part of the Superior Province of the Canadian Shield craton, in the *Lac des Montagnes* volcano-sedimentary formation which is principally composed of metasediments and mafic and ultramafic amphibolites. A spodumene-bearing pegmatite intrusive dyke swarm occurs on the Property and is composed of a series of sub-parallel and general sub-vertical pegmatite bodies up to 90 m total composite width. The mineralized pegmatite swarm has a general NE-SW orientation, extends 1.3 km along strike and reaches a depth of more than 500 m below surface.

The lithium mineralization occurs mainly in medium to large spodumene crystals (up to 30 cm in size) but petalite also occurs, averaging less than 2% in the deposit. Figure 1.2 shows the drill holes location on the Property and the typical geology in the area.



Figure 1.2– Map of the Property Geology with Drill Holes Location



The Whabouchi deposit is a lithium-bearing rare metal pegmatite. Emplacement of rare metal pegmatites is the last phase of the crystallization of a parent granite pluton. High pressure residual fluids, with abundant water, silica, alumina, alkalis, and rich in rare elements and other volatiles from the crystallization of a pluton at modest depth, concentrate in the cupola or upper domed contact of the granite as it crystallizes.

Under increasing pressure, this fluid dilates fractures in overlying rocks in a manner analogous to that of hydraulics in mechanical equipment, thereby providing feeder channels for emplacement of pegmatites at shallower depth. Progressive crystallization of the main rock-forming minerals out of this fluid enriches the final fluids in rare metals and the process culminates in the formation of rare metal pegmatites still under fluid pressure.

A variety of types occur depending on the abundance and type of rare metals associated with the pluton and the physico-chemical conditions affecting the sequence of emplacement events. Two (2) distinct phases are observed in the Whabouchi pegmatites: a spodumene-bearing phase comprising most of the pegmatite material and a lesser, white to pink barren quartz-feldspar pegmatite. The lithium mineralization occurs mainly in medium to large spodumene crystals (up to 30 cm in size) but petalite also occurs, averaging less than 2% in the deposit.

## 1.6 Deposit Types

The interpretation of the pegmatite model was developed by Gary H. K. Pearse in 2011, based on geological mapping, evaluation work, and development work on a number of major pegmatite deposits over many years.

The Whabouchi deposit is a lithium-bearing rare metal pegmatite. Emplacement of rare metal pegmatites is the last phase of the crystallization of a parent granite pluton. High-pressure residual fluids, with abundant water, silica, alumina, alkalis, and rich in rare elements and other volatiles from the crystallization of a pluton at modest depth, concentrate in the cupola or upper domed contact of the granite as it crystallizes.

Under increasing pressure, this fluid dilates fractures in overlying rocks in a manner analogous to that of hydraulics in mechanical equipment, thereby providing feeder channels for emplacement of pegmatites at shallower depth. Progressive crystallization of the main rock-forming minerals out of this fluid enriches the final fluids in rare metals and the process culminates in the formation of rare metal pegmatites still under fluid pressure. A variety of types occur depending on the abundance and type of rare metals associated with the pluton and the physico-chemical conditions affecting the sequence of emplacement events.

Pegmatite petrologists classify the variety of types and subtypes by combinations of the following criteria:

- Mineralogical-geochemical signatures;
- Internal structure/zonation;
- Pressure-temperature conditions of crystallization.

The criteria are related through degree of fractionation, which arises from the chemical, temperature and pressure evolution of the pegmatite fluids over time and distance from the parent granite. The complex rare element pegmatites generally evolve as follows: at depth under high-pressure and temperature conditions, simple granite pegmatites of quartz, feldspar and mica crystallize in fractures above and within the solidified granite pluton. Above this level, columbo-tantalite minerals appear starting with high niobium compositions and progress to higher tantalum/niobium ratios where the complex pegmatites appear with lithium, cesium, and rubidium bearing minerals.

Variations may appear, in which petalite is the dominant lithium mineral, often along with pollucite, lepidolite, etc. Alternatively, spodumene dominates in a classification known as albite-spodumene pegmatite. Tantalum may occur in a variety of minerals and cassiterite may be present. A final, mariolitic or greisen phase at low pressure-temperature, may be present with lepidolite, quartz, tantalum-rich minerals, tin, topaz, etc. Where beryllium is relatively abundant, beryl (most commonly) or other beryllium minerals, these often occur throughout the sequence from the parent granite through all phases to the final mariolitic mineralization.

Three (3) characteristics of the geological setting for rare metal pegmatites are common:

- Emplacement in concordant stacked sills;
- Presence of a compressed, near-vertical, syntectonic mobile zone that is the locus of pegmatite intrusion;
- Host rocks most commonly are dominantly mafic volcanics often with intercalated metasediments and gabbroic rocks.

The Whabouchi pegmatite is a highly fractionated, spodumene-rich pegmatite swarm, individual bodies of which display typical zoning to varying degrees – a comparatively thin albite wall zone at the contacts followed by a K-feldspar rich zone with lesser albite, quartz, mica, and little or no spodumene, followed by a spodumene-quartz-rich core zone (with variable feldspars and mica) making up more than 90% of the cross-section.

The Whabouchi deposit lacks a quartz core which is one of the classic zoned pegmatite features. Insufficient stratigraphic work has been done on the host rocks to establish that the bodies are dominantly sills as in the classic case. The concordance of the bodies with the greenstone belt and the persistence of even thin pegmatite bodies over a 100 m or more on strike and at depth support this structural control. The drilled sections at 700E and 800E on the grid do appear to show this, in that the hanging wall of the main pegmatite zone is basalt and the footwall gabbro.

## 1.7 Exploration

Nemaska (formerly Nemaska Exploration Inc.) began its exploration program in October 2009 and consisting of mechanical stripping, trenching (16 trenches, 1,000 m strike), channel sampling (35 channels for a total of 295 samples) successfully exposing spodumene-bearing pegmatites. Seven (7) diamond drill holes were completed (+1 hole abandoned) successfully intersecting pegmatites zones.

A second exploration program was conducted from January to April 2010. During that program, 59 drill holes totaling 11,600 m were completed. In addition to drilling, 14 line-km of ground magnetic surveying covering the main mineralized occurrence and 670 line-km of helicopter-borne magnetic surveying covering the Property were completed. Later in May 2010, Nemaska completed 2,780 m of mechanical stripping of the south contact of the main mineralized zone with (16 trenches and seven (7) contact zones) and collected 649 channel samples. The stripping also allowed the mapping of the surface geology.

In late 2010, 23 drill holes were completed. An additional 41 holes were drilled in 2011 including 26 for infill drilling, three (3) for metallurgical tests for a total of 9,500 m. In May 2011, a 50-tonne bulk sample was collected at surface for metallurgical testing purposes.

In 2013, 14 drill holes were added to better define the mineralization towards the Eastern boundary and also, to increase the level of confidence of the 2011 in-pit mineral resources. A total of 1,815 m of drilling was completed and 351 samples were sent for Li<sub>2</sub>O assay.

In 2016, 51 drill holes were added to: 1) convert the inferred in pit inferred resources to indicated; 2) increase the confidence level of mineral resources from 0 m to 200 m, and 3) extend the mineral potential at depth. A total of 17,424 m of drilling were completed and 4,039 samples were sent for Li<sub>2</sub>O% analysis. A new zone named Doris was discovered to the Southeast of the known Whabouchi deposit.

The 2017 campaign aimed to confirm the extension of pegmatite veins of the Doris Zone and to better define the geological continuity and lithium content in the main zone targeted to be mined during the first five (5) years of mining operation. This campaign added 48 drill holes totaling 4,361 m on the Whabouchi Property.

In 2018, 20 diamond drill holes were added. Out of which fourteen drill holes totaling 2,070 m were infilling drilling between section 900 and 1100 and six (6) drill holes totaling 960 m were core oriented geotechnical holes. The objective of the campaign was to better define and increase the confidence level of mineral resources in between section 900 and 1100 which would be exploited in the first years of operation and also to increase the geotechnical data for a better conception of the open pit design.

## 1.8 Drilling

A total of 258 drill holes were completed by Nemaska to define the mineral deposit. In addition to the drilling, extensive mechanical stripping on surface permitted the completion of more than 140 channels. Tables 1.2 and 1.3 summarize the drilling and channel sampling completed by Nemaska to define the mineralized pegmatite intrusion.

**Table 1.2 – Drilling Completed by Nemaska at Whabouchi**

Year	Count	Metres Drilled
2009	8	999
2010	82	15,670
2011	41	9,257
2013	14	1,815
2016	51	17,424
2017	48	4,361
2018	14	2,070
<b>Total</b>	<b>258</b>	<b>51,596</b>

**Table 1.3 – Channel Sampling done by Nemaska at Whabouchi**

Year	Channels	Total Samples
2009	35	295
2010	108	649
<b>Total</b>	<b>143</b>	<b>944</b>

## 1.9 Sample Preparation, Analysis and Security

Nemaska implemented an internal QA/QC protocol by regularly inserting reference materials (standards and blank) and core duplicates in the samples stream. Nemaska also conducted in the 2010 and 2011 re-analysis of selected pulps in a second laboratory, as part of their QA/QC protocol.

SGS completed a review of the sample preparation and analysis including the QA/QC analytical protocol implemented by Nemaska for the Project. SGS visited the Whabouchi Property on November 27, 2013 and numerous times in the summer of 2016 to review Nemaska sample preparation procedures, local infrastructure and in order to conduct an independent sampling program.

The author visited the site on May 20, 2019. The QA/QC data from previous campaigns and up to 2018 was reviewed. A review of the QA/QC analytical results for blanks and core duplicates did not highlight any analytical issues. However, the observations for the 2016 standard material and pulp duplicates suggest the presence of a bias in the analytical data between SGS and ALS laboratories of about 5%, SGS Laboratory having the higher average grade. SGS verified the effect of a 5% grade added value on the 2016 assay results in the resources estimates and found the results to be negligible.



Specific Gravity ("SG") measurements were completed in 2010 and 2011 on mineralized core samples to estimate an average bulk density value for the Whabouchi deposit and are considered acceptable for the present Report.

The author is of the opinion that the sample preparation, analysis and QA/QC protocol used by Nemaska for the Whabouchi Project follow generally accepted industry standards and that the Project data is of a sufficient quality SGS recommends continuing its internal QA/QC protocol for blanks, duplicates (core and pulp), and standards (reference materials).

### 1.10 Data Verification

A total of 39 mineralized core duplicates were collected in 2013 by SGS on 2011 and 2013 drill hole samples and submitted for Li analysis at the SGS Minerals Laboratory in Lakefield, Ontario and followed the same analytical protocol used by Nemaska during the 2009 and 2010 drilling programs (code ICP90Q) except that the sample preparation has been done directly at the SGS Mineral Services and not at the TJCM laboratory.

The comparative results show the average relative grade differences between the original and the control samples range between 1% and 12%, which can be considered acceptable for core duplicates, considering the coarse nature of the spodumene mineralization generally observed at Whabouchi. The weighted average grades between the original and the control samples outline similar results.

The digital drill hole database supplied by Nemaska has been validated for the following data field: collar location, azimuth, dip, hole length, survey data, lithology and analytical values. The validation returned only minor discrepancies located in lithology and assay data, which were communicated to Nemaska and corrected in the final drill hole database.

As part of the data verification of the Project, the analytical data from the database has been validated with the values from the laboratories analytical certificates. No errors were noted during the validation.

The final revised database includes the channel samples collected in 2009 and 2010 from surface trenches and the drilling data from the 2009, 2010, 2011, 2013, 2016, 2017, and 2018 drilling programs. The final drill hole with reported analytical results included in the database is WHA-18-257. The few historical drill hole and channel analytical data were considered for the current mineral resource estimate and were kept for modeling purposes. The author is in the opinion that the final drill hole database is adequate to support a mineral resource estimate.

### 1.11 Mineral Processing and Metallurgical Testing

Mineral processing testing was performed on spodumene concentrate production and lithium hydroxide monohydrate (LHM) production separately. A summary of spodumene concentrate production test work is presented in Section 1.11.1. The electrochemical production of LHM test work is presented in Section 1.11.2.

### 1.11.1 WHABOUCHI CONCENTRATOR

Between 2010 and 2017, multiple test work programs were done to develop the Whabouchi concentrator flow sheet. This involves crushing, ore sorting, hydro classification, dense media separation (“**DMS**”) and flotation methods. It also includes summaries from screening, settling, filtration, freezing, drying, and magnetic separation tests performed by various laboratories and suppliers.

Ore Sorting was tested at full scale by two (2) suppliers to evaluate the ore amenability to coarse size sorting. The ore can be effectively separated into rejects and accepted with minimal lithium losses. This was implemented in the flow sheet to reduce contamination with amphibolite.

Hydraulic separation has been tested to remove muscovite before the two (2) main separation processes (DMS and flotation). It has been used in pilot plant campaigns. It was also tested in a manufacturer laboratory.

Multiple DMS testing programs, at bench scale with Heavy Liquid Separation tests and in pilot plant tests, have been done since the beginning of the flow sheet development. DMS performs well with particles of less than 9.5 mm and improves as the top size is reduced to 6.3 mm. DMS can produce a final concentrate, a final reject and a middlings stream which will be reprocessed in flotation.

Multiple test programs involved flotation. Both bench scale and pilot plant work were performed since 2010. The most recent programs aimed at taking advantage of the coarse liberation of the material and coarse flotation with Hydroflotation was introduced. In addition, column flotation shows a better selectivity against muscovite and other contaminant in the fine flotation concentrate by using wash water addition. Final design tests were performed at Eriez which supplies the Hydroflotation technology. The grade and recovery of these tests were very good. The reagent consumption was reduced drastically through optimization.

Thickener, filtration and freezing tests have been done to size various equipment and validate conditions where concentrate transportation could be problematic.

The Whabouchi DMS pilot plant operated in 2016, whilst not a piloting the current flowsheet, did demonstrate that then contaminant minerals behaved similarly to spodumene and proved the necessity to include ore sorting and dry magnetic separation into the commercial flowsheet. The Whabouchi DMS pilot plant was important derisking activity for the project.

Finally, DMS concentrate drying tests have been done to evaluate conditions required to have a good concentrate for dry magnetic separation of the Coarse DMS concentrate. This last operation in the upgrading of the ore was tested at two (2) supplier’s facilities with good results.

## 1.11.2 SHAWINIGAN ELECTROCHEMICAL PLANT

### 1.11.2.1 Offsite Laboratory and Pilot Scale Testing

Extensive process testing was conducted on the Nemaska Whabouchi spodumene concentrate to determine the design and sizing of a facility to produce high quality Lithium Hydroxide Monohydrate (“LHM”).

Key aspects of the process were tested at the laboratory and/or pilot scale. A high-level summary follows:

- **Crushing and Screening:** Crushing and screening of DMS was extensively tested at multiple suppliers to confirm the technology and size the equipment. It was later decided to integrate this plant area into the Whabouchi concentrator.
- **Calcination:** Large scale pilot test work was performed with reputable suppliers of flash calciners. The test work demonstrated that under the right conditions the concentrate could be calcined and achieve high lithium extraction rates (> 95%).
- **Acid Bake:** Laboratory and pilot test work was performed to determine the required mixing and acid bake parameters to adequately sulfate the lithium and obtain a high lithium extraction. Impact of using recycled acid was extensively studied.
- **Leaching:** Multiple leaching laboratory and pilot tests were performed to determine optimum operating and design parameters. Belt filter sizing was determined through filterability and washability test work.
- **Impurity Removal:** A series of impurity removal tests were performed to meet the stringent feed requirements of the Electrochemical cells. The traditional impurity removal flow sheet was modified to improve efficiency and reduce equipment size. Lab scale and pilot scale test work investigated reagents and residence times to develop the proposed flow sheet. Test work was performed to determine filtering and thickening behavior and select and size the appropriate filters. Dedicated ion exchange tests were used to size the ion exchange columns. Test work showed that high purity solution meeting the electromembrane requirements could be produced.
- **Electromembrane Process:** Various phases of membrane electrolysis test work were performed by the Electrosynthesis Company. The objectives were to determine optimal operating parameters (concentration, current efficiency, current density, configuration, etc.) and to estimate membrane and anode life cycle. Long term stability of the process was demonstrated by a series of tests on a continuous basis totaling about 1,000 hours and referred to as the “1,000 hour test”. In addition, the Phase 1 Demonstration Plant (P1P) has operated for over a year bringing valuable insight into the operation and performance of the electrolysis cells.
- **LHM Crystallization and Drying:** LHM crystallization laboratory scale test work was performed. Pilot test work was also performed at a supplier to size the LHM dryer.

- Acid Concentration: Work was performed to develop the ternary phase diagram for the lithium sulphate – sulfuric acid – water system as a function of temperature. This included the solubility and to a more limited extent the boiling point curves. The experiments allowed the flow sheet structure to be confirmed and provided basic data for equipment design. Laboratory and pilot test work at suppliers provided further information to be used in equipment sizing and design.
- Multiple other tests were performed to gather data for proper engineering of the facility. This included: material handling properties, river water quality testing, materials of construction testing in the sulphation area, etc.

#### 1.11.2.2 Electrochemical Demonstration Plant – Phase 1 Plant – 2017-2019

The Phase 1 Plant is a ~1/65 scale demonstration plant with full scale electrolysis cells installed. It is designed for continuous operation, with complete instrumentation and DCS, allowing automated and safe operation. It can produce high quality lithium hydroxide monohydrate (LHM) from spodumene and recycled lithium sulfate salts. It has a nameplate capacity of 500 t/y of LHM crystal production from recycled lithium sulfate salts and 100 t/y of LHM from spodumene concentrate.

**Figure 1.3 – Phase 1 Plant Overview Picture - Purification and Crystallization Unit Operation**



The objectives of Nemaska in building and operating the Phase 1 demonstration plant in advance of starting commercial scale operation were multiple:



- To demonstrate its ability to repeatedly produce lithium hydroxide according to quality specifications as defined by customers including battery customers.
- To qualify its products with customers and sign off-take agreements before starting operation of the commercial plant.
- For the development of staff skills and internal processes and to provide strong foundations for the integration of new staff in the commercial plant.
- Process improvements made during the life of the demonstration plant and operational lessons learned can be integrated in the engineering of the commercial plant.
- To demonstrate the versatility of the process by also converting lithium sulfate salts (that are produced by some customers in their industrial processes) into lithium hydroxide.

The timeline for the Phase 1 Plant is as follows:

- May 2016 – P1P financing completed. The estimated total budget to build and operate the Phase 1 Plant for two years was established at \$38M;
- June 2016 – Beginning of construction at Shawinigan site;
- December 2016 – Phase 1 Plant operation team training;
- February 2017 – Start Electrolysis continuous operation on synthetic lithium sulfate solution from LiOH and H<sub>2</sub>SO<sub>4</sub>;
- March 2017 – First tonne equivalent of LiOH-H<sub>2</sub>O solution produced from synthetic lithium sulfate solution;
- April 2017 – Start Purification and Electrolysis on recycled lithium sulfate salts from a client;
- June 2017 – First tonnes equivalent of LiOH-H<sub>2</sub>O solution produced from recycled lithium sulfate salts meeting Johnson Matthey Battery Materials battery grade specification;
- October 2017 – Start processing spodumene concentrate feed while over 20 tons of LHM meeting our client specification were produced from lithium sulphate salts;
- December 2017 – First tonnes equivalent of LiOH-H<sub>2</sub>O solution produced from spodumene concentrate meeting battery grade specifications;
- February 2019 – First tonnes of LiOH-H<sub>2</sub>O crystals and samples to potential clients within 60 days of installing a fluid bed dryer and packaging equipment;
- May 2019 – Over 240 tonnes of Whabouchi spodumene concentrate processed and over 100 tonnes equivalent of LiOH-H<sub>2</sub>O produced from spodumene concentrate and/or recycled lithium sulfate salts. Phase 1 Plant continues to deliver High purity lithium hydroxide monohydrate commercial samples to potential clients internationally.

The Phase 1 Plant includes the following key unit operations:

- Acid bake pug mixer, kiln, and cooler;
- Leaching reactor and filter;



- PIR reactors and filter;
- SIR reactors and filter;
- TIR reactors and filter;
- IX columns;
- Electromembrane cells within electrolyzer;
- Crude and pure LHM crystallizer;
- LHM dryer
- Services.

When running on recycled lithium sulfate salts, the acid bake and leaching steps aren't used, and impurity removal is adapted for the specific feedstock.

Since the acid regeneration circuit is not present, the spent anolyte from electrolysis is recycled to PIR where it is neutralized.

The spodumene concentrate was sourced from the Whabouchi mine. Spodumene calcination was performed offsite by third-party suppliers.

Key operational learnings by process sectors:

- Lithium Extraction Circuit

Between Q4-2017 and Q1-2019, approximately 240 tonnes of Whabouchi spodumene concentrate were processed. Operational learnings influenced commercial plant materials selection to prevent premature corrosion and erosion of equipment;

- Purification Circuit

Conditions to produce gypsum with low lithium losses and removal of almost all metallic impurities;

- Electrolysis Circuit

Operation of commercial scale electrolysis cell at various current densities. Confirmation of key design parameters;

Conditions that affect membrane and anode life, and current efficiency. More than 5,000 hours of continuous operation to understand cell performance over time;

- Lithium Hydroxide Monohydrate Circuit

Confirmation of two step crystallization process configuration to obtain product quality. In Q1-2019 quality battery grade was confirmed for at least two (2) potential clients.

Since the beginning of its operation in Q1 2017 to Q1 2019, many of the objectives and milestones were achieved:

- Phase 1 Plant was operated in several campaigns and produced over 100 tonnes equivalent of LiOH-H<sub>2</sub>O produced from spodumene concentrate and/or recycled lithium sulfate salts. The plant was deliberately run at lower than nameplate capacity to ramp up and stabilize operation and adapt operation to match the availability of feedstock. This material qualified as battery grade as per typical market specifications.

**Table 1.4 – Nemaska Lithium LiOH-H<sub>2</sub>O Produced at P1P from Recycled Lithium Sulfate Solution**

Element	Unit	Market LiOH-H <sub>2</sub> O Specs* Span of Max Values	Nemaska LiOH-H <sub>2</sub> O Product measures
LiOH	% w/w	54.8 - 56.5	Min 56.5
Ca	mg/kg	10 - 100	< 4
Na	mg/kg	20 - 500	< 4
K	mg/kg	10 - 250	< 4
Mg	mg/kg	10	< 4
Fe	mg/kg	5 - 21	< 4
Al	mg/kg	10	< 4
CO <sub>2</sub>	% w/w	0.035 - 0.35	< 0.1
Cl	mg/kg	15 - 100	< 10
SO <sub>4</sub>	mg/kg	50 - 300	< 120
Cr	mg/kg	5 - 100	< 4
Cu	mg/kg	1 - 5	< 4
Ni	mg/kg	1 - 10	< 4
Si	mg/kg	20 - 30	< 4
Zn	mg/kg	10	< 4
Sol. Acid	mg/kg	40 - 1,000	< 50

\* Data from publicly available company product list

- Since the end of 2016, engineers, process specialists, support teams, key management staff, and 20 technical operators have been hired and trained to operate Phase 1 Plant. These highly skilled technicians have educational backgrounds in mechanical, chemical, and electrical disciplines as well as a range of technical work experience including chemical plant start-up. Both process safety reviews during engineering and skilled personnel proved to be efficient at preventing accidents during commissioning, start-up, and operation of the plant. This phase allowed the development of important internal processes and know-how required for the commercial phase.

- Learnings from Phase 1 Plant operation were transferred and integrated to the process and engineering design of the commercial concentrator. This mitigates many of the technical risks associated with new process development.

In 2019, the Phase 1 Plant will continue to produce LHM crystal from recycled lithium sulfate salts and/or spodumene concentrate from the Whabouchi mine, to further demonstrate and optimize the process, qualify product with clients, and to develop the know-how of the workers in advance of the start-up of the commercial process. In addition, optimisation tests will be done to increase current efficiency, increase lithium recovery in acid bake and leaching, reduce impurities concentration in electrolysis feed, reduce purge from the crude LHM crystalliser, and to extend life of resins of IX columns before regeneration, amongst others.

## 1.12 Mineral Resource Estimates

SGS Canada Inc. (“**SGS**”) completed the Mineral Resource update using the digital database supplied by Nemaska (as of January 25, 2019) which included channel data from trenches and drill holes data completed by Nemaska since 2009.

The aim of the updated mineral resource estimation was to better define the geological units present in the model and highlighting the presence of distinct mineralised and barren pegmatites in the geological model. The 2018-2019 geological interpretation also highlighted the presence of smaller parallel dykes and dykelets (1-3 m wide) close to the Main deposit, within the designated mining area outlined by previous open pit scenarios.

The database used to produce the Mineral Resource estimate was derived from a total of 617 channels and diamond drill holes, including historical diamond drill holes and un-assayed channels.

The Mineral Resource was estimated from a resource block model interpolated using ordinary kriging. The 2019 geological model was updated with the new exploration information from 2018; the analytical data contained within the wireframe solids was then normalized, to 2 m length composites. The composite data was used to interpolate the  $\text{Li}_2\text{O}$  grade of blocks by ordinary kriging on a regularly spaced defined grid that fills the 3-D wireframe solids.

The general requirement that all mineral resources have “reasonable prospects for economic extraction” implies that the quantity and grade estimates meet certain economic thresholds and that the mineral resources are reported at an appropriate cut-off grade taking into account extraction scenarios and processing recoveries. The Authors consider that the Whabouchi deposit mineralization is amenable for open pit extraction.

An optimized pit shell model was done by SGS in Whittle software in 2019 and using the completed block model. The interpolated blocks located below the bedrock/overburden interface, within the optimized pit shell and above a determined cut-off grade comprise the mineral resources. The blocks are then classified based on confidence level using proximity to composites, composite grade variance and mineralized solids geometry. The 3D wireframe modelling, block model, and mineral resource estimate were completed by SGS based on information provided by Nemaska.

The final mineral resource estimates within the open pit are reported at a cut-off of 0.30% Li<sub>2</sub>O and totals 17.734 Mt, with an average grade of 1.60% Li<sub>2</sub>O in the Measured category, 20.532 Mt, with an average grade of 1.33% Li<sub>2</sub>O in the Indicated category, with an additional 11.745 Mt, with an average grade of 1.27% Li<sub>2</sub>O in the Inferred category. Table 1.5 depicts the In-Pit mineral resource estimates.

The mineral resource estimates below the optimized pit are reported at a cut-off of 0.60% Li<sub>2</sub>O and totals 274,000 t of indicated resources with an average grade of 1.13% Li<sub>2</sub>O and 5.423 Mt of inferred resources with an average grade of 1.32% Li<sub>2</sub>O. Table 1.6 depicts the below pit mineral resource estimate.

**Table 1.5 – Whabouchi Deposit In-Pit Mineral Resource Estimate**

Cut-Off Grade (Li <sub>2</sub> O%)	Category	Tonnage* (t)	Average Grade (% Li <sub>2</sub> O)
0.30	Measured	17,734,000	1.60
0.30	Indicated	20,532,000	1.33
<b>0.30</b>	<b>Measured + Indicated</b>	<b>38,266,000</b>	<b>1.45</b>
0.30	Inferred	11,745,000	1.27

Note: The Mineral Resource estimate has been estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definitions Standards for Mineral Resource and Mineral Reserve in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects. Mineral resources which are not Mineral Reserve do not have demonstrated economic viability.  
 Inferred Mineral Resource are exclusive of the Measured and Indicated Resources.  
 Bulk density of 2.71 t/m<sup>3</sup> is used.  
 Effective date is June 26, 2019  
 Blocks centers were used as extraction factor for the overburden and pit surfaces  
 \* Rounded to the nearest thousand.  
 Blocks from Bulk sample area were taken out from Block Model.  
 Mineral resources on the Pad of 19,200 t at 1.56% Li<sub>2</sub>O are included in the Measured category

**Table 1.6 – Whabouchi Deposit Below Pit Mineral Resource Estimate**

Cut-Off Grade (Li <sub>2</sub> O%)	Category	Tonnage* (t)	Average Grade (% Li <sub>2</sub> O)
0.60	Measured	--	--
0.60	Indicated	274,000	1.13
<b>0.60</b>	<b>Measured + Indicated</b>	<b>274,000</b>	<b>1.13</b>
0.60	Inferred	5,413,000	1.32

Note: The Mineral Resource estimate has been estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definitions Standards for Mineral Resource and Mineral Reserve in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects. Mineral resources which are not Mineral Reserve do not have demonstrated economic viability.  
 Inferred Mineral Resource are exclusive of the Measured and Indicated Resources.  
 Bulk density of 2.71 t/m<sup>3</sup> is used.  
 Effective date is June 26, 2019  
 Blocks centers were used as extraction factor for the overburden and pit surfaces  
 \* Rounded to the nearest thousand.

## 1.13 Mineral Reserve Estimates

The Whabouchi deposit will be mined using conventional open pit mining for the first 26 years of operation, followed by seven (7) years of underground mining. The Project life of mine (“**LOM**”) plan and subsequent Mineral Reserves are based on a lithium Spodumene concentrate selling price of \$800/t CAD. The effective date of the Mineral Reserve estimate is July 5, 2019.

Development of the LOM plan included pit optimization, pit design, mine scheduling and the application of modifying factors to the Measured and Indicated Mineral Resources. The reference point for the Mineral Reserves is the feed to the primary crusher. The tonnages and grades reported are inclusive of mining dilution, geological losses and operational mining losses.

### 1.13.1 OPEN PIT MINERAL RESERVE

The first step in estimating the Mineral Reserves for the open pit component of the Whabouchi deposit was to convert the mineral resource block model into a sub-blocked model for the purpose of estimating mining dilution and ore losses. This step was completed using the 3D wireframes for the mineralized pegmatite dykes, the non-mineralized pegmatite dykes, and the bedrock contact that were provided by SGS. The host waste rock around the pegmatite dykes was modelled as amphibolite.

The next step in estimating the open pit Mineral Reserves was to run a mineable shape optimizer (“**MSO**”) tool to evaluate the mining dilution and operational losses that can realistically be achieved using the selected mining fleet and operational conditions. The MSO tool resulted in a total mining dilution of 14.1% and a mining recovery of 96.7% within the open pit. Upon completion of the mining dilution and ore loss modelling, the sub-blocked model was regularized in order to complete the following steps of the open pit mine design work.

A pit optimization analysis was carried out to determine the part of the orebody that is economic to mine using open pit methods. The pit optimization was based on mining and processing costs, revenue per block and operational and technical parameters such as the mill recovery, concentrate grade, pit slopes and other imposed constraints. The pit optimization analysis produced a series of pit shells whose discounted cash flows were calculated and evaluated to select the optimum pit shell. The optimum pit shell was then used as a guide for the open pit design.

The open pit design was done following the recommendations from a geotechnical pit slope stability analysis that was updated for the project in 2019. The design incorporates 12 m high benches, a 25 m wide haul ramp at a maximum grade of 10% and a minimum mining width of 30 m. The ultimate open pit for the Whabouchi deposit is approximately 1,300 m long and 350 m wide at surface and has a total surface area of roughly 42 ha. The deepest part of the pit is 210 m below surface.

Table 1.7 presents the Mineral Reserves that have been estimated for the open pit component of the Whabouchi deposit which include 18.3 Mt of Proven Mineral Reserves at an average grade of 1.41% Li<sub>2</sub>O and 9.6 Mt of Probable Mineral Reserves at an average grade of 1.18% Li<sub>2</sub>O for a total of 27.9 Mt of Proven and Probable Mineral Reserves at an average grade of 1.33% Li<sub>2</sub>O. In order to



access these Mineral Reserves, 1.3 Mt of overburden and 75.2 Mt of waste rock must be mined, resulting in a stripping ratio of 2.7:1.

**Table 1.7 - Whabouchi Open Pit Mineral Reserves**

Category	Tonnes (Mt)	Li <sub>2</sub> O Grade (%)
Proven	18.3	1.41
Probable	9.6	1.18
<b>Proven and Probable</b>	<b>27.9</b>	<b>1.33</b>

- The Mineral Reserves are above a cut-off grade of 0.4% Li<sub>2</sub>O.
- The Mineral Reserves are based on a Spodumene concentrate selling price of \$800/t CAD delivered to the hydrometallurgical plant in Shawinigan at an average concentrate grade of 6.25% Li<sub>2</sub>O.
- The Reference Point for the Mineral Reserves is the feed to the primary crusher.
- The open pit Mineral Reserves for the Whabouchi deposit have been estimated by Mr. Jeffrey Cassoff, P. Eng. OIQ#5002252, a Qualified Person as defined by NI 43-101
- The effective date of the Mineral Reserves is July 5, 2019.

#### 1.13.2 UNDERGROUND MINERAL RESERVE ESTIMATE

Table 1.8 presents the Mineral Reserves that have been estimated for the underground component of the Whabouchi deposit. Table 1.9 presents the combined open pit and underground Mineral Reserves that have been estimated for the Whabouchi deposit.

**Table 1.8 - Whabouchi Underground Mineral Reserves**

Category	Tonnes (Mt)	Li <sub>2</sub> O Grade (%)
Proven	0.7	1.42
Probable	8.0	1.20
<b>Proven and Probable</b>	<b>8.7</b>	<b>1.21</b>

**Table 1.9 - Whabouchi Combined Mineral Reserves**

	Category	Tonnage (Mt)	Li <sub>2</sub> O Grade (%)
<b>Open Pit (OP)</b>	Proven	18.3	1.41
	Probable	9.6	1.18
	<b>Proven and Probable</b>	<b>27.9</b>	<b>1.33</b>
<b>Underground (U/G)</b>	Proven	0.7	1.42
	Probable	8.0	1.20
	<b>Proven and Probable</b>	<b>8.7</b>	<b>1.21</b>
<b>Total OP &amp; U/G</b>	Proven	19.0	1.41
	Probable	17.6	1.19
	<b>Proven and Probable*</b>	<b>36.6</b>	<b>1.30</b>

\* due to rounding errors, totals may not add-up exactly.

## 1.14 Mining Methods

The Whabouchi deposit characteristics make open pit mining more favourable from a technical and economic standpoint because of its proximity to surface. Open pit mining will, therefore, be favoured for the upper portions of the deposit. However, open pit mining is commonly associated with more significant environmental and social impacts than underground mining, essentially because of the associated larger surface footprint. In order to mitigate environmental and social effects of the projected mine, where geological characteristics and economic factors made it feasible to switch to underground mining, the latter was favoured.

Consequently, from Year 26, the mine will be operating from underground, thus not only limiting the surface footprint of the ultimate open pit, but also minimizing the amount of waste rock to be managed and stockpiled at the surface. Such an approach also enables a longer mine life without significantly increasing the surface area impacted by mining activities, something which extends the duration and cumulative importance of the Project's economic spin offs for local, regional and provincial stakeholders.

### 1.14.1 OPEN PIT MINING

The mining method selected for the Project is a conventional open pit, truck and shovel, drill and blast operation. Vegetation, topsoil and overburden will be stripped and stockpiled for future reclamation use. The ore and waste rock will be drilled and blasted with 12 m high benches and loaded into haul trucks with mining backhoes in 6 m flitches.

Phases, also referred to as pushbacks, have been designed to access ore quicker and to defer waste stripping. A total of three (3) phases were designed in addition to the ultimate pit design. A minimum working width of 40 m between phases was considered acceptable based on the size of the mining equipment and the proposed scale of mining operations.

The overburden stripped from the open pit will be placed in the overburden stockpile and used for future closure and reclamation activities. The overburden stockpile is located to the east of the open pit and south of the concentrator facilities.

The waste rock excavated from the open pit will be hauled to and placed with the tailings in the co-disposal storage facilities. Co-disposal involves the construction of waste rock cells in which fine tailings are disposed. Mixing the fine and coarse waste reduces the empty void space primarily associated with coarse waste streams, while simultaneously increasing the strength of the fines. Tailings produced at the concentrator will have a moisture maximum content of around 15%. The tailings will be transported from the concentrator to the waste rock pile with the same fleet of 64 tonne haul trucks that will be used in the open pit mine.

The life of mine ("**LOM**") plan for the open pit was completed using MSSO (MineSight Schedule Optimizer) and was scheduled monthly for the first four (4) years and annually thereafter. The mine plan includes a pre-production period of ten (10) months, which begins in June 2019 and lasts until March 2020. The pre-production phase will be used to build the haul roads, prepare the co disposal

storage facility, stockpile 80,000 tonnes of ore, and to develop the open pit for mine production. During pre-production only one shift per day will be in operation. The concentrator is scheduled to begin to receive ore feed in April 2020 and will gradually ramp up to 100% of its nominal production capacity which is targeted for May 2021. Mining of the open pit is planned to be completed in 2045 when the mine will convert to an underground operation.

The ore production in the mine plan is limited to the maximum feed of the DMS plant which is 949 kt/y. A 5% increase in the DMS plant capacity was considered as of 2023, bringing the annual limit to 996 kt. The maximum material mined from the open pit in any given year is 5.5 Mt.

Mining operations for the Project are based on two (2) 12-hour shifts per day, seven (7) days per week, for 50 weeks per year. The fleet calculations consider seven (7) days of lost mine production due to inclement weather. The mine will operate on day shift only until June 2020 when the night shift operations will begin.

The mining equipment fleet will be owner operated with the exception of the production drilling which will be carried out on a contract basis. In full production, the open pit mining operation will have two (2) PC1250SP-11 mining backhoes, seven (7) HD605-8 haul trucks, three (3) WA600-8 wheel loaders as well as a fleet of support and service equipment. In addition to supporting the open pit mining operations, the fleet of wheel loaders will be used to feed the primary crusher from the ore stockpile, feed ore to the DMS, and load the tailings and ore sorter rejects into the haul trucks.

Drilling and blasting will be done using bulk emulsion which will be transported to site by an explosives supplier using 20,000 kg tankers. The explosives supplier will provide down the hole service.

The total workforce for the open pit operation including supervision, mine equipment maintenance, and mine technical services is expected to reach a peak of 129 employees.

#### 1.14.2 UNDERGROUND MINING

The ore extraction will switch from an open pit operation to an underground mine located underneath the pit floor. The duration of the underground mining is seven years and planned to be in operation from second quarter of 2045 to the end of 2052. An underground mine production ramp up period of four (4) months is planned during the second and third quarters of 2046 to reach the annual production rate of 1.3 M tonnes of ROM.

The underground mine development and operation will be awarded to a mining contractor who will excavate and haul the ore and waste from underground to a rolling stockpile located at the bottom of the open pit. Hauling of the ore and waste from the bottom of the pit to the crusher and the waste disposal area along with the mine tailings operation will continue to be managed directly by the owner's personnel and the mobile equipment fleet from the open pit operation. The underground mine will be operated on two (2) shifts of ten (10) hours, seven (7) days per week.

The mining methodology selected is 30 m high long-hole type stopes. Based on the favorable geotechnical and hydrogeological conditions, backfilling of the excavated stopes will not be required. The very last excavation phase consists of mining the 30 m thick remaining crown pillar from the open pit floor.

The mine design is purposely kept as simple as possible in order to minimize the development capital expenditure due to the period of seven (7) years of the remaining life of mine of the project. Halfway down in the western area of the open pit, an underground entry portal to a main ramp driven downward will provide access to the six (6) horizontal haulage drifts which in turn provides access to the draw points of the various stopes.

The annual production requirement is the same as the full regime of the open pit extraction period with yearly lithium concentrate production ranging from 201 to 221 k tonnes. An overlapping underground mine ramp-up production period of four (4) months with a target ROM production of 300 k tonnes is planned with the open pit ore extraction finishing at the end of Year 26. This will ensure an uninterrupted ROM feed to the concentrator.

The underground mine work schedule will be similar to the open pit operation with two (2) shifts per day, seven (7) days per week and 50 weeks per year. The shifts will be ten (10) hours with two (2) hours between shifts for clearing of the blasting fumes.

The contractor will supply and operate the underground mining fleet consisting of development jumbos (2), production drills (2), LHDs (3) and haulage trucks (4). The underground haulage trucks will haul the ore and waste up to the mine portal where it will be dumped into stockpiles to be reclaimed by the Owner and hauled out of the pit to the crusher or waste dump.

The underground mine will require 86 employees for the development phase while 70 will be required during the production phase, excluding Owner's management and engineering team and waste and tailings personnel.

## 1.15 Recovery Methods

### 1.15.1 WHABOUCHI CONCENTRATOR

The Whabouchi concentrator is located at 675 m north east of the open pit mine. The concentrator is designed to produce a nominal 215,000 tonnes of spodumene concentrate per year. The Run-of-Mine ("ROM") mineralized material will be fed into the primary jaw crusher and then screened 15 to 80 mm to enable efficient selection by the ore sorters. The sorted material will then go to the secondary and tertiary cone crushers. The final crushed product will be stored into a stockpile at the concentrator.

The crushed mineralized material will be screened on the fine ore screen and the oversize will be upgraded in a dense media circuit after a stage of mica hydroseparation removal to produce a coarse spodumene concentrate, a tailings product and a middlings product. The DMS coarse concentrate will then be dried in a rotary dryer before treatment by a dry magnetic separation system. The

magnetic product will be discarded with the tailings and the non-magnetic product will be the first portion of the final spodumene concentrate. In Phase 2, this product will be crushed to less than 1 mm.

The DMS middlings product will be ground to less than 0.85 mm and combined with fine ore screen undersize. This ground product feeds a fine stage of mica hydroseparation removal and then goes to flotation circuit. The flotation circuit consists of de-sliming, wet magnetic separation, attrition and finally 2-stages of spodumene flotation. The flotation is performed at coarse size (850  $\mu\text{m}$  /+ 200  $\mu\text{m}$ ) in a hydro float separation unit and at fine size (200  $\mu\text{m}$  / 20  $\mu\text{m}$ ) by flotation columns circuit.

Tailings from DMS concentration, dry magnetic separation, mica hydroseparation, de-sliming, wet magnetic separation and flotation will be dewatered by a combination of screen dewatering, thickening and filtration before storage into a dome. The tailings will be transported by haul truck to the co-disposal area with mine waste.

The spodumene flotation concentrate will be thickened and filtered by a belt filter pressure filter to less than eight percent (8%) moisture. In Phase 2, the concentrate will be dried using a rotary dryer to one and half percent (1.5%) moisture. The dry flotation concentrate will be combined with the dry DMS concentrate for transport by road trucks to Matagami or possibly Chibougamau. The shipped concentrate will have moisture of less than five percent (5%) to prevent freezing during the winter months. In Phase 2, this concentrate will be always less than two percent (2%). In Matagami or possibly Chibougamau, the concentrate will be transferred into railcars for transport to the Shawinigan Electrochemical plant for further processing.

#### 1.15.2 SHAWINIGAN ELECTROCHEMICAL PLANT

Electrochemical plant process design criteria, mass balance, process flow sheets, equipment list as well as plant layouts were prepared for a plant design feed rate of 215,000 t/y (dry) of 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate and a lithium sulfate feed rate of 2,000 tonnes per year  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$  eq. (dry). The Electrochemical plant is designed to produce 37,000 t/y lithium hydroxide monohydrate crystals (LHM) (approximately 33,000 t/y of Lithium Carbonate Equivalent (“LCE”). The plant is scheduled to operate seven (7) days per week and 24 hours per day. The plant availability has been estimated at 85% based on benchmarks with comparable industries and dynamic simulation availability analysis. The overall lithium recovery is based on laboratory results and extensive mass balance modeling.

A summary of the key design criteria is given in Table 1.10.

The plant feed consists primarily of a blend of Dense Media Separation (“DMS”) concentrate and flotation concentrate which has been dried and crushed at Whabouchi to the appropriate size for calcination. The spodumene concentrate is transported from the mine and concentrator site to the process plant in bottom dump type railcars. It is unloaded at the site and stored in a silo.

The first major process step is the calcination of the concentrate where the spodumene mineral is converted from the alpha to the beta form.



**Table 1.10 – Electrochemical Plant Design Criteria – Summary**

Parameters	Unit	Value
Site	Text	Shawinigan
Future Expansion	Text	No
Concentrate Design Processing Rate	tonne per year (dry)	215,000
Concentrate Composition	% DMS /% Flotation	42 / 58
Concentrate Grade (Total)	% Li / Li <sub>2</sub> O	2.9 / 6.25
Concentrate% Moisture	% H <sub>2</sub> O	0.5%
Concentrate Size Distribution F95	microns	1,000
Lithium Sulfate Feed Rate	tonne per year Li <sub>2</sub> SO <sub>4</sub> H <sub>2</sub> O eq. (dry)	2,000
Plant Operating Time	hours per day	24
Overall Plant Availability	%	85
Lithium Hydroxide Monohydrate Design Production	tonne per year	37,000
Lithium Hydroxide Monohydrate Product Moisture	%	≤0.1
Lithium Hydroxide Monohydrate Product Grade	% LiOH-	≥57.5 (< 20 ppm Na)
Overall Lithium Recovery	%	94.9

The beta-spodumene is then mixed with sulfuric acid in a pug mixer and the blend of acid and mineral is sent to an acid-bake kiln. The heat provided in the kiln allows the reaction of oxides with the sulfuric acid to make sulfates (mostly lithium sulfates, but also minor amounts of sulfates of select impurities).

The acid bake product is mixed with water in the leach process step. The sulfates dissolve in the water while the gangue material remains insoluble. The leach slurry is sent to a belt filter that separates the gangue mineral (a form of aluminum-silicate) from the Pregnant Leach Solution that contains the lithium sulfates and certain impurities.

The Pregnant Leach Solution is combined with purchased lithium sulfate solution (when available) and then undergoes three (3) purification and filtration steps: Primary Impurity Removal (“**PIR**”), Secondary Impurity Removal (“**SIR**”) and Tertiary Impurity Removal (“**TIR**”). The solution is polished in an Ion Exchange (“**IX**”) system that removes trace amounts of remaining calcium and magnesium. These three (3) purification steps and Ion Exchange remove many impurities including, excess acid, calcium, silicon, iron, aluminum, manganese and magnesium.

The IX polished solution is fed to the electrolyzers. During this process, lithium sulfate is converted to lithium hydroxide (catholyte solution) and sulfuric acid (anolyte solution). The anolyte solution is sent to Sulfuric Acid Concentration where excess water is evaporated to create a suitably strong

regenerated acid. The regenerated acid is recycled to the pug mixer along with fresh make-up acid. The catholyte from electrolysis is sent to the LHM Crystallization step.

A double crystallization process produces pure LHM crystals and condensate that is fully re-used in the process. The LHM crystals are dried and bagged to produce LHM crystals for sale. A small bleed stream from the LHM crystallization is sent to a treatment unit where lithium is recovered, and sodium and potassium are purged.

A simplified flow sheet is presented in Figure 1.4 and summarizes the electrochemical plant process.

## **1.16 Project Infrastructure**

### **1.16.1 WHABOUCHI CO-DISPOSAL STORAGE FACILITY**

Co-disposal methodology will be used for the storage of the tailings produced at the concentrator and the waste rock from the mine. The adopted co-disposal methodology consists of confining filtered tailings into waste rock cells.

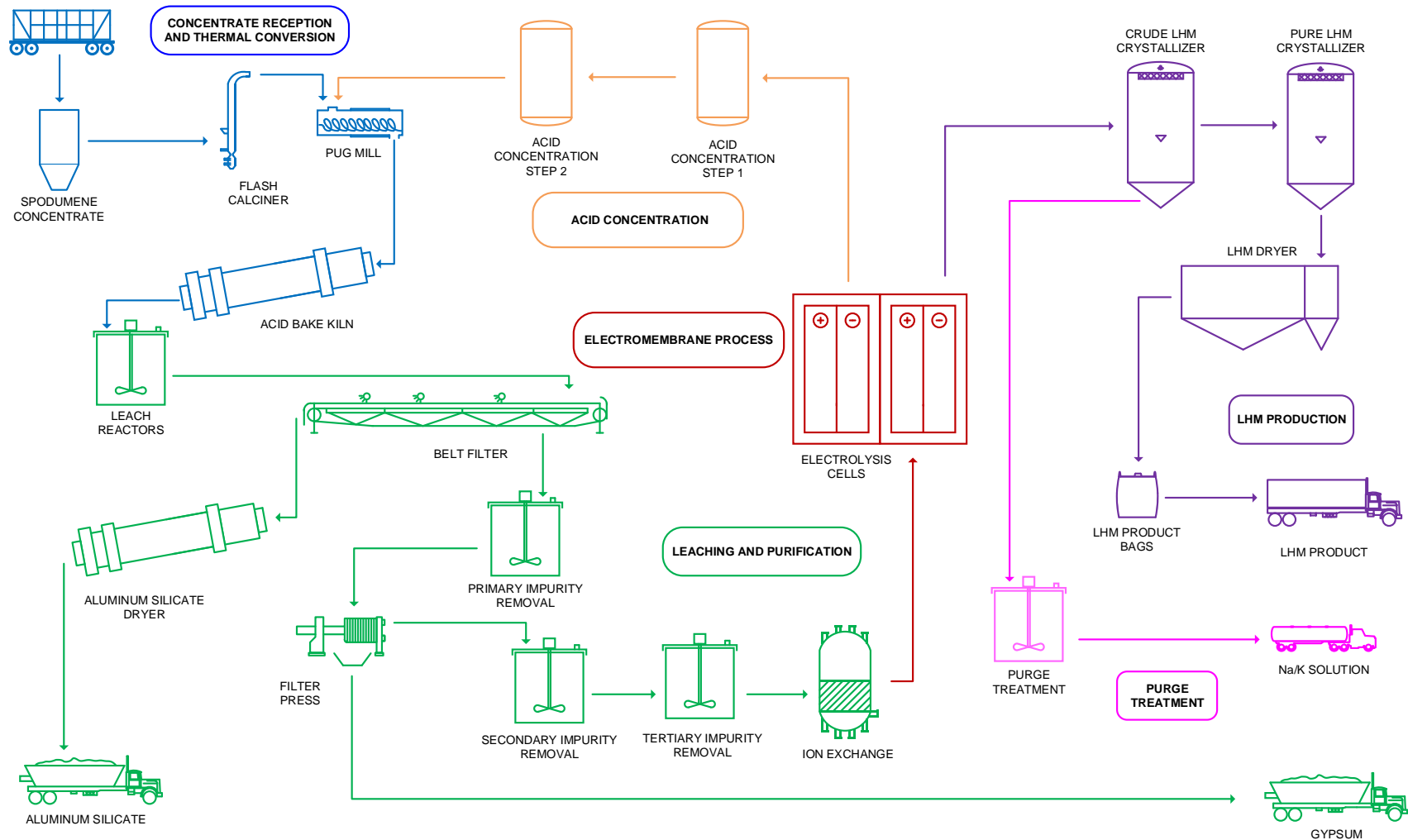
With both open-pit and underground mining, the lifespan of the Project will be 33 years and will generate 52.4 Mm<sup>3</sup> of material. Four (4) co-disposal storage facilities located north of the Route du Nord were designed, all located on the Whabouchi Mining Property. All the waste rock and filtered tailings will be contained in these co-disposal storage facilities, except six (6) Mm<sup>3</sup> of waste rock that is expected to be disposed in the open pit mine that could be used as backfill material for the underground operation.

### **1.16.2 WHABOUCHI CONCENTRATOR**

The Whabouchi mine site is located at km 276 on the Route du Nord public road. The infrastructure required to service a project in a remote location and fulfil the needs of the workers is significant and comprises the following facilities with their current status (in parenthesis):

- Project access and Gate House (completed);
- Maintenance Garage (completed with minor work to complete);
- Administration Office and Construction Camp Facilities (completed and operational);
- Construction Camp Facilities (completed and operational);
- Laboratories (in fabrication);
- Fuel Tank Farm (currently being designed);
- Fresh water supply (completed and operational);
- Fire protection (Fire water network installed around concentrator, pump station ready for installation);
- Sewage Treatment (temporary facilities in place);
- Electrical sub-station, power supply and distribution (completed with minor modifications remaining).

Figure 1.4 – Lithium Electrochemical Plant Simplified Flow Sheet



### 1.16.3 SHAWINIGAN ELECTROCHEMICAL PLANT

The Electrochemical plant will be located in the City of Shawinigan, QC on the site of an old pulp and paper mill. The infrastructure that have been planned in addition to the process plant include the following:

- Upgrade of the existing rail network;
- Spodumene reception and unloading facilities;
- Sub-station, power distribution;
- Residues/by product handling;
- Site services;
- Site buildings;
- Roads;
- Guard house;
- Control system;
- Communication system.

### 1.17 Market Studies and Contracts

The market study is mostly based on Lithium: Outlook to 2028, 16<sup>th</sup> edition, published by Roskill Consulting Group Ltd (“**Roskill**”), an independent and experienced consultant, on July 5, 2019. The main conclusions from their report are:

- Demand for battery-grade lithium hydroxide is expected to grow at 35.3% Compound Annual Growth Rate (“**CAGR**”) between 2018 and 2028;
- Lithium hydroxide expected growth demand is mainly related to secondary batteries use over the next years;
- The prices for technical grade and battery grade lithium hydroxide are expected to range between \$14,000 to \$18,400 USD from 2022 to 2028.

At the date of this Technical Report, Nemaska has three (3) commercial off-take agreements in place totalling about 14,000 t/y LCE and valid between 60 and 120 months from the start of commercial production. There is one (1) established contract for the sale of spodumene concentrate for the material that will be produced at Whabouchi Mine before production starts at the Shawinigan electrochemical plant.

Based on the information supplied by Roskill, the current off-take contracts in place and information gathered through discussions with potential customers and other sources, Nemaska has established its sale prices as follows (on a per metric ton basis):

- Lithium Hydroxide (EXW Shawinigan): \$14,000 USD;
- Spodumene Concentrate Sales (FOB Port of Trois-Rivières): \$600 USD.

## 1.18 Environmental Studies, Permitting and Social or Community Impact

For the Whabouchi Mine Project, a first version of the Environmental and Social Impact Assessment (“**ESIA**”) document was submitted to both federal (Canadian Environmental Assessment Agency) and provincial (Review Committee of the James Bay and Northern Quebec Agreement, or “**COMEX**”) authorities for review in April 2013. Questions and comments on that first version were sent by those authorities to Nemaska Lithium late in 2013. Nemaska Lithium provided answers to all questions in early May 2014.

The COMEX held public hearings in March-April 2015; as well, other forms of consultation were organized by Nemaska and/or the Cree Nation of Nemaska, enabling the COMEX to consider the concerns of the people in the territory and ensure they were accounted for in the Whabouchi Mine Project and reflected in the General CA. On September 4, 2015, following a positive recommendation by the COMEX, the Provincial Administrator of the James Bay and Northern Quebec Agreement granted authorization for the Project and Nemaska Lithium announced that it has received the General CA for the Whabouchi Project from the MELCC.

On July 29, 2015, following a comprehensive assessment of the Whabouchi Mine Project, the Canadian Minister of Environment decided that the Project is not likely to cause any significant adverse environmental effects, and set out in its positive decision statement the conditions relative to the mitigation measures and monitoring program to be respected by Nemaska Lithium. The Agency issued on that same date its final EA report.

Nemaska Lithium has already begun and is continuing to fulfill the provisions included in the General CA for Whabouchi, and the authorization application and permitting process for construction was started in Q1-2016. Applications are being filed in a timely manner with the construction works and have therefore no impact on Project schedule.

The Electrochemical Plant will be located in Shawinigan using part of the former Resolute Forest Products (“**RFP**”)’s Laurentide pulp and paper mill buildings. MELCC has indicated that this part of the Project will need only a Certificate of Authorization (“**CA**”) and not a complete ESIA. The legal framework for the construction and operation of the projected facilities is a combination of provincial, national, and municipal policies, regulations and guidelines.

The permitting process has been fully identified and applications are being filed concurrently with the construction works and should therefore not impact the Project schedule. Since construction works are to take place within existing buildings, most of the environmental permits and authorizations are only needed for infrastructure located outside of the existing buildings and for the operations to be initiated.

### 1.18.1 WATER AND TAILINGS MANAGEMENT AT THE WHABOUCHI MINE

The mine water management plan addresses the management of runoff water collected in the open pit, industrial area, mining stockpiles, overburden/topsoil stockpile and co-disposal storage facilities at the Whabouchi mine site.



The water management infrastructure (i.e. ponds, ditches and pumping requirements) are sized based on the required volume of surface runoff to manage, which varies according to the catchment area of the co-disposal storage facilities. A total of 13 water collection ponds, located in strategically selected areas, are required to manage the surface runoff and pit dewatering on the Whabouchi mine site.

The final effluent pipeline of Whabouchi mine will direct water from the collection ponds (BC-1 and BC-11) to the final effluent in the Nemiscau River with regular monitoring of flow and water quality in full compliance with applicable laws, regulations and standards. It should be noted that multiple ponds designed for the Project will serve as polishing ponds for suspended solids sedimentation and an active water treatment plant will be installed if required.

With regards to tailings management, best economically and technically available technologies have been integrated to the Project design so that filter-pressed tailings will be produced at the mine site and co-disposed with waste rocks on a dedicated pile (Co-Disposal Storage Facility).

## **1.19 Capital and Operating Costs**

### **1.19.1 WHABOUCHI MINE SITE, CHIBOUGAMAU, AND MATAGAMI**

#### **1.19.1.1 Capital Cost**

The Whabouchi Scope covered in this estimate is based on the remaining construction work as at the end of May 2019 of the green field facilities at Whabouchi mine site, the Matagami transfer site and expended costs at Chibougamau.

The initial Capex consists of the direct and indirect costs, rehabilitation costs, as well as expended costs to May 31, 2019 that are considered for economic analysis purpose. The indirect costs include EPCM and Owner's costs. A contingency of 11% is also included.

The total provision for closure and rehabilitation is \$9.2 M, of which \$6.9 M was paid previous to May 31, 2019 and the balance paid in June 2019 and also included in the actual costs to date (May 31, 2019).

Table 1.11 shows the summary Capex for Whabouchi, Chibougamau, and Matagami.

#### **1.19.1.2 Operating Cost**

The Operating cost was estimated for the Whabouchi Mine operation and concentrate transport up to the Electrochemical plant and cover the costs related to ore extraction, spodumene concentration, management of tailings, waste and water, General and Administration costs including site services, transport and lodging of workers and operation expenses and concentrate shipping to the Electrochemical plant.

The operating cost was based on a concentrate production rate of 205,364 t/y (dry),

The average operating cost estimate is summarized in Table 1.12.

**Table 1.11 –Whabouchi / Chibougamau / Matagami Capex (\$M CAD)**

Description	Actuals to Date	Estimate to Complete	Estimate at Completion
<b>Whabouchi / Chibougamau / Matagami Site Capex</b>			
Total Direct Costs	125.7	138.7	264.4
Total Indirect Costs	87.7	39.7	127.4
Nemaska Corporate Costs	0.0	27.8	27.8
Contingencies	0.0	18.3	18.3
Rehabilitation Payment Year (-1)	9.2	0.0	9.2
<b>Total Whabouchi / Chibougamau / Matagami Site Capex</b>	<b>222.6</b>	<b>224.5</b>	<b>447.1</b>
The totals may not add up due to rounding errors.			

**Table 1.12 – Average Annual Operating Cost Estimate for Whabouchi**

Description	Operating Cost (\$/y)	Average Operating Costs <sup>2</sup> (\$/t of Concentrate)
Mining (Open Pit Year 1 to 26)	24,850,366	121.01
Stockpile Re-handle, Tailings, Ore Sorter Rejects, DMS Loading (Open Pit Year 1 to 26)	3,418,318	16.65
Tailings and Water Management Cost	14,595	0.07
Mill Operating Cost	22,307,680	108.63
G & A Operating Cost	20,492,778	99.79
Concentrate Transport Cost	17,742,218	86.39
<b>Total <sup>1</sup></b>	<b>88,825,955</b>	<b>432.53</b>
1) Based on Year 2021 to 2025 average mill throughput of 1,086,990 tonnes per year.		
2) Based on Year 2021 to 2025 average spodumene concentrate production of -205,364 tonnes per year		

## 1.19.2 SHAWINIGAN ELECTROCHEMICAL PLANT

### 1.19.2.1 Capital Costs

The capital cost estimate consists of the direct and indirect costs. The indirect costs include the EPCM and owner's costs. A contingency of 16% on the remaining capital costs is also included. Table 1.13 shows the Shawinigan site Capex costs.

**Table 1.13 – Shawinigan Site Capex (\$M CAD)**

Description	Actuals to Date	Estimate to Complete	Estimate at Completion
<b>Shawinigan Site Initial Capital Cost</b>			
Total Direct Costs	68.2	450.1	518.3
Total Indirect Costs	49.1	127.5	176.6
Contingency	0.0	92.3	92.3
Nemaska Corporate Costs	0.0	28.3	28.3
Labour Cost Escalation	0.0	5.9	5.9
<b>Total Shawinigan Site Capex</b>	<b>117.3</b>	<b>704.1</b>	<b>821.4</b>
The totals may not add up due to rounding errors.			

### 1.19.2.2 Operating Costs

Operating costs were estimated for the Electrochemical plant and cover the costs related to the transformation of spodumene concentrate and lithium sulfate into lithium hydroxide monohydrate crystals.

The operating cost estimate includes reagents, consumables, rental equipment, personnel, power, fuel, maintenance and various other indirect costs.

The following items are not included in the operating cost estimate and are treated in the financial analysis, either because they normally vary with time, or because they reflect a temporary situation associated with the first years of operation:

- Normally vary with time:
  - Cost of Whabouchi concentrate and related shipping costs (production varies with mine plan);
  - Cost of concentrate purchased from the market to make-up for any variations in Whabouchi concentrate supply due to the mine plan (annual tonnage and/or grade of concentrate);
  - Cost of Green House Gas (GHG) emissions
- Temporary situations associated with the first years of operation:

- Improvements in electrolysis current efficiency over the first four years as production experience improves;
- Electricity cost discounts (Hydro-Québec electricity cost reduction program for clients at tariff L which provides 20% discount on the electricity cost for 4 years for clients that invest in installations in Quebec);
- Disposal costs for aluminum silicate by-product over the first five (5) years;
- Disposal cost of purge solution over the first five (5) years;
- Increased operations and maintenance manpower for the first four years;
- Increased maintenance costs (materials and external maintenance costs) during first two years of operation;
- Property tax credit for the first 5 (five) years equivalent to 75% of the amount by which the taxes increase due to the property modifications.
- Debottlenecking projects during the first four (4) years of operation;
- Other:
  - Cost of lithium sulfate and related shipping costs are included in the financial analysis to be coherent with the financial treatment of the concentrate.

The following items are excluded from the operating cost estimate:

- Corporate costs shared between the concentrator and the electrochemical plant, such as, General and Administrative Costs, R&D, etc. These are treated separately.
- A contingency of 5-10% is typically applied to operating cost estimates to cover the risks related to assumptions made during the estimate development (see Section 25.2). No contingency is included in the current estimate.

Quantities used in the operating costs are based on the heat and mass balance for reagents, the heat and mass balance and supplier information for utilities, and the equipment list for power.

The sources of pricing used to develop the operating costs include standard rate sheets (electricity), budgetary pricing (other utilities, reagents, residues), technical literature (maintenance), existing Nemaska experience from the demonstration plant (salaries, manpower) and detailed estimates by Nemaska for general expenses.

The expected operating costs for the design conditions are summarized in Table 1.14.

Design conditions assume:

- Ramp-up to full capacity is complete and all equipment is operating at the design efficiency;
- The facility receives 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate at a feed rate of 215,000 t/y (dry), lithium sulfate at a feed rate of 2,000 t/y  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$  eq. (dry), and produces lithium hydroxide monohydrate at a rate of 37,000 t/y (dry);

- Aluminum silicate is sold at net zero cost to Nemaska. Gypsum is disposed. Purge solution is sold or disposed at net zero cost to Nemaska.

**Table 1.14 – Average Annual Operating Cost Estimate Shawinigan**

Cost Item	Total Operating Cost ****(\$M CAD /y)	LiOH.H <sub>2</sub> O (\$CAD /t)
<b>Direct Costs</b>		
Plant Operations	26.99	728
Utilities	25.37	685
Maintenance	21.38	576
<b>Indirect Costs</b>		
General Administration Personnel	1.15	31
Management Staff	0.51	14
General Expenses	2.78	75
Tax & Insurance***	4.88	132
Other External Services	0.50	13
<b>Total</b>	<b>83.6</b>	<b>2,253</b>

\* Cost of concentrate from Whabouchi or purchased from market and cost of lithium sulfate solution are not included in the Opex, but are included in the financial analysis.  
 \*\* Assumes no cost for aluminum silicate or purge disposal  
 \*\*\* Cost of GHG emissions is not included in the Opex but is included in financial analysis.  
 \*\*\*\* Excludes those costs treated in the financial analysis

Fixed and variable costs are summarized for the design conditions in Table 1.15. These costs are also used to estimate production costs during production ramp-up. Reagents, consumables, by-product disposal costs, electricity for the electrolysis cells and fuel are considered variable costs. All other costs are considered fixed.

**Table 1.15 – Average Annual Operating Cost Estimate – Fixed Versus Variable Costs**

Description	Total Operating Cost* (CAD M\$/y)	CAD\$/t LiOH.H <sub>2</sub> O
Variable Costs	36.3	978
Fixed Costs	47.3	1275
<b>Total</b>	<b>83.6</b>	<b>2,253</b>

\* Excludes those costs treated in the financial analysis

## 1.20 Economic Analysis

An economic assessment based on the production and costs parameters of the Project has been carried out. Q2-2019 price projections in U.S. currency and cost estimates in Canadian currency have been used. An exchange rate of 1.30 CAD per USD was assumed to convert USD market price



projections and particular components of the cost estimates into CAD. Selling prices of \$600 USD per tonne (FOB SLP) for the concentrate and \$14,000 USD (EXW SHA) for the lithium hydroxide have been assumed.

Current Canadian tax regulations were applied to assess the corporate tax liabilities and the regulations adopted in 2013 were applied to assess the Quebec mining tax liabilities. This assessment is based on the fact that the Project is on-going, i.e., significant work on the property began in July 2016. Consequently, all funds invested up until May 31, 2019 are considered sunk and are omitted from the capital expenses in the present economic analysis.

Only that part of the capital expenditure that remains to be incurred to bring the project to the production phase is considered.

Table 1.16 summarizes the life of project production, revenue and cost statistics.

**Table 1.16 – Summary of Life of Project Production, Revenue and Cost Statistics**

Description	Units	Value
Production – Mineralization	k tonnes	36,594
Production – Concentrate @ 6.25% LiO <sub>2</sub>	k tonnes	6,570
Production – LiOH-H <sub>2</sub> O product – Mine Concentrate	tonnes	1,032,748
Production – LiOH-H <sub>2</sub> O product – Other Sources	tonnes	64,099
Concentrate Sold	tonnes	368,202
Revenue	M CAD	20,249.8
Initial Capital Costs (excludes Working Capital and Sunk Costs)	M CAD	928.7
Sustaining Capital Costs	M CAD	419.4
Operating Costs (includes Royalty Payments)	M CAD	6,161.0
General and Administration Corporate Costs	M CAD	252.2
RDPA Payments (excludes \$4.5 M already paid)	M CAD	383.0
Closure Costs (excludes \$9.2 M already paid)	M CAD	0.0
Pre-Tax Total Cash Flow	M CAD	12,105.5
After-Tax Total Cash Flow	M CAD	9,021.0

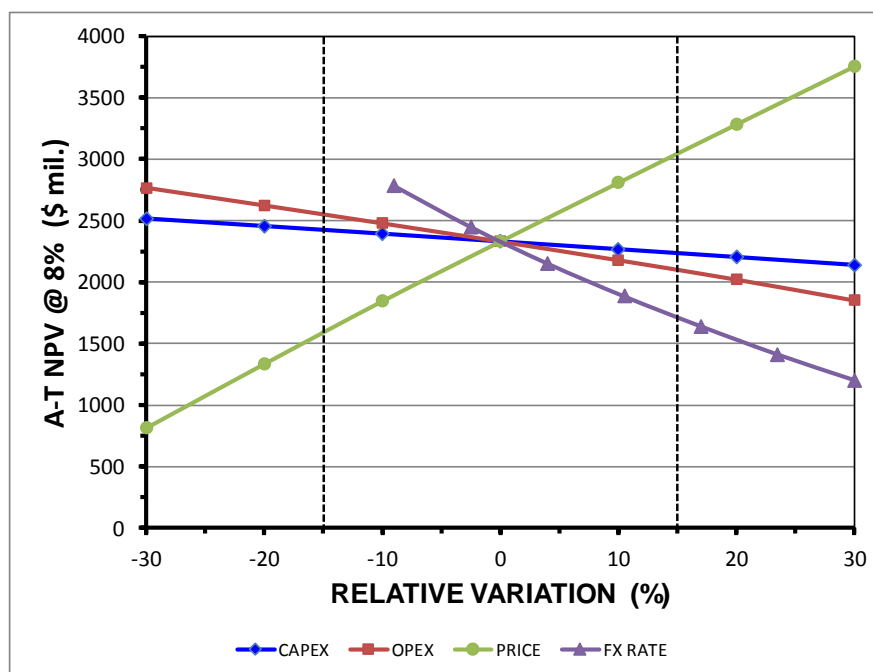
Table 1.17 presents the financial indicators under base case conditions.

**Table 1.17 – Base Case Scenario Results**

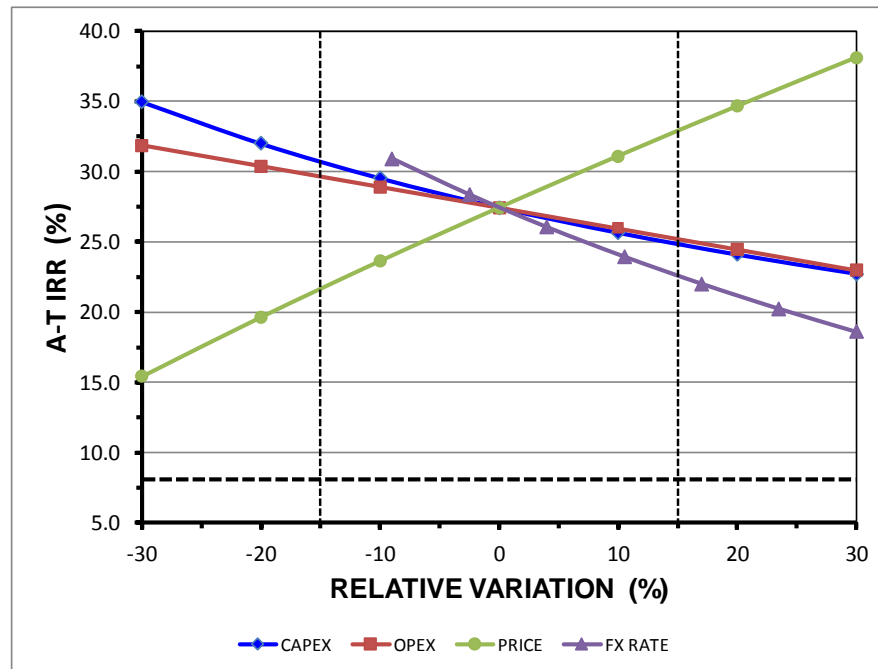
Base Case Financial Results	Unit	Value
Pre-Tax (P-T) NPV @ 8%	M CAD	3,127.6
After-Tax (A-T) NPV @ 8%	M CAD	2,330.3
P-T IRR	%	30.3
A-T IRR	%	27.4
P-T Payback Period	years	4.5
A-T Payback Period	years	4.6

Figures 1.5 and 1.6 illustrate the sensitivity of the after-tax NPV and IRR, respectively, to variations in Capital Costs, Operating Costs, Selling Prices and the USD/CAD Exchange Rate.

**Figure 1.5 – Sensitivity of Project NPV @ 8% (After Tax)**



**Figure 1.6 – Sensitivity of Project IRR (After Tax)**



A sensitivity analysis reveals that the Project's viability will not be significantly vulnerable to variations in capital and operating costs, within the margins or error associated with projects of this nature. However, the Project's viability remains more vulnerable to the CAD/USD exchange rate and to the larger uncertainty in future market prices.

This Technical Report has been compiled according to widely accepted industry standards. However, there is no certainty that the outcome of the economic analysis will be realized as assessed.

## 1.21 Other Relevant Information

Currently, the Project has been slowed down until additional financing is completed. The current schedule is based on assumptions as to restart times. Activities will continue at a slower pace during the summer and early fall months, but are expected to resume full construction activities for the purposes of the Technical Report by November 2019. The anticipated production start-up is June 2020 for Whabouchi and November 2021 for Shawinigan.

## 1.22 Interpretation and Conclusions

The Whabouchi Lithium Mine and Electrochemical Plant Project consists of the development of a mine approximately 300 km North of Chibougamau and a lithium hydroxide production complex to be built in Shawinigan.

## 1.22.1 WHABOUCHI MINE AND CONCENTRATOR

### 1.22.1.1 *Mining*

On the mining side, although moderate, a potential risk exists concerning the stability of the pit slopes and underground openings. Mitigation measures include re-evaluation of the final pit walls after a few years of operation and prepare a detail geotechnical study for the stability of the underground infrastructure and open stopes.

Although considered a small risk, trace amounts of sulphide minerals could be present in the orebody or waste rock and potentially generate acidic drainage waters if unmanaged. Should sulfur bearing mineral species be present in quantities warranting it, a small dedicated storage cell would be constructed in the tailings facility and appropriate water treatment provided, if required.

### 1.22.1.2 *Process*

The concentrator is designed with a very high internal water recirculation rate. The impact of the accumulation of chemical species cannot be realistically assessed during the design phase. It could potentially be detrimental to the project performance. However, the process was specifically designed to reduce chemicals usage and the only process section that requires reagents is the flotation of spodumene. The other concentration methods are done by physical separation (hydroseparation, DMS and magnetic separation) which will not be impacted significantly, if at all, by any accumulated chemical species present. This risk is therefore limited.

The concentrator design is very flexible and can be adapted during operation to optimize recovery and final product quality. The grade and recoveries projected from individual tests performed by various laboratories and suppliers at bench scale or pilot scale have been used to predict the process plant performance that is stated in this Report. This has not been specifically demonstrated in a formal pilot plant test in its final flowsheet configuration as it is comprised of a high number of unit operations that are very difficult to size and operate at that scale.

Where feasible, full scale equipment were tested by manufacturers which increased the confidence in the expected performance. There is a risk that the performance recovery or the grade cannot be reached if some unforeseen factor affects the total concentrator performance. The concentrator should however meet the total spodumene production output considering the design factors used to select equipment.

In the drying, crushing and loadout facility, the High Pressure Grinding Roll (HPGR) equipment will crush DMS concentrate to less than 1 mm. The risk is that the DMS concentrate may still be very warm and the HPGR performance on warm material is unsure. Testwork will be required to mitigate this risk. The loadout silo will also be designed to minimize risk of blockage to ensure reliable, rapid and dust managed loading of trucks.

#### 1.22.1.3 *Infrastructure Risk*

As the Whabouchi Site is well advanced in design and construction, there are only a few areas that have not been developed. The major area under development is the water management system. The system is well designed and advanced but requires some geotechnical investigation and final location studies for the catchment basins and interconnecting piping and canals.

The concentrator is located in a remote region with access by road. The concentrator facilities are designed to minimize noise, dust and other emissions to meet regulations. Fuel and reagents must be brought in by road throughout the year. The design of the fuel and reagent storage covers provision for delivery interruptions during inclement weather.

The concentrate will be transported by truck to Matagami. Storage bins above the loading equipment will be designed to ensure sufficient excess capacity to cover delays in truck arrivals or departures due to inclement weather or other delays. However, a prolonged road closure will provoke a slow down or cessation of mill operations.

#### 1.22.1.4 *Execution Risk*

The balance of the work to be completed assumed to start in November 2019 in this report would be completed in June 2020. This is an ambitious schedule as a large percentage of the work will be done during the winter months, however almost all of the civil works, with the exception of water management infrastructure, has been completed and buildings are enclosed. The major risk is furnishing ample construction personnel to complete the work especially during the winter months.

Almost all of the equipment has been delivered to site or ready to be delivered. With the exception of the new drying and crushing facility, only minimal equipment is yet to be procured. Prior to re-start of construction, it is anticipated that all piping isometric drawings will be completed and issued for bid. The design work on the cable tray layouts and wiring diagrams would also be completed and issued for bid. This work will be constructed within the confines of the concentrator building which is enclosed and heated.

Currently, it is envisioned that the work will continue to follow an EPCM type project and be performed by an EPCM firm with proven track record of this type of facility in Quebec. However, it is possible that Nemaska will manage the Project with assistance from engineering consultants and experts as required.

For the upcoming work, Nemaska will re-negotiate existing contracts with the firms who have or are currently providing service at the site.

#### 1.22.1.5 *Capital Cost Risk*

Capital cost risk has been significantly reduced because:

- The overall engineering advancement is estimated at 75% with engineering of the concentrator and crushing facilities at over 90%;



- The remaining work is well defined and estimated based on the contracts currently awarded;
- The process equipment is purchased and delivered to site or stored in vendor warehouses;
- Nevertheless, the risk of lack of available construction labour forces could be a concern; however, only a relatively small workforce is required.

#### 1.22.1.6 *Schedule Risk*

The planned start and duration for the Whabouchi Project completion is tight and much of the work will be performed during the winter months. Although a significant portion of the work will be performed inside the contractor, other work such as the completion of the crushing area, the water management system, the warehouse and the new dryer and crushing building will be performed in the elements and will be affected by productivity and work interruptions due to extreme weather conditions. However, these activities can be scheduled in spring 2020 and thus, mitigate the impact of winter conditions.

#### 1.22.1.7 *Operating Costs Risk*

Operating cost risks have been reduced due to better definition of:

- Reagent, electricity and natural gas quantities
- Manpower requirements
- Maintenance costs
- Consumables
- General expenses, property taxes and insurance

### 1.22.2 SHAWINIGAN ELECTROCHEMICAL PLANT

Regular risk review sessions were held since 2017. These risk review sessions tended to focus on process engineering risks, but also touched on general engineering and infrastructure risks. Execution risks (procurement, market, financing, permitting, by-product sales and construction execution risks) are the responsibility of Nemaska or other parties.

#### 1.22.2.1 *Process Risk*

Process risk has been significantly reduced by:

- Substantial test work at the laboratory and pilot level;
- Operation of the Phase 1 Demonstration plant;
- Advancing the process engineering and performing detailed studies on buffer sizing (dynamic simulation), heat and mass balances, minor impurity impacts, HAZOPs, materials selection, purge requirements, etc.
- Selecting suppliers and advancing the detailed equipment design;
- Allowing space within the design for the addition of equipment should this be necessary;

- Preparing a preliminary hot commissioning plan.

Nevertheless, process risks remain as described in detail in Section 25.2. Key risks include:

- The inherent risk related to novel process development;
- The complex interplay of plant areas and the difficulty in predicting the impact of deviations from the expected operating conditions, upset conditions, planned and unplanned maintenance, and ramp up times;
- The possibility that the concentrator produces a concentrate of lower grade or different composition than that expected;
- Lack of data on the variation of impurities across the orebody;
- The potential for minor impurity build-up within recycle loops;
- The use of flash calciners for the calcination of spodumene, an industry first and dependent on high quality concentrate feed;
- Limits to what can be tested and to the extent items can be tested within the desired time frame and budget;
- Uncertainty in chlorine and fluorine extraction levels to the process and efficiency of control systems presently in the design;
- The use of acid concentration for lithium containing acid solutions, an industry first;
- Loss of knowledge within the Nemaska and engineering teams should financing take longer than planned.

All the above process risks can have a significant impact on production, operating cost and ramp up times. If necessary, mitigating these risks can add significant capital cost.

#### 1.22.2.2 *Electromembrane Process Risk*

In the electromembrane process, membranes degrade over time and must be replaced when their efficiency decreases to an unacceptable performance level. Analogous information from the chlor-alkali industry, 1,000-hour tests, and experience of the technology suppliers have allowed an estimation of the membrane and electrode coatings, life to be in the order of two (2) years, assuming high-quality brine feed. Nevertheless, actual membrane life span remains unknown as no test has been performed of sufficient duration under the required conditions.

In addition, membrane life will be significantly affected by operating methods and electromembrane feed quality. Should membranes degrade more rapidly than expected the operating costs will increase and production may decrease. Existing mitigation measures includes on-going confirmatory laboratory test work at the equipment vendor, specific programs of process and optimization support by the equipment vendor, issuing basic engineering packages to the vendor to advance the engineering, and reserving space in the layout for additional electrolyzers should these be required.

Future mitigation strategies include development of detailed operating guidelines, and adequate sparing philosophy so that membranes and associated components are available, if required.

#### 1.22.2.3 *Infrastructure Risk*

Infrastructure risk has been significantly reduced:

- Geotechnical investigation has been completed so that piling design and layout of installation is taking advantages of the existing rock profile;
- Inspection of existing buildings has been completed allowing the scope to be confirmed and allowing the existing buildings to be adapted to the new process;
- Sub-station elevation was adjusted for 1-500 years water level;
- A berm for a 1-100 years water level was added to the scope along the road near the St-Maurice river;
- A new road and gate house will be constructed south of the plant that will allow for the segregation of trucks vs operating personal vehicle, Reception of reagent and shipping of aluminum silicate and gypsum will use that new road;
- Water intake will be from a connection to an existing pipe on the Hydro-Québec water dam which avoid the construction of a new water intake in the St-Maurice river;
- Rail layout was reviewed with key stakeholders and is respecting CN design criteria;
- Demolition inside Buildings #67 and #80 is essentially completed;
- Administrative building is already constructed.

The plant is located near a residential area. The design will ensure that noise, dust and other emissions meet regulations. The traffic of truck for reagent, product and, most importantly, by-products, will be significant but the new road south will allow traffic to use a secondary road that will avoid most of the residential area. Nemaska works in close collaboration with the City of Shawinigan in order to mitigate potential community issues.

Nevertheless, careful monitoring and interface with the community will be required due to the large amount of truck traffic that is expected. To reduce truck traffic, it may in be possible to ship out aluminum silicate by-product by rail (depending on the final destination of the aluminum silicate).

Nemaska will need to finalize the negotiation with the city of Shawinigan to obtain the right of way to construct the new road south of the plant and the permanent access road west on the land that was previously owned by Genesee & Wyoming.

#### 1.22.2.4 *Execution Risk*

Execution risks are described below.

A preliminary execution strategy has been prepared for the purpose of the present report. Following the temporary suspension of the Project by Nemaska, a detailed strategy has yet to be completed.

As a result, some uncertainty remains around the exact execution strategy, changes to which can affect the schedule and project cost. Future mitigation includes development of a detail execution strategy prior to recommencement of the project.

Nemaska has yet to fully define and commit to an execution strategy. The present execution schedule, and the associated capital cost estimate, assume that the execution strategy will follow the typical full EPCM model, and be performed by an EPCM firm with proven track record of this type of facility in Quebec. Changes to the execution model may generate schedule and capital costs risks.

Stakeholder management has been historically shown to be a significant source of project risk. The present execution plan assumes that Nemaska has properly addressed and will continue to address key stakeholder management issues.

The present project schedule assumes that all permits are obtained as planned. Delays in permitting will increase project schedule and likely project cost.

The present owners team size is likely too small for the size of project. It is expected that Nemaska will increase its owners team size upon project financing to allow for enough resources to properly guide the project in a timely manner.

From a construction point of view the project execution plan will use strategies that consider the constraints and risks associated with the site and location. Nevertheless, the detailed construction strategy and sequencing has yet to be prepared. A preliminary strategy has been prepared for the purpose of this report and to develop a realistic schedule. It is possible that when the detailed construction strategy and construction sequence are defined, changes will affect the schedule and project costs. Future mitigation includes development of a detailed construction strategy including a detailed construction sequence.

#### 1.22.2.5 *Capital Cost Risk*

Capital cost risk has been significantly reduced because:

- The project makes use of the existing Buildings #67 and #80 and a detailed assessment of these buildings has been completed and the scope to reinforce and adapt the building to the new equipment is defined.
- Geotechnical investigation of the Shawinigan site has been completed for all the process area and design is based on the geotechnical report. Only confirmation drilling for the berm design along the east road is required.
- All the critical equipment (calciner, electrolysis, LHM crystallizer and acid concentration system) and key process equipment have been purchased and a large portion of the vendor documents are available to complete the design.
- Demolition of existing infrastructure is essentially complete, and a clear scope for the reinforcement and repair has been developed.

- Piling and concrete contracts for Buildings #67 and #80 have been awarded and construction started. Structural reinforcement of Building #67 is also well underway.
- Engineering is approximately 45% complete;

Nevertheless, the following capital cost risks remain:

- The plot plan and layout are frozen for all process plant area. However, Nemaska must finalize agreements with the CN and the City of Shawinigan (which is in the process of acquiring the land from Genesee & Wyoming) for the access road leading to the site
- Inflation on the construction labor has been included, but no provision for material cost increase or unusual market conditions is included.
- Any process risks described above could negatively affect the capital cost should additional equipment be required following testwork, detailed engineering or plant commissioning.

#### 1.22.2.6 *Schedule Risk*

The current estimate is using assumptions for financing date and full notice to proceed. If these dates are delayed, the project team may need to be demobilized and the estimate will be impacted. There may be cost penalties with suppliers or Nemaska may be put in a position where they need to change suppliers. The project may also lose key resources which will create inefficiency upon re-mobilization. Equipment delivery may also be impacted which may change the critical path.

The present site and buildings will lead to a challenging construction environment with respect to congestion and related productivity and safety issues. Similarly, the commissioning scheduling assumes that there will be concurrent construction and commissioning activities. Risk of schedule delays have been partially mitigated by the development of a preliminary schedule, a schedule risk analysis and multiple workshops to develop optimal construction sequences. Further mitigation is planned with the:

- Development of a detailed project execution plan;
- Validation and optimization of the construction sequence via BIM4D construction simulation.

The commissioning and ramp up to full capacity may prove difficult due to the risks described herein. Existing mitigation measures include the development of a high-level hot commissioning strategy, including the addition of temporary and permanent bypasses, equipment and reagents, and the strategic placement of surge vessels throughout the process which permit a plant area to operate at a different throughput to a neighboring plant area by providing buffering between plant areas. This will allow a plant area to continue operating, even while a neighboring plant area is experiencing a maintenance or performance issue.

McNulty curves have been used to estimate a reasonable ramp up time to be used for the financial analysis. Future mitigation strategies include the development of a detailed commissioning and start-up strategy, as well as the implementation of appropriate levels of operational readiness planning. It is possible that during the development of this strategy it is realized that additional equipment must



be installed to allow for a rapid ramp up to full production, or that the ramp up time will be longer due to the inability to ramp up multiple sectors in parallel.

Currently, the Project has been slowed down until additional financing is completed. The current schedule is based on assumptions as to restart times. Any delays to secure Project financing required to start construction will delay the beginning of production of concentrate at Whabouchi and the commissioning of Shawinigan as well. This may allow a competing project to begin production before Nemaska and therefore reduce the market opportunity that Nemaska is targeting and could impact sales level and Project economics.

#### 1.22.2.7 Operating Cost Risk

Operating cost risks have been reduced due to better definition of:

- The performance of electrolysis;
- Reagent, electricity and natural gas quantities;
- Manpower requirements;
- Maintenance costs;
- Consumables;
- General expenses, property taxes and insurance.

Nevertheless, several operating cost risks remain as described below.

Aluminum silicate and Na/K purge solution by-products are produced in large quantities by the Shawinigan Electrochemical facility and could incur significant residue disposal costs (>\$20M CAD) should Nemaska not find end-users capable of accepting the product as is. Mitigation strategies include on-going investigations by Nemaska of potential end users. The anticipated market for the aluminum silicate by-product is as a cementitious additive, similar to fly ash for example. The anticipated market for the aluminum silicate by-product is as a cementitious additive, similar to fly ash for example.

It is difficult to evaluate the maintenance requirements for a new process such as this one that includes multiple highly abrasive, acidic or caustic chemicals which have the potential, despite diligent materials of construction selection, to require significant maintenance. Maintenance costs have been based on industry benchmarks. A detailed maintenance strategy should be prepared to further mitigate this risk.

No contracts have been signed for spodumene concentrate, lithium sulfate, reagents, by-product disposal, electricity or natural gas supply. Some variability in these costs is, therefore, likely. Mitigation strategies include signing contracts. In addition, for by-products, an investigation and qualification of potential disposal sites is necessary to ensure their ability to accept the large amount of aluminum silicate during the first years of operation, as well as gypsum residue which will be sent on an on-going basis.

As mentioned in the process risks section, there is a lack of data on the variability of impurities in the ore over the life of the mine. In addition, confirmatory test work to validate key reagent consumptions and expected residue quantities is presently on-going. Thus, some variability in reagent and residue quantities may occur.

The cost of greenhouse gas (“GHG”) emissions has been calculated and integrated within the financial analysis based on commonly used methods, various assumptions and following guidelines from the Quebec Ministry of the Environment. Should GHG credits change, the market cost of CO<sub>2</sub> vary unexpectedly, or future maximum costs exceed the assumptions made, then costs could be incurred.

### 1.22.3 OVERALL PROJECT RISK

Lithium is considered as an industrial mineral and the sales prices for the different lithium compounds are not public. Sales agreements are negotiated on an individual and private basis with each different end-user. Therefore, it is possible that the sales prices used in the financial analysis be different than the actual market when Nemaska is in fact in a position to sell lithium compounds. In addition, there are a limited number of producers of lithium compounds and it is possible that these existing producers try to prevent newcomers in the chain of supply by increasing their production capacity and lowering their sales prices. In such cases, the economics of the Project could be affected.

Nemaska intends to produce mainly hydroxide monohydrate to address the increasing demand for that compound favored in the making of cathodes for rechargeable batteries. If cathode manufacturers use less hydroxide than expected or if the demand for rechargeable batteries, mainly in the electric and hybrid vehicles, is less than forecast, it could have an effect on the sales price of that compound and the need for new production.

The estimate includes some provision for cost increase on equipment supply. If there are additional financing delays it may become necessary to renegotiate with suppliers about costs and delivery times.

## 1.23 Recommendations

Based on the Project's demonstrated economic, it is recommended to proceed to the implementation phase and resume construction once the Project is financed.

For the Whabouchi mine site, site work has already been started and engineering is progressed with the available funds that Nemaska already has. It has allowed the various parties involved to develop a clear detailed execution plan that fits the proposed schedule. A total estimate of \$224.6 M is needed to complete construction of the Whabouchi mine.

For the Electrochemical Plant, detailed engineering is well underway. The revised budget to complete all engineering and construction related activities for the Electrochemical Plant in Shawinigan is \$704.1 M.

Specific elements that need to be monitored or done are listed below.

#### 1.23.1 FOR WHABOUCHI SITE

##### 1.23.1.1 *Process*

- In order to control the grinding product, Nemaska should consider an automated media feeder. This would ensure near constant ball loading in the grinding circuit and reduce somewhat the slime production.
- Confirm the concentrate loadout flow for effective bin design properties;
- Confirm the moisture content of the concentrate through the dryer.

##### 1.23.1.2 *Co-Disposal and Water Management Systems*

- Phases 2B and 3 of the co-disposal and the water management strategy will have to be optimized during the detailed engineering phase when detailed deposition plans will be available, i.e. in a timely manner to secure the required environmental authorizations prior to its use, as outlined in Section 20.1.2.

##### 1.23.1.3 *Execution*

- Complete the design and contract documents for the co-disposal and water management areas;
- Complete the design of the drying and crushing facility. Go for tender for long lead equipment and place orders;
- Finalize the piping Isometric drawings and P&ID's;
- Finalize specifications for piping materials and instruments and issue purchase orders / contracts. Start fabrication of instruments and materials to meet scheduled dates;
- Perform trade-off studies for the infrastructure such as the locations for the mine dry facility, laboratories, warehouse facility and complete design engineering;
- Complete the cable tray and wiring arrangements for the concentrator and issue for construction;
- Finalize outstanding equipment specification and place orders;
- Negotiate with Hydro-Québec on increased power requirements;
- Ensure that the construction management team is in place prior to start of construction;
- Perform a detailed inspection of the site to determine the optimal methodology of proceeding with completing partially completed work and associated new construction;
- Minimize outside work during the winter months if schedule permits.

##### 1.23.1.4 *Capital Cost*

- Re-negotiate existing contracts to be ready for construction start in November;

- Put in place a strong cost management team to manage costs, deliveries and schedules.

## 1.23.2 FOR ELECTROCHEMICAL PLANT

### 1.23.2.1 *Process*

- Ensure that the quality of the concentrate is maintained for processing in the electrochemical plant.
- Confirm the composition of the concentrate, including the level of minor impurities, that are in the process design criteria. Re-analyze impurities that have had limited repeat analyses.
- Analyze the concentrate for a range of minor impurities that have yet to be measured. Determine which impurities may build-up (if any) and develop mitigation strategies.
- Perform sensitivity analysis on the impact of variability of impurity levels in the concentrate on the electrochemical plant process and equipment sizing. If required, develop mitigation plans at the mine, concentrator and/or electrochemical plant.
- Determine the quantity and quality of spodumene concentrate and lithium sulfate that will be purchased and incorporate physical and compositional differences in the design and/or operating strategy.
- Perform or complete outstanding test work including: lab and pilot scale tests on chlorine and fluorine deportment and control; pilot scale testing to validate key reagent consumptions and for final confirmation of filter sizing by vendor; lab scale testing for optimization of the ion exchange system; lab scale testing by vendor of the water treatment system; and lab scale testing for drying of spodumene and aluminum-silicate.
- Continue operation of the Shawinigan Demonstration Plant, ideally operating with 100% spodumene feed for extended periods of time. Analyze the historical and future performance from the Demonstration Plant.
- Consider adding the acid concentration loop to the Shawinigan Demonstration Plant in order to gain practical experience in the operation of this equipment, gain information on the effect of the use of regenerated acid within the process, and evaluate the potential of impurity build up. If such an integrated pilot cannot be performed, consider batch, semi-pilot or pilot acid concentration test work at the selected vendor to confirm the design and gain operating insight.
- Update the dynamic simulation to incorporate recent flowsheet changes and further refine operating and control strategies
- Develop a detailed commissioning, start-up and operational readiness strategy to meet target ramp up times.
- Document process knowledge to ensure that knowledge is conserved.

### 1.23.2.2 *Electromembrane Process*

- Continue studies of optimization of systems peripheral to the electrochemical cells to reduce capital cost;

- Continue studies of membrane and coating lifetimes as a function of impurity profile and other process variables.

#### 1.23.2.3 *Execution*

- Continue to expedite permitting according to key schedule date;
- Issue the documentation and letter to the government to officialise the opening of the construction site as a major project (required when resource peak higher than 500 workers);
- Finalize the qualification process for mechanical & piping and electrical and instrumentation contractors;
- Continue to engage with the key stakeholders external to the project (government, city of Shawinigan) to mitigate the risk of social issues during construction and operation;
- Confirm the detailed project organization with key position identified;
- Develop a detailed commissioning plan.

#### 1.23.2.4 *Capital Cost*

- Revise the execution plan to include detailed strategies for all groups (engineering, procurement, project control, construction, POV, OR);
- Finalize negotiation with CN and the City of Shawinigan to obtain servitude for the access road.

#### 1.23.2.5 *Operating Cost*

- Pursue work on aluminum silicate and Na/K purge solution by-product characteristics and value to confirm their attractiveness for potential clients;
- Complete confirmatory test work on reagent consumptions;
- Confirm spodumene concentrate, lithium sulfate, reagent, by-product disposal, electricity and natural gas costs and sign contracts and agreement with main suppliers;
- Develop a detailed maintenance strategy.



## 2 INTRODUCTION

The Whabouchi Property is located in the Eeyou Istchee / James Bay area of the Province of Quebec, approximately 30 km east of the community of Nemaska and 300 km north-northwest of the town of Chibougamau, more specifically at km 276 on the *Route du Nord*.

This NI 43-101 Technical Report supersedes all previous NI 43-101 Report.

### 2.1 Terms of Reference - Scope of Study

Met-Chem, a division of DRA Americas Inc. ("**DRA/Met-Chem**") has provided engineering and integration services for all aspects of the Updated NI 43-101 Technical Report on the Whabouchi Lithium Mine and Shawinigan electrochemical plant with the participation of other companies. The Technical Report includes the Resource Estimation (by SGS Geostat ("**SGS**"), Open Pit Mine Design and Mineral Reserve Estimation (by BBA Inc. "**BBA**"), Underground Mine Design (by DRA/Met-Chem), concentrator (by DRA/Met-Chem), Electrochemical plant (by **Hatch and NORAM**), infrastructure (by Hatch for Shawinigan and DRA/Met-Chem elsewhere), waste rock and tailings disposal and water management (by SNC-Lavalin "**SNC**"), capital and operating costs (by Hatch for Shawinigan and DRA/Met-Chem elsewhere), and economic analysis (by DRA/Met-Chem).

The following document was prepared in compliance with the provisions of National Instrument 43-101 Standards of Disclosure for Mineral Projects.

This Report was compiled by DRA/Met-Chem at the request of Nemaska Lithium Inc. ("**Nemaska**"), a Quebec based company trading on the Toronto Stock Exchange (TSE) under the symbol "NMX", with its corporate office at:

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Tel.: 418 704-6038  
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### 2.2 Source of Information

This Report is based, in part, on internal technical reports and maps, published government reports, letters and memoranda, and public information as listed in the "References", Section 27 of this Report. Several sections from reports authored by other consultants have been directly quoted in this Report, and are so indicated in the appropriate Sections.

#### 2.2.1 CONTRIBUTING AUTHORS

At the request of Nemaska, DRA/Met-Chem has been retained to prepare a NI 43-101 Report for the Nemaska Project with the participation of specialized consultants. Table 2.1 provides a detailed list of qualified persons as defined in Section 1.5 of NI 43-101 and their respective sections of responsibility.

**Table 2.1 – Qualified Persons and their Respective Sections of Responsibilities**

Section	Title of Section	Qualified Persons
1	Summary	Daniel Maguran and related QPs
2	Introduction	Daniel Maguran
3	Reliance on Other Experts	Daniel Maguran
4	Property Description and Location	Maxime Dupéré, SGS
5 and 5.1	Accessibility, Climate, Local Resources, Infrastructure, and Physiography – Whabouchi Site	Maxime Dupéré, SGS
5.2	Accessibility, Climate, Local Resources, Infrastructure, and Physiography – Shawinigan Site	Pierre Girard, Hatch
6	History	Maxime Dupéré, SGS
7	Geological Setting and Mineralization	Maxime Dupéré, SGS
8	Deposit Types	Maxime Dupéré, SGS
9	Exploration	Maxime Dupéré, SGS
10	Drilling	Maxime Dupéré, SGS
11	Sample Preparation, Analysis and Security	Maxime Dupéré, SGS
12	Data Verification	Maxime Dupéré, SGS
13 and 13.1	Mineral Processing and Metallurgical Testing Spodumene Concentration	Rock Gagnon, DRA/Met-Chem
13.2 to 13.2.7	Electrochemical Process Test Work Leaching and Impurity Removal Test Work – Phase 1 – 2011	James Anson, Hatch
13.2.8	Electromembrane and LHM Crystallization Test Work – Phase 2 - 2011	Anthony Boyd, NORAM
13.2.9 to 13.2.12	Acid Bake, Leach and Impurity Removal Test Work – 2017 and Ion Exchange Test Work – 2019	James Anson, Hatch
13.2.13	Membrane Electrolysis Test Work	Anthony Boyd, NORAM
13.2.14	LiOH-H <sub>2</sub> O Crystallization Test Work – 2014 and 2017	James Anson, Hatch
13.2.15	LHM Drying Test Work	James Anson, Hatch
13.2.16	Acid Recycle Solubility Test Work – 2016 and 2017	Anthony Boyd, NORAM
13.2.17	Acid Recycle Test Work – 2017	James Anson, Hatch
13.2.18	Other Test Work – 2017-2019	James Anson, Hatch
13.2.19	Electrochemical Demonstration Plant – P1P – 2017-2019	Anthony Boyd, NORAM
14	Mineral Resources Estimates	Maxime Dupéré, SGS
15	Mineral Reserve Estimates	
15.1 to 15.3	Open Pit Mining	Jeffrey Cassoff, BBA

Section	Title of Section	Qualified Persons
15.4	Underground Mining	André-François Gravel, DRA/Met-Chem
16	Mining Methods	
16.1 to 16.4	Open Pit Mining	Jeffrey Cassoff, BBA
16.5	Underground Mining	André-François Gravel, DRA/Met-Chem
17 and 17.1	Recovery Methods Whabouchi Processing Plant	Ewald Pengel, DRA/Met-Chem
17.2	Electrochemical Processing Plant	James Anson, Hatch
18 and 18.1.1	Project Infrastructure Whabouchi General Site Plan Sewage Treatment	Daniel Maguran, DRA/Met-Chem
18.1.2	Co-Disposal Storage Facility	Dominic Tremblay, SNC
18.1.3 to 18.1.8	Whabouchi Control System Whabouchi Camp Accommodations	Daniel Maguran, DRA/Met-Chem
18.2	Electrochemical Plant Infrastructure	Pierre Girard, Hatch
19	Market Studies and Contracts	Daniel Maguran, DRA/Met-Chem
20 to 20.1.3 (except for 20.1.1.3) and 20.1.6	Environmental Studies, Permitting and Social or Community Impact, Rehabilitation and Mine Closure Plan; Whabouchi Mine	Daniel Maguran, DRA/Met-Chem
20.1.1.3	Waste Rock and Tailings Characterization	Dominic Tremblay, SNC
20.1.4 and 20.1.5	Water Management and Note on Tailings Management	Dominic Tremblay, SNC
20.2	Environmental Studies, Permitting and Social or Community Impact; Electrochemical Plant	Daniel Maguran, DRA/Met-Chem
21 and 21.1.1 to 21.1.6	Capital and Operating Costs Capital Costs Summary – Whabouchi and Chibougamau	SNC, BBA, DRA/Met-Chem
21.1.7	Waste Rock and Tailings Disposal and Water Management	Dominic Tremblay, SNC
21.1.8 to 21.1.16	Basis of Estimate for Indirect Costs Sustaining Capital	Daniel Maguran, DRA/Met-Chem
21.2	Capital Cost Summary – Shawinigan Electrochemical Plant Site	Pierre Girard, Hatch
21.3 and 21.5	Whabouchi Operating Cost and General and Administration (Corporate)	Daniel Maguran, DRA/Met-Chem
21.4	Shawinigan Electrochemical Plant Operating Cost	James Anson, Hatch
22	Economic Analysis	Daniel Maguran, DRA/Met-Chem
23	Adjacent Properties	Maxime Dupéré, SGS

Section	Title of Section	Qualified Persons
24	Other Relevant Data and Information	Daniel Maguran, DRA/Met-Chem
24.1 to 24.1.2	Project Schedule	Daniel Maguran, DRA/Met-Chem
24.1.3	Shawinigan Schedule	Pierre Girard, Hatch
24.2	Whabouchi Construction	Daniel Maguran, DRA/Met-Chem
24.3	Shawinigan Construction	Pierre Girard, Hatch
25	Interpretation and Conclusions	Daniel Maguran and related QPs
26	Recommendations	Daniel Maguran and related QPs
27	References	Daniel Maguran and related QPs

## 2.3 Effective Date and Declaration

This Technical Report has the following effective dates:

- Technical Report: May 31, 2019;
- Date of Capital and Operating Costs / Economic Analysis: May 31, 2019.
- Date of Mineral Resource Estimate: June 26, 2019;
- Date of Mineral Reserve Estimate: July 5, 2019;

This Report is considered effective as of May 31, 2019 and is in support of the Nemaska's press release, dated July 31, 2019, entitled "Nemaska Lithium Releases Updated NI 43-101 Technical Report."

The current Report provides an independent Technical Report for the estimate to complete for the Whabouchi Mine and Shawinigan Electrochemical Plant, in conformance with the standards required by NI 43-101 and Form 43-101F1.

DRA/Met-Chem, Hatch, SNC, and other collaborators are not insiders, associates, or affiliates of Nemaska and neither DRA/Met-Chem nor any affiliate has acted as advisor to Nemaska, its subsidiaries or its affiliates, in connection with this Project.

It should be understood that the Mineral Reserves presented in this Report are estimates of the size and grade of the deposits based on a number of drillings and samplings and on assumptions and parameters currently available. The level of confidence in the estimates depends upon a number of uncertainties. These uncertainties include, but are not limited to, future changes in product prices and/or production costs, differences in size and grade and recovery rates from those expected, and changes in Project parameters.

## 2.4 Site Visit

Maxime Dupéré, P. Geo., has visited the Whabouchi Property on December 5, 2017, and May 20 and 21, 2019.

Jefferey Cassoff, P. Eng., has visited the Whabouchi Property on May 20 and 21, 2019.

Tony Boyd, P. Eng. has visited the Shawinigan Electrochemical Plant site on five (5) occasions, including: September 29-30, 2016; May 1, 2017; Sept. 7, 2017; January 25-26, 2018.

Daniel Maguran, P. Eng., has visited the Whabouchi Property on May 7, 2019.

James Anson, P. Eng., Ph.D., has visited the Shawinigan Electrochemical Plant site January 26, February 3 and 20, June 13 and 20, July 4, 11, 12, 13 and 27, and August 24, 2017 for the NI43-101 report of February 2018. For the current Report, he has visited the site every few months since February 2018 as part of process review meetings.

Pierre Girard, P. Eng., has visited the Shawinigan Electrochemical Plant site on four (4) occasions dated: February 20, 2017, March 22, 2017, June 20, 2017, and July 13, 2017 for the NI 43-101 Report of February 2018. For the current Report, he has visited the Shawinigan site for a bi-weekly coordination meeting between June 2018 to March 2019.

Dominic Tremblay, P. Eng., M.A. Sc., has visited the Whabouchi site on May 16, 2017.

Rock Gagnon, P. Eng., conducted a site visit to the Whabouchi site on May 9, 2017.

## 2.5 Units and Currency

In this Report, all currency amounts are Canadian Dollars (“**CAD**”, “**\$**”) unless otherwise stated, with commodity prices typically expressed in US Dollars (“**USD**”). Quantities are generally stated in *Système international d’unités* (“**SI**”) metric units, the standard Canadian and international practices, including metric tons (“**tonnes**, **t**”) for weight, and kilometres (“**km**”) or metres (“**m**”) for distance. Abbreviations used in this Report are listed in Section 28.

### 3 RELIANCE ON OTHER EXPERTS

The QPs prepared this Report using reports and documents as noted in Section 27. The Authors wish to make clear that they are qualified persons only in respect to the areas in this Report identified in their “Certificates of Qualified Persons”, submitted with this Report to the Canadian Securities Administrators.

A draft copy of the report has been reviewed for factual errors by Nemaska. Any changes made as a result of these reviews did not involve any alteration to the conclusions made. Hence, the statement and opinions expressed in this Document are given in good faith and in the belief that such statements and opinions are neither false nor misleading at the date of this Report.

The Qualified Persons (QP) who prepared this Report relied on information provided by experts who are not QPs. The QPs who authored the sections in this Report believe that it is reasonable to rely on these experts, based on the assumption that the experts have the necessary education, professional designations, and relevant experience on matters relevant to the Technical Report.

The QPs used their experience to determine if the information from previous reports was suitable for inclusion in this Technical Report and adjusted information that required amending. This Report includes technical information, which required subsequent calculations to derive subtotals, totals and weighted averages. Such calculations inherently involve a degree of rounding and consequently introduce a margin of error. Where these occur, the QPs do not consider them to be material.

DRA/Met-Chem has relied upon market studies provided by Nemaska. The market study was prepared by Roskill Information Services Ltd (Roskill), an independent consultant. Section 19 summarizes the key information from this Report about lithium market overview and outlook. Roskill was mandated to prepare a market study to evaluate potential target markets for the battery grade lithium hydroxide and lithium carbonate. DRA/Met-Chem has reviewed the content of the market study report and believes that it provides a reasonable overview of the past and current lithium minerals market as well as projections according to various recognized sources.

DRA/Met-Chem has relied on reports and opinions provided by Nemaska and their Consultants (*Enviro-accès* and Pr. Carmel Jolicoeur (University of Sherbrooke)) for information in Section 20 pertaining to Environment Studies, Permitting and Social or Community Impact. DRA/Met-Chem has reviewed the content of this Section (except for sub-sections 20.1.1.3, 20.1.4, and 20.1.5) and believes that it provides current and reliable information on environmental, permitting and social or community factors related to the Project.

SNC relied on reports and opinions provided by Nemaska Lithium and their Consultants BBA and UQAT-IRME for information relative to Section 20.1.1.3c pertaining to Waste Rock and Tailings Characterization. SNC has reviewed the content of this sub-section and believes that it provides current and reliable information on Whabouchi Mine’s Waste Rock and Tailings Characterization related to the Project.



The Economic Analysis was prepared in collaboration with Michel L. Bilodeau, B.Eng., M.Sc. (App.), Ph.D., as well as with KPMG, Montreal office, for information related to taxation. DRA/Met-Chem has reviewed the content of this Section and believes that it provides current and reliable information.

DRA/Met-Chem is relying on the previous NI 43-101 reports and its referenced documents in relation to all pertinent aspects of the Property. The Reader is referred to these data sources, which are outlined in the “References”, Section 27 of this Report, for further details.

SGS is relying on Information concerning claim status and ownership (Section 4) which have been provided to the Author by Nemaska by way of E-mail and past discussions. The Authors only reviewed the land tenure in a preliminary fashion, and has not independently verified the legal status or ownership of the property or any underlying agreements. However, the Authors have no reason to doubt that the title situation is other than what is presented in this technical report. The Authors are not qualified to express any legal opinion with respect to Property titles or current ownership.

## 4 PROPERTY DESCRIPTION AND LOCATION

### 4.1 Location

The Whabouchi Property is located in the James Bay area of the Province of Quebec, approximately 30 km East of the Cree community of Nemaska and 300 km north-northwest of the town of Chibougamau. The center of the Property is situated at about UTM 5,725,750mN, 441,000mE, NAD83 Zone 18 (Figure 4.1). The Property is accessible by the *Route du Nord*, the main all-season gravel road linking Chibougamau and Nemaska. The road crosses the Property near its center. The Nemiscau airport is 18 km west of the Property (Figure 4.2).

### 4.2 Property Ownership and Agreements

The Property is composed of one (1) block containing 35 map-designated claims covering a total of 1,632.24 ha. and one (1) Mining Lease by the *Ministère de l'Énergie et des Ressources naturelles*. Nemaska owns 100% interest in the Property.

On October 26, 2017, Nemaska Lithium Inc. ("**Nemaska**"), obtained Mining Lease number 1022, under the conditions provided for in the Mining Act and those prescribes by regulation. The surface of the Mining Lease totals 138.106 ha, consisting of lot 4,994,037 of the Quebec cadastre, registration division of Lac-Saint-Jean-Ouest. This lease gives the tenant the right to extract all mineral substances owned by the Crown in the above-named land, but it does not give entitlement to surface mineral substances, petroleum, natural gas, or brine. This lease is for a period of 20 years from the date of the landlord's signature on October 26, 2017 and will end on October 25, 2037.

Nemaska owns 100% interest in the Property. Sixteen (16) claims were acquired from Victor Cantore Group ("Cantore claims") on September 17, 2009, ten (10) claims were acquired from Golden Goose Resources Inc. ("Golden Goose") on January 15, 2010 as part of a larger mining titles purchase agreement (594 claims forming the *Lac Levac* and *Lac des Montagnes* properties), and seven (7) claims were acquired by map designation directly by Nemaska. All the claims are registered in the name of Nemaska. After a more precise determination of the mining lease, residual surface created two (2) additional small claims

As of the effective date of this Report, all 35 claims are in good standing. The mining lease expires on October 25, 2037. The Whabouchi deposit is located on the Cantore claims. The expiry dates for the claims range from November 2, 2019 to January 24, 2020. Several mining titles affect the mining lease: 2203108, 2519870, 2137248, 2137249, 214920, 2137252, 2137251, 2137250, 259871, 2137247. The mining titles are listed in Table 4.1 and shown in Figure 4.3.

In September 2009, Nemaska acquired a 100% interest in 16 mining claims included in the Whabouchi Property. At the effective date of this Report, Nemaska paid a total amount of \$1,010,000 in cash. Furthermore, Nemaska issued 4,500,000 common shares for a total amount of \$1,020,500 since the signing of the agreement. The vendors kept a 3% royalty on the 16 claims and on four of the seven (4 of the 7) claims acquired by map designation by the Nemaska. One percent (1%) of this royalty may be purchased for an amount of \$1,000,000. No value was assigned specifically to the

ten (10) claims acquired from Golden Goose, since they were part of the *Lac Levac* and *Lac des Montagnes* purchase agreement relating to the purchase of 594 claims.

The following mining titles: 2137259, 2137280, 2137261 and 2137262 are on Category II land. Category II lands are areas in which Native Community have the exclusive rights to hunt and fish (CBJNQ - 5.2.6 b). The Category II land affected claims fall under the Chinuchi Agreement, signed in 2014 and available on SEDAR and Nemaska Lithium web site.

The following is a brief description of the objectives of The Chinuchi agreement. The agreement was signed to provide for the establishment and maintenance of a long-term working relationship between Nemaska Lithium Inc. and the Cree nation of Nemaska; the Grand Council of the Crees (Eeyou Istchee) and the Cree Nation Government based on mutual trust and respect; to adopt and maintain a sustainable development approach during all phases of the Whabouchi Project; to provide for a framework through which communication and cooperation can take place between the Parties in the performance of their respective obligations under this Agreement.

#### 4.3 Property in Shawinigan

Nemaska Lithium Inc., (via its subsidiary 9672486 Canada Inc.), has also completed an agreement to purchase land and buildings at a price of \$2,000,000 from the city of Shawinigan, QC (via its "*Société de Développement de Shawinigan Inc.*"). Located in the *Grand-Mère* area, it is close to highway and railway network. Port access is available at *Trois-Rivières* 50 km to the south. The property is also adjacent to the *Grand-Mère* Hydro-Québec power station.

#### 4.4 Royalty Obligations

According to Nemaska, the Property is subject to two (2) separate agreements. The first concerns the ten (10) claims acquired from Golden Goose, where a 2% NSR is retained by Golden Goose; of which, 1% can be repurchased by Nemaska for \$1 M within the first three years from the acquisition. The second relates to the 20 other acquired claims; of which, 16 claims were acquired from Cantore Group plus four (4) of the seven (7) claims acquired by map designation. Cantore retains a 3% Net Smelter Return ("**NSR**") on these 20 claims, of which 1% can be repurchased by Nemaska for \$1 M. The Whabouchi deposit is located on the Cantore claims.



Figure 4.1 – Property General Location

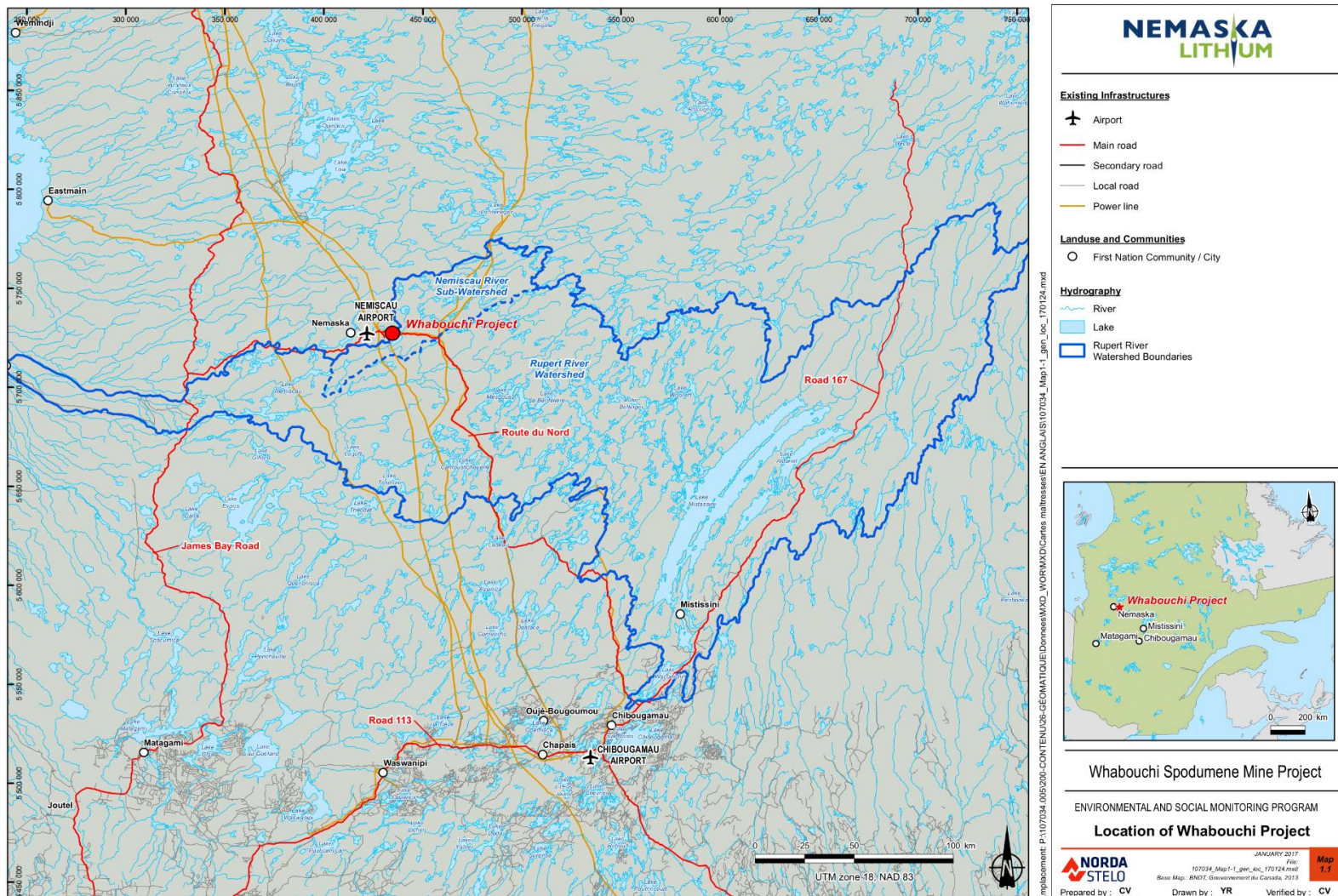
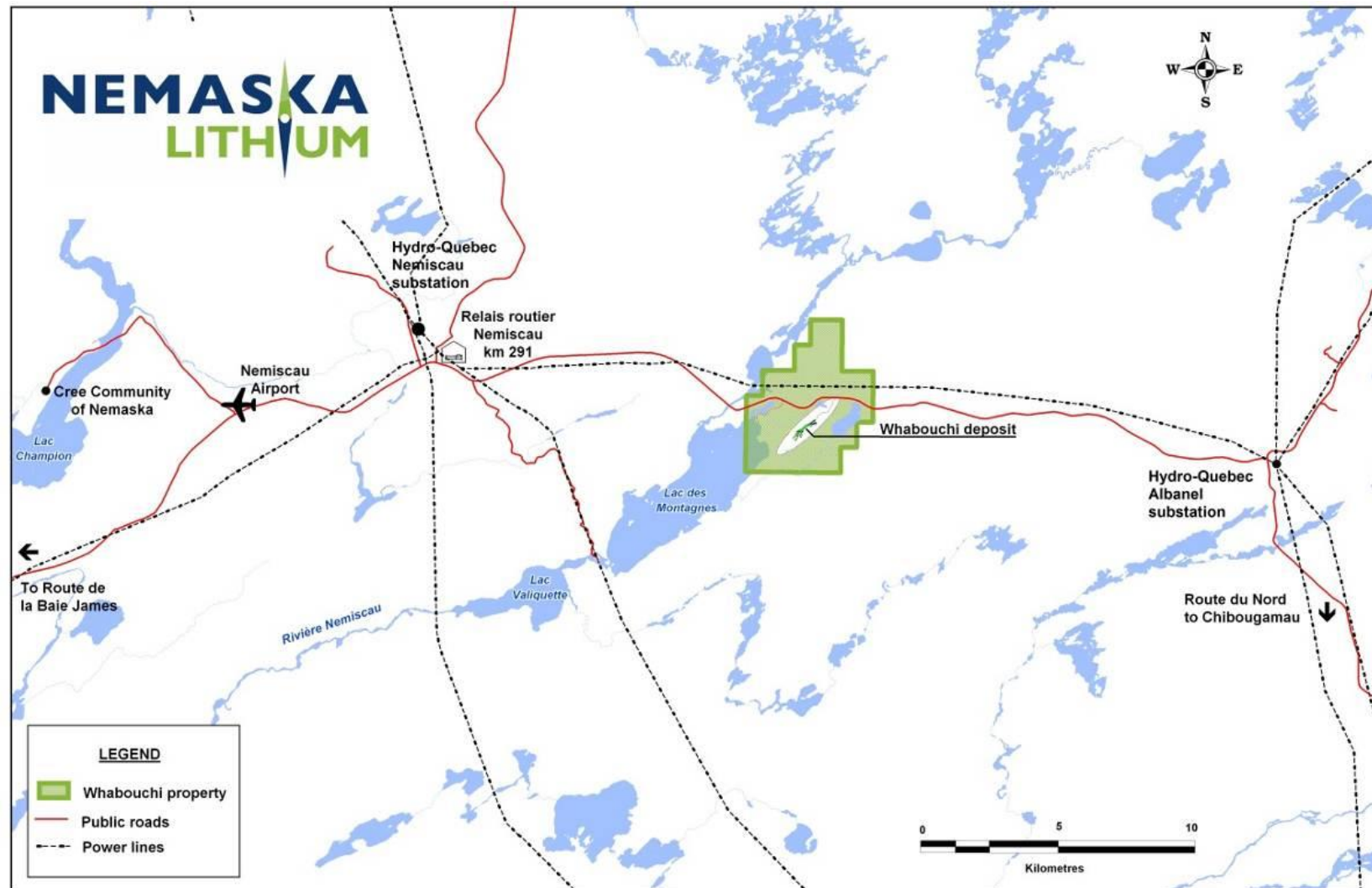


Figure 4.2 – Property Location with Near-by Infrastructure





**Table 4.1 – List of the Property Mineral Titles**

SNRC	Area (ha)	Title	Title #	Status*	Expiration Date	Registration Date	Renewals Done	Title Holder
32O12	52.27	CDC	101251	Active	2019-11-02	2005-11-03	6	Corporation 100%
32O12	53.38	CDC	101252	Active	2019-11-02	2005-11-03	6	Corporation 100%
32O12	53.41	CDC	101253	Active	2019-11-02	2005-11-03	6	Corporation 100%
32O12	14.73	CDC	2137247	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	9.63	CDC	2137248	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	32.38	CDC	2137249	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	45.11	CDC	2137250	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	27.09	CDC	2137251	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	58.08	CDC	2137252	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137253	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137254	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137255	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137256	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137257	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.38	CDC	2137258	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.37	CDC	2137259	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.37	CDC	2137260	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.37	CDC	2137261	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.37	CDC	2137262	Active	2019-11-25	2007-11-26	5	Corporation 100%
32O12	53.41	CDC	2141913	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	51.42	CDC	2141920	Active	2020-01-23	2008-01-24	5	Corporation 100%



SNRC	Area (ha)	Title	Title #	Status*	Expiration Date	Registration Date	Renewals Done	Title Holder
32O12	53.40	CDC	2141921	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	53.39	CDC	2141927	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	53.39	CDC	2141928	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	53.38	CDC	2141933	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	53.38	CDC	2141934	Active	2020-01-23	2008-01-24	5	Corporation 100%
32O12	53.41	CDC	2202355	Active	2020-01-20	2010-01-10	4	Corporation 100%
32O12	53.40	CDC	2202356	Active	2020-01-20	2010-01-10	4	Corporation 100%
32O12	53.39	CDC	2202357	Active	2020-01-20	2010-01-10	4	Corporation 100%
32O12	53.41	CDC	2203107	Active	2020-01-24	2010-01-10	4	Corporation 100%
32O12	53.13	CDC	2203108	Active	2020-01-24	2010-01-10	5	Corporation 100%
32O12	53.39	CDC	2203109	Active	2020-01-24	2010-01-10	4	Corporation 100%
32O12	53.39	CDC	2203110	Active	2020-01-24	2010-01-10	4	Corporation 100%
32O12	6.88	CDC	2519870	Active	2019-11-25	2018-06-21	1	Corporation 100%
32O12	0.24	CDC	2519871	Active	2019-11-25	2018-06-21	1	Corporation 100%
32O12	138.10	BM	1022	Active	2017-10-26	2037-10-25	0	Corporation 100%

[illegible]

## 4.5 Permits and Environmental Liabilities

The main permits required to conduct exploration work on the Property are the forest management permit delivered by the provincial *Ministère des Forêts, de la Faune et des Parcs* (“**MFFP**”) along with owning active mining rights. A Certificate of Authorisation from the *Ministère de l'Environnement et de la Lutte contre les changements climatiques* (“**MELCC**”) may also be necessary to conduct specific advanced exploration works such as, for example, the mechanical stripping of more than 1,000 m<sup>3</sup> of overburden. As of the date of this Report, Nemaska's management confirmed having valid work permits and authorisations. To the knowledge of the author, there are no environmental liabilities pertaining to the Property.

For the Whabouchi mine Project, a first version of the Environmental and Social Impact Assessment (“**ESIA**”) document was submitted to both federal (Canadian Environmental Assessment Agency) and provincial (Review Committee of the James Bay and Northern Quebec Agreement, or “**COMEX**”) authorities for review in April 2013. Following questions and comments as well as public hearings, Nemaska announced September 4, 2015 that it has received the General CA for the Whabouchi Project from the MELCC.

On July 29, 2015, the Canadian Minister of Environment decided that the Project is not likely to cause any significant adverse environmental effects, and set out in her positive decision statement the conditions relative to the mitigation measures and monitoring program to be respected by Nemaska. Nemaska has already begun and is continuing to fulfill the provisions included in the General CA for Whabouchi and the authorization application and permitting process for construction has started in Q1-2016. Applications are being filed in a timely manner with the construction works and have therefore no impact on Project schedule.

Nemaska announced in May 2016 that it completed the acquisition of part of the land and of existing manufacturing facilities of the former Resolute Forest Products (“**RFP**”)’s Laurentide plant for the installation of its Electrochemical Plant. That site operated from the late 1880s to 2014 when it was shut down by RFP. The facilities acquired by Nemaska date from the 1960s through the 1990s.

As part of the acquisition process, the City of Shawinigan and RFP are fully responsible for the environmental site characterization and associated site rehabilitation, in full compliance of the applicable laws and regulations, including Quebec's Soil Protection and Contaminated Lands Rehabilitation Policy. To that regard, the Agreement in Principle specifies that all liabilities associated to the past activities which took place at that site are under the full responsibility of the City of Shawinigan. Nemaska will not, by any means, be accounted for those. Furthermore, the Agreement also specifies that all lands delivered to Nemaska will comply with applicable soil quality criteria for industrial use.

Section 20 provides further information on environmental impacts and permitting.

## 5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE, AND PHYSIOGRAPHY

### 5.1 Whabouchi Site

#### 5.1.1 ACCESSIBILITY

The Property is easily accessible via the *Route du Nord* road that crosses the Property near its center. This road links the town of Matagami, via the *Route de la Baie-James* road, approximately 390 km to the SSW. The Route du Nord also links the town of Chibougamau, located approximately 300 km to the SSE, and leads to the community of Nemaska.

#### 5.1.2 PHYSIOGRAPHY

The Property is characterized by a relatively flat topography with the exception of the local ridge where the more competent pegmatites outcrop, forming the surface expression of the deposit. The elevation above sea level ranges from 275 m, at the lowest point on the Property, to 325 m at the top of the pegmatite ridge, with an average elevation of 300 m. Lakes and rivers cover approximately 15% of the Property area. The flora in the area is typical of the taiga environment observed in the region with a mix of black spruce forest and peat moss-covered swamps. A vast portion of the Property was devastated by forest fires less than 20 years ago. There is no permafrost at this latitude and the overburden cover ranges in depth from 0 m near the ridge to 25 m in the south part of the Property.

#### 5.1.3 CLIMATE

The climate in the region is sub-arctic. This climate zone is characterized by long, cold winters and short, cool summers. Daily average temperature ranges from -20°C in January to +17°C in July. Break-up usually occurs in early June, and freeze-up in early November. The annual precipitation averages 479 mm of rain mostly from March to November and 117 cm of snow from September to May. Averages are based on data from 2009 to 2016.

(<https://www.worldweatheronline.com/nemiscaw-weather-averages/quebec/ca.aspx>)

#### 5.1.4 LOCAL RESOURCES AND INFRASTRUCTURE

The nearest infrastructure with general services is the *Relais Routier Nemiscau* Camp, located 12 km west of the Property, where Nemaska has access to lodging facilities, if needs exceed the capacity of the camp installed on the property. The community of Nemaska, located 30 km west of the Property, can also provide accommodation and general services. The area is serviced by the Nemiscau airport, serviced by regular Air Creebec flights and charter flights, and by mobile phone network from the main Canadian service providers.

Hydro-Québec owns several infrastructure and facilities in the area including the *Poste Albanel* and *Poste Nemiscau* electrical stations located approximately 20 km east and 12 km west from the Property, respectively. Electrical (735 kV) transmission lines connecting both stations run alongside the *Route du Nord* road and cross the Property near its center. Also, a 69 kV power line connecting

the *Poste Nemiscau* electrical station to the mine site has been put in service and is supplying power to the facilities.

#### 5.1.5 SURFACE RIGHTS

All claims comprising the Property are located on Crown Lands. Nemaska secured in October 2017 all surface rights to construct and operate the projected infrastructure.

### 5.2 Shawinigan Site

The Shawinigan site is located in a sector of the City identified as *Grand-Mère*, adjacent to the St-Maurice River between the *Grand-Mère* Bridge and 8<sup>th</sup> street south.

#### 5.2.1 ACCESSIBILITY

The site is easily accessible via Highway 40 or Highway 20 and Highway 55. It is located about 40 km north of *Trois-Rivières*; 140 km west of Quebec City; 170 km east of Montreal; and 860 km south-east of Matagami.

#### 5.2.2 PHYSIOGRAPHY

The Shawinigan area is located at the transition from the St-Lawrence River Lowlands to the Canadian Shield (Grenville; Laurentide's, Geologic Province). Landscape is mainly composed of rounded hills surrounded by small river valleys, with the large St-Maurice River valley acting as a central element. The main physiographic regional element is indeed the St-Maurice River (watershed of 42,651 km<sup>2</sup>) which is the 4<sup>th</sup> largest tributary of the St-Lawrence River, representing from 6 to 15% of its flow depending on time of the year. Mean annual flow is estimated to be about 755 m<sup>3</sup>/s near Shawinigan, i.e. about 40 km upstream of its mouth in the St-Lawrence River. The Shawinigan area is located in the Laurentian Forest region which is dominated by maple sugar, yellow birch, basswood and American beech, with balsam fir present in some areas.

#### 5.2.3 CLIMATE

The climate in the Shawinigan area is cold and temperate. The average annual temperature in Shawinigan is 4.7°C. About 1,063 mm of precipitation falls annually. Daily average temperature ranges from -12.7°C in January to +19.5°C in July.

#### 5.2.4 LOCAL RESOURCES AND INFRASTRUCTURE

Shawinigan has access to the CN rail network and is located less than 45 km from two (2) ports: *Trois-Rivières* and *Bécancour*. A regional airport is located in *Trois-Rivières*, approximately 20 minutes from Shawinigan. The Montreal and Quebec international airports are both less than two (2) hours away from Shawinigan.

For international overseas shipments, the port of *Trois-Rivières* is easily accessible and is connected to the Montreal highway network. Both are open year-round and thus provide options for shipping.

The site is supplied with a high-pressure natural gas line, city water and sewer system.



## 6 HISTORY

### 6.1 Regional Government Surveys

Numerous geological surveys and geoscientific studies have been conducted by the Québec Government in the James Bay area. Geological surveys in the 1960s (Valiquette 1964, 1965 and 1975) cover the entire property area. In 1998, the MRNF released the results of a regional lake bottom sediment survey completed in 1997.

### 6.2 Mineral Exploration Work

The first exploration work reported in the area, dates back to 1962 by Canico and included the discovery of a lithium-bearing pegmatite by the geologists of the Québec Bureau of Mines. That same year, Canico drilled two (2) packsack drill holes on the pegmatite, followed by three (3) diamond drill holes on the same pegmatite ridge in 1963. A total of 462.99 m was drilled. The best result obtained was 1.44% Li<sub>2</sub>O over 83.2 m (Elgring 1962).

No exploration was reported for the next ten (10) years. In 1973, James Bay Nickel Ventures (Canex Placer) performed a large-scale geological reconnaissance that covered the property (Burns 1973). From 1974 to 1982, the exploration work was exclusively reported by the *Société de Développement de la Baie James* ("SDBJ"), which mainly executed large scale geochemical surveys, followed by geological reconnaissance of the anomalies (Pride 1974, Gleeson 1975 and 1976).

Two (2) exploration programs, one in 1978 and the other in 1980 were aimed at lithium exploration, with the evaluation of the Whabouchi spodumene-bearing pegmatite (Goyer et al. 1978, Bertrand 1978, Otis 1980, Fortin 1981, and Charbonneau 1982). No channel sampling or drill holes are reported. No work was conducted from 1982 to 1987.

In 1987, Westmin Resources completed an airborne Dighem III survey. A part of this survey was located immediately east of the property (McConnell 1987). In 1987-1988, Muscocho Exploration also completed ground magnetic and VLF surveys that covered a major part of the property. The spodumene-bearing pegmatite gave a weak magnetic and VLF response. The Muscocho Exploration efforts were oriented toward the search for massive sulphides. A program of 14 holes, 11 of them located on the southern part of the Whabouchi Property, was completed. Several arsenic anomalies were obtained, with a maximum of 3,750 ppm, as in Hole ML-88-8 (Brunelle 1987, Gilliat 1987 and Zuiderveen 1988).

In 2002, while exploring for tantalum, Inco re-sampled the spodumene-bearing pegmatite, taking 11 channel samples and seven (7) grab samples. The best value obtained by Inco was 0.026% Ta, and Li<sub>2</sub>O values ranging from 0.30% to 3.72% (Babineau 2002).

In 2008, Golden Goose Resources visited and sampled the Valiquette (Ni) and chromite showings south of the Whabouchi Property (Beaupre 2008).

Nemaska, as part of the Qualifying NI 43-101 Technical Report dated July 14, 2010 initiated its exploration work on the Property during the fall of 2009. During the site visit, several outcrops of



spodumene-bearing pegmatite were observed and nine samples were collected and analyzed for  $\text{Li}_2\text{O}$ . The highest and lowest results obtained during the site visit are the grab sample # 946511, with a value of 6.3%  $\text{Li}_2\text{O}$ , and grab sample # 946508 at 1.18%  $\text{Li}_2\text{O}$  (Théberge 2009). During the fall of 2009, a mechanical stripping and trenching program was conducted to expose and sample the main spodumene-bearing pegmatite along with a small drilling program designed to validate the historical results.

During 2010 and 2011, exploration work completed by Nemaska on the Property included three (3) drilling campaigns, mechanical stripping, ground and airborne geophysics, a 50-tonne bulk sample and metallurgical testing. An initial mineral resource was estimated in May 2010 by SGS Geostat and was followed by an initial preliminary economic assessment of the Project completed in March 2011 by Equapolar in collaboration with BBA. The initial mineral resource estimate of the Whabouchi Property, effective May 28, 2010, totaled 9.78 Mt grading 1.63%  $\text{Li}_2\text{O}$  in the measured and indicated resources categories, with an additional 15.40 Mt grading 1.57%  $\text{Li}_2\text{O}$  in the inferred resources category.

Following further drilling in 2011, SGS Geostat provided Nemaska with an updated mineral resource (effective June 6, 2011) to be included in the Preliminary Economic Assessment (Prepared by Met-Chem and dated October 2, 2012). This updated mineral resource comprised 11.294 Mt of Measured resources with an average grade of 1.58%  $\text{Li}_2\text{O}$ , 13.785 Mt of Indicated resources with an average grade of 1.50%  $\text{Li}_2\text{O}$  and 4.401 Mt of inferred resources with an average grade of 1.54%  $\text{Li}_2\text{O}$ . The mineral resources were reported within an optimized pit shell and a cut-off grade of 0.43%  $\text{Li}_2\text{O}$ .

From 2012 to 2013, Nemaska conducted further drilling in order to measure the geotechnical properties of the rocks, condemn certain sector of the Property for construction and increase the level of confidence on the 2011 in-pit resources.

In the summer of 2016, the company conducted a definition drilling program on the Whabouchi deposit. The details of the drilling can be found in Section 10. The program also enabled to highlight a new mineralization zone named Doris. Furthermore, the company started a bulk sampling program in December 2016 in order to extract and pilot test up to 60,000 tonnes of mineralized material.

In the winter 2017, the company conducted a definition drilling program on the Whabouchi deposit. The focus was the better definition of measured areas based on the first five (5) years of mining. The program also enabled to add to the new Doris mineralization zone that was discovered in 2016. The details of the drilling can be found in Section 10.

In 2018, Nemaska conducted a drilling program in order to increase the level of confidence on the shallow, eastern extension part of the measured category mineral resources.

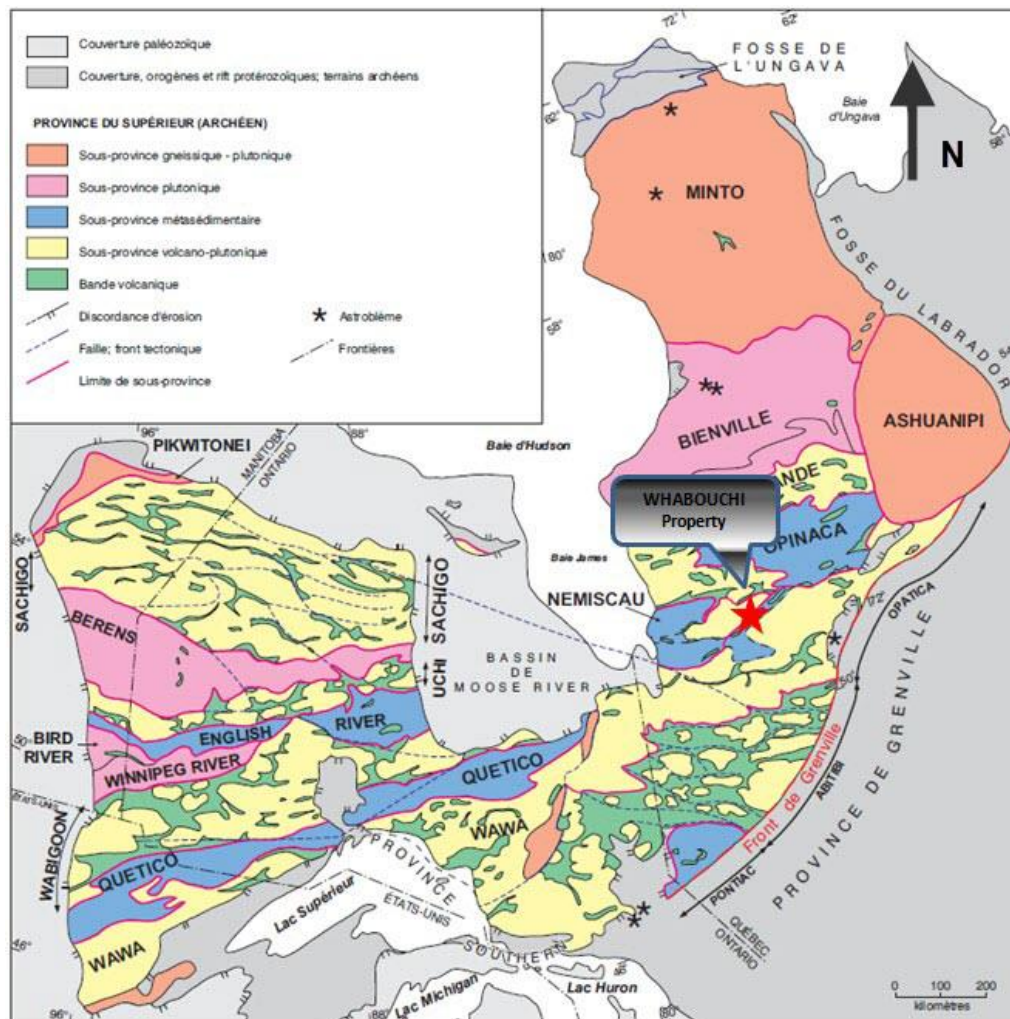
## 7 GEOLOGICAL SETTING AND MINERALIZATION

### 7.1 Regional Geology

The Whabouchi Property is located in the northeast part of the Superior Province of the Canadian Shield craton. The Superior Province extends from Manitoba to Quebec and is mainly composed of Archean-age rocks. The general metamorphism is of greenschist facies, except in the vicinity of intrusive bodies, where it reaches the amphibolite-to-granulite facies.

In Quebec, the eastern extremity of the Superior Province has been classified into nine (9) sub-provinces, from south to north: 1) Pontiac, 2) Abitibi, 3) Opatica, 4) Nemiscau, 5) Opinaca, 6) La Grande, 7) Ashuanipi, 8) Bienville and 9) Minto (Hocq 1994). According to Card and Ciesielski (1986), the area covered by the Property is located in the Opinaca or Nemiscau sub- province. Figure 7.1 shows the position of the Property in the Superior Province.

**Figure 7.1 – Regional Geology Map**

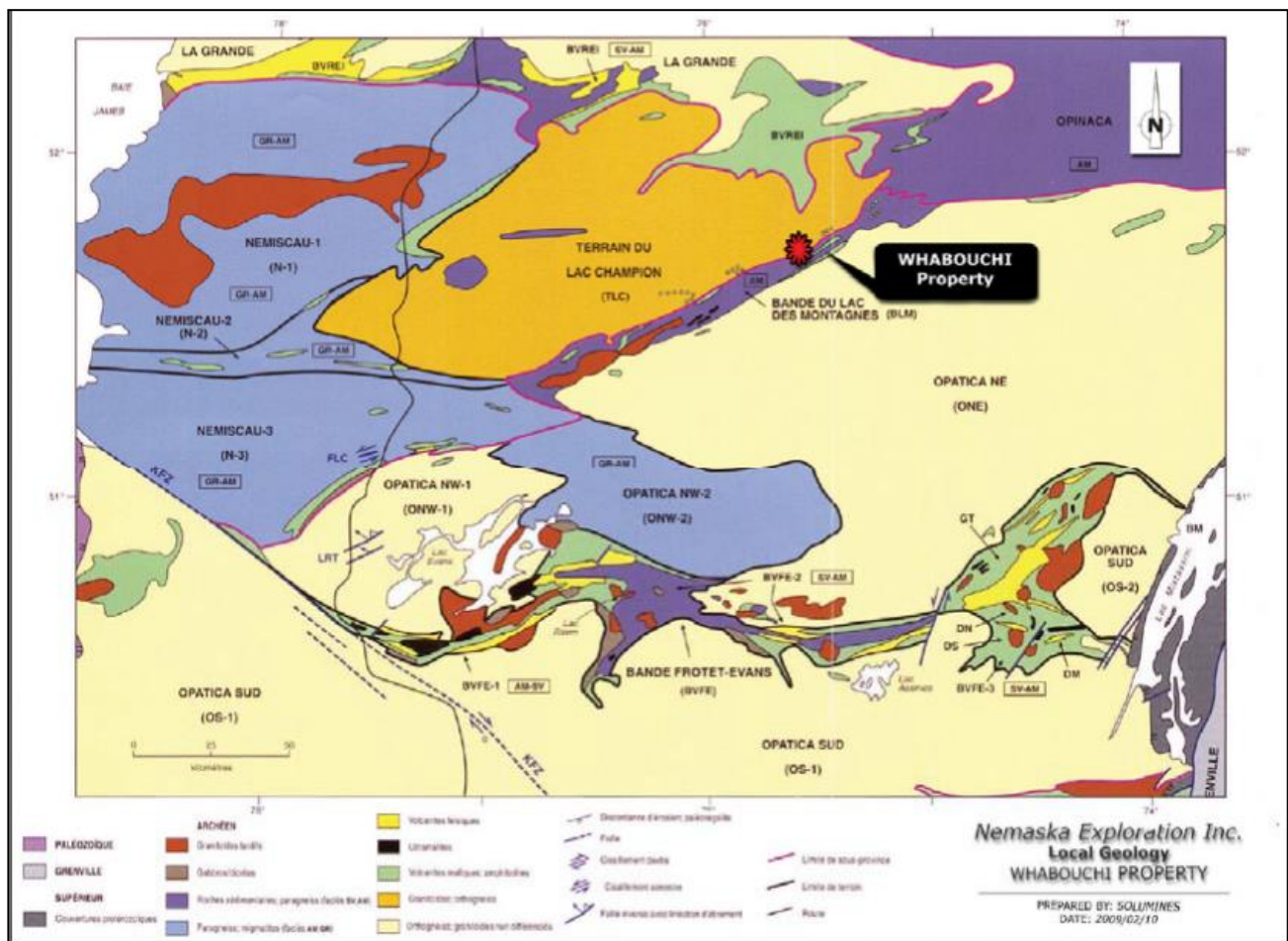


## 7.2 Property Geology

The Whabouchi Property is located in the *Lac des Montagnes* volcano-sedimentary formation and sits between the Champion Lake granotoïds and orthogneiss and the Opatica Northeast, which comprises orthogneiss and undifferentiated granitoïds. From the northwest to the southeast, the Property is underlain by the Champion Lake granitoïds, a grey oligoclase gneiss and then by the *Lac des Montagnes* formation.

The *Lac des Montagnes* belt is approximately 7 km wide in the area, oriented northeast, and is principally composed of metasediments (quartz-rich paragneiss, biotite-sillimanite-staurolite schist and garnet-bearing schist) and amphibolites (mafic and ultramafic metavolcanics). These rocks are strongly deformed and cut by late granitoïds (leucogranites and biotite-bearing white pegmatites) (Valiquette 1975). Figure 7.2 shows the location of the Property relative to the *Lac des Montagnes*, the Champion Lake and Opatica NE formations. Table 7.1 summarizes the different lithologies occurring in the area.

Figure 7.2 – Local Geological Map



**Table 7.1 – Summary of the Different Lithologies Occurring in the Area**

<b>Pleistocene and Holocene</b>	Moraines, eskers, alluvial deposits, reticulated peat bogs, morainic belts
<b>PRECAMBRIAN</b>	11: Diabase
	10: Pegmatites a) White with muscovite, tourmaline, garnet and magnetite b) Pink, with microcline
	9: White and pink granite
	8: Grey hornblende-oligoclase granite with phenocryst of pink microcline
	7: Ultramafic rocks: Serpentinites, tremolite rocks
	6: Hornblende-plagioclase gneiss
	5: Metasomatic anthophyllite-cordierite rocks (mineralization susceptible)
	4: Paragneiss or biotite schists; garnet-biotite schists; porphyroblastic schist: a) Garnet, sillimanite, biotite b) Garnet, cordierite, biotite c) Garnet, andalousite, biotite d) Staurotide, sillimanite, andalousite, biotite e) Sillimanite, cordierite, andalousite, biotite f) Amphibole paragneiss
	3: Quartz-rich paragneiss; sillimanite, sericite and quartz schist; impure quartzite
	2: Pillowed metavolcanic amphibolites
	1: Oligoclase gneiss

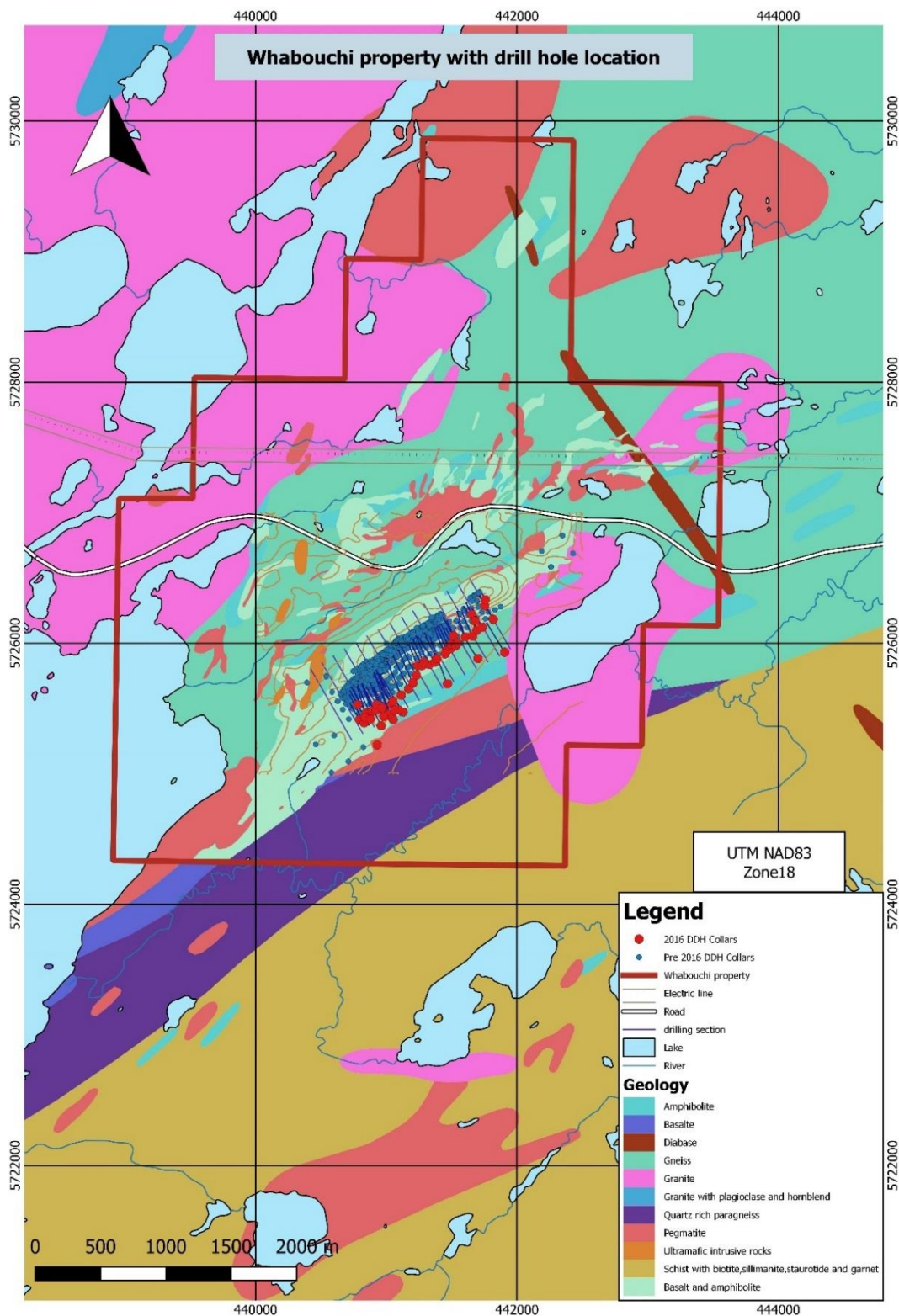
### 7.3 Local Geology

At the property level, the geology consists of a volcano-sedimentary assemblage metamorphosed to the amphibolite level (Figure 7.3). The volcanic rocks mostly comprise basalt-andesite rocks and gabbro formation. The primary textures are not identifiable, and no geochemistry data enables to correctly identify the rock types. The sedimentary units range from meta-conglomerates with elongated clasts to fine grained sedimentary units.

The volcano-sedimentary sequence is intruded by different bodies of granites and pegmatites with varying composition and probably age (no age constraints are available on the local intrusive bodies). The granites vary in texture and composition, from white and pink granite fine-grained granites to grey hornblende-oligoclase granite with phenocryst of pink microcline.

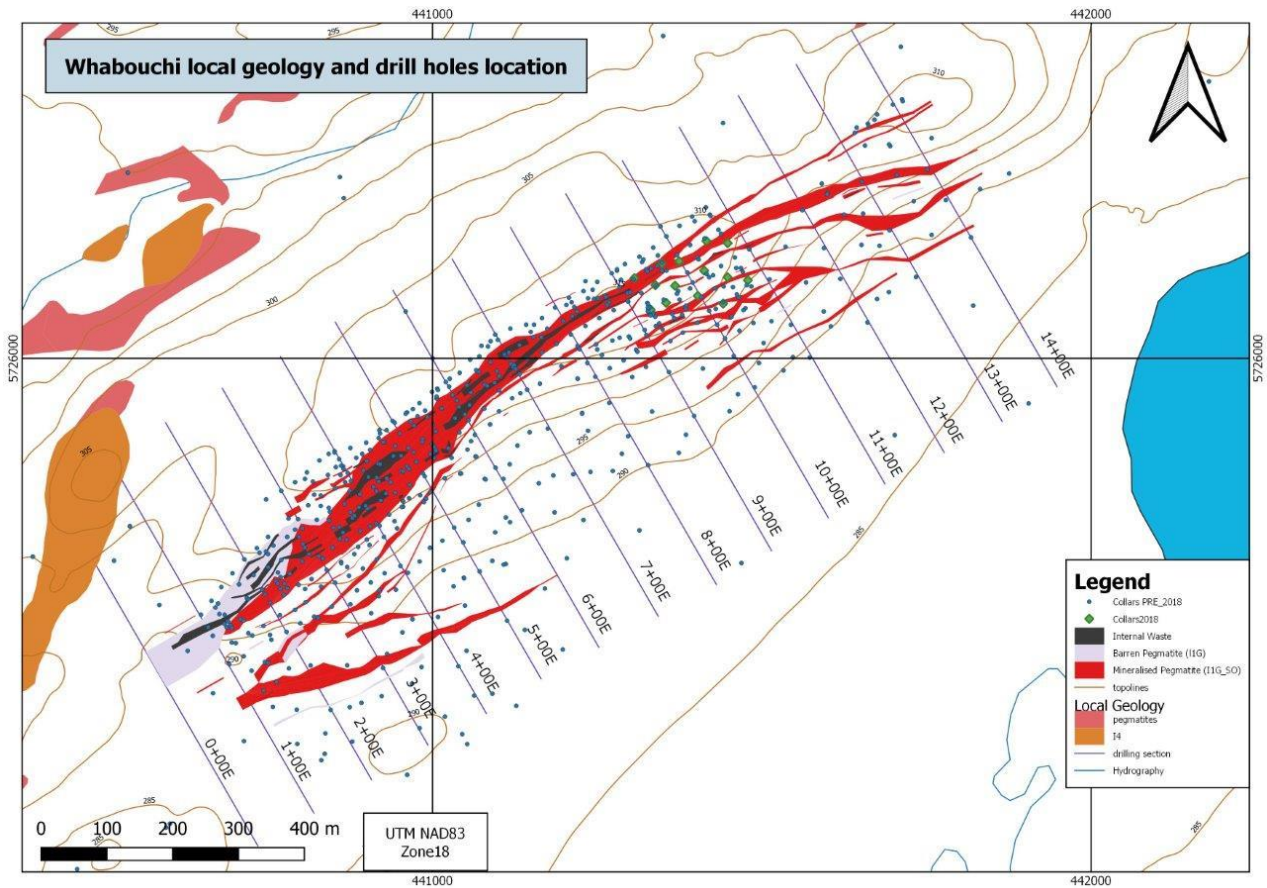


Figure 7.3 – Map of the Property Geology



The pegmatite bodies form a swarm of interconnecting dykes and plug shaped intrusions. The Whabouchi dyke swarm comprises the Main dyke (Figure 7.4) and a series of subsidiary dykes, like the Doris zone. The dykes vary in orientation from N055° to N070° and are steeply dipping towards the southeast (Main zone) and northeast (Doris). In cross sections, the dykes form “Y” shaped bodies that connect at depth (Figure 10.3). The corridor occupied by this dyke swarms as been recognized on a strike length of 1,340 m with a width ranging from 60 m to 330 m.

**Figure 7.4 – Local Map of the Pegmatite Dykes Interpretation with Drill Holes**



## 7.4 Mineralization

The regional prospecting done in the region over the years highlighted a potential for precious and base metal deposits. Cu, Zn, and Au lithogeochemical anomalies are found in the region, which is consistent with the volcano-sedimentary setting of this particular region.

The mineralization of economic interest at the Whabouchi site is found in spodumene-bearing rare metal bearing pegmatite dyke complexes. Spodumene is a lithium-bearing mineral, which contains 8% Li<sub>2</sub>O when pure. Spodumene also contains minor amounts of niobium and tantalum. Assays for spodumene normally range between 7.6% and 8.0% Li<sub>2</sub>O depending on the degree of replacement



by  $\text{Na}_2\text{O}$ . Typically, the Whabouchi pegmatite sampled from drill core averages 1.62%  $\text{Li}_2\text{O}$  with values up to 4.59%  $\text{Li}_2\text{O}$ .

Rare metal bearing pegmatites are normally found in moderately metamorphosed terranes near vast granitic plutons: a possible parental source for the pegmatitic magmas. Pegmatites are associated with granitic intrusions and are generally zoned around these intrusive centers. Pegmatites tend to be more enriched in volatile elements further away from the intrusive centers. Pegmatites are thought to be derived from primary crystallization of highly differentiated volatile enriched granitic magmas. The host rocks of the intrusion also play a significant role in the final composition of the pegmatites due to the incorporation of host rock in the magma during the intrusive process.

Pegmatite complexes can vary from a few meters to a hundred meters in length with the same variation in widths. Typically, pegmatite intrusions are zoned and show the following structures from the exterior to the interior:

- The rim zone is usually very narrow and fine-grained;
- The wall zone is normally composed of quartz, feldspar and muscovite and marks the development of larger crystals typical of pegmatites;
- The intermediate zone, when present, comprises a more complex mineralogy with varying amounts of economic minerals such as micas, beryl (Be), spodumene (Li), amblygonite (Li), lepidolite (Li-Rb), colombite-tantalite (Nb-Ta) and cassiterite (Sn). Crystals in this zone can extend up to metric lengths and
- The central zone is mainly composed of quartz in pods or automorph crystals.

Two (2) distinct phases are observed in the Whabouchi pegmatites: a spodumene-bearing phase comprising most of the pegmatite material and a lesser, white to pink barren quartz-feldspar pegmatite. The lithium mineralization occurs mainly in medium to large spodumene crystals (up to 30 cm in size) but petalite also occurs, averaging less than 2% in the deposit. Muscovite also contains minor lithium but is not recoverable by the treatment method discussed in the present Report.

## 8 DEPOSIT TYPES

*This Section has not changed since the 2014 Technical Report.*

### 8.1 Origin and Features of Rare Metal Pegmatites

The interpretation of the pegmatite model was developed by the author, Gary H. K. Pearse in 2011, based on geological mapping, evaluation work, and development work on a number of major pegmatite deposits over many years.

The Whabouchi deposit is a lithium-bearing rare metal pegmatite. Emplacement of rare metal pegmatites is the last phase of the crystallization of a parent granite pluton. High-pressure residual fluids, with abundant water, silica, alumina, alkalis, and rich in rare elements and other volatiles from the crystallization of a pluton at modest depth, concentrate in the cupola or upper domed contact of the granite as it crystallizes.

Under increasing pressure, this fluid dilates fractures in overlying rocks in a manner analogous to that of hydraulics in mechanical equipment, thereby providing feeder channels for emplacement of pegmatites at shallower depth. Progressive crystallization of the main rock-forming minerals out of this fluid enriches the final fluids in rare metals and the process culminates in the formation of rare metal pegmatites still under fluid pressure.

A variety of types occur depending on the abundance and type of rare metals associated with the pluton and the physico-chemical conditions affecting the sequence of emplacement events.

Pegmatite petrologists classify the variety of types and subtypes by combinations of the following criteria:

- Mineralogical-geochemical signatures;
- Internal structure/zonation;
- Pressure-temperature conditions of crystallization.

The criteria are related through degree of fractionation, which arises from the chemical, temperature and pressure evolution of the pegmatite fluids over time and distance from the parent granite. The complex rare element pegmatites generally evolve as follows: at depth under high-pressure and temperature conditions, simple granite pegmatites of quartz, feldspar and mica crystallize in fractures above and within the solidified granite pluton. Above this level, columbo-tantalite minerals appear starting with high niobium compositions and progress to higher tantalum/niobium ratios where the complex pegmatites appear with lithium, cesium, and rubidium bearing minerals.

Variations may appear, in which petalite is the dominant lithium mineral, often along with pollucite, lepidolite, etc. Alternatively, spodumene dominates in a classification known as albite-spodumene pegmatite. Tantalum may occur in a variety of minerals and cassiterite may be present. A final, mariolitic or greisen phase at low pressure-temperature, may be present with lepidolite, quartz, tantalum-rich minerals, tin, topaz, etc. Where beryllium is relatively abundant, beryl (most commonly)

or other beryllium minerals, these often occur throughout the sequence from the parent granite through all phases to the final mariolitic mineralization.

Three (3) characteristics of the geological setting for rare metal pegmatites are common:

- Emplacement in concordant stacked sills;
- Presence of a compressed, near-vertical, syntectonic mobile zone that is the locus of pegmatite intrusion;
- Host rocks most commonly are dominantly mafic volcanics often with intercalated metasediments and gabbroic rocks.

## 8.2 Stacked Sill Structure

Although a field of rare metal pegmatites is commonly termed a dyke swarm, the major economic ones are most commonly emplaced in concordant, shallow to medium dipping sills with one or more steeply dipping feeder dykes. The mechanism for emplacement of the rare metal pegmatite sills is as follows: stratification in volcanic-metasedimentary-gabbroic piles provides planes of weakness along contacts that facilitate entry of, and hydraulic dilation by late-stage pressurized rare metal bearing fluid.

The layering also provides a barrier or cap to the escape of the volatile fluids from which the final rare metal pegmatites crystallize. Zoning in the pegmatite results from a continuation of crystallization of the rock forming minerals from the cooler contacts inward in the dilated space-albite at the contact, dominantly K-feldspar with quartz-mica next, spodumene quartz with some feldpars and mica, and finally, a core of quartz (in the albite-spodumene type). This simple zoning is often made more complex by two (2) or more pulses of intrusion, albitization and other replacement reactions.

## 8.3 Syntectonic Mobile Zone Feeder Dykes

The feeder dykes are near vertical and represent the conduit from depth connecting the pluton to the final rare metal pegmatite bodies. In most cases, shearing at the contacts of the dyke and mylonitization and/or plastic deformation of the feeder pegmatite identifies this as a deeper, syntectonic mobile zone. In extreme cases, the feeder pegmatite may be stretched and result in the formation of boudinage structure (as occurs at the Moblan Lake “Southwest Dyke” in northern Quebec). The feeder dykes tend to be intermediate in composition in the fractionation chain.

## 8.4 Mafic Host Rocks

Virtually all pegmatite researchers make only passing reference or none at all to the host rocks of rare metal pegmatites. Their interest has been limited to contact geochemistry and mineralogy and to some extent, the structural setting. The fact that most often the host rocks are volcanic-metasedimentary-gabbroic piles indicates that these rocks are an important part of the genesis of rare metal pegmatite fields.

Gary H. K. Pearce submits that the presence of these host rocks may be the most important factor after parent granite composition in the genesis of rare metal pegmatites. The layering and ductility, particularly of mafic volcanics and gabbros, causes the pile to flex and stretch without fracturing, thereby confining the high pressure volatiles to permit final crystallization of the rare metal pegmatite. This mechanical behaviour is also conducive to selective emplacement along contact zones between units of the host rock, which accounts for the preponderance of sill-controlled pegmatite deposits.

Were the host to be brittle and isotropic, the rocks would tend to fracture, the confinement required to permit coarse crystallization would be absent or greatly reduced, the volatiles would be essentially lost and the final product may be a more uniform feldspar-mica-spodumene rock with more subtle zoning or little zonation at all (examples are: the Thompson Brothers deposit at Wekusko Lake, Manitoba and the Quebec Lithium deposit near Amos, QC). In cases where the active feeder dyke propagates through brittle fractures quickly to the surface, the final phase would be an extrusive rhyolite.

## 8.5 Whabouchi Pegmatite

The Whabouchi pegmatite is a highly fractionated, spodumene-rich pegmatite swarm, individual bodies of which display typical zoning to varying degrees – a comparatively thin albite wall zone at the contacts followed by a K-feldspar rich zone with lesser albite, quartz, mica, and little or no spodumene, followed by a spodumene-quartz-rich core zone (with variable feldspars and mica) making up more than 90% of the cross-section.

The Whabouchi deposit lacks a quartz core which is one of the classic zoned pegmatite features. Insufficient stratigraphic work has been done on the host rocks to establish that the bodies are dominantly sills as in the classic case. The concordance of the bodies with the greenstone belt and the persistence of even thin pegmatite bodies over a 100 m or more on strike and at depth support this structural control. The drilled sections at 700E and 800E on the grid do appear to show this, in that the hanging wall of the main pegmatite zone is basalt and the footwall gabbro.

## 9 EXPLORATION

Exploration Nemaska Inc., at that time, began working on the Property in October of 2009 with a first exploration program that lasted 25 days. During the fall 2009 exploration program, mechanical stripping successfully exposed the spodumene-bearing pegmatites in 16 trenches spaced between 50 and 100 m apart and covering 1,000 m in strike length. From these trenches, 35 channels were cut and a total of 295 samples were collected for analysis. In addition to the trenching work, seven (7) diamond drill holes were completed including one hole abandoned for technical reasons. All successful drill holes have intersected pegmatites zones.

A second exploration program was conducted from January to April 2010. During that program, 59 drill holes totaling 11,600 m were completed. In addition to drilling, 14 line-km of ground magnetic surveying covering the main mineralized occurrence and 670 line-km of helicopter-borne magnetic surveying covering the Property were completed. Later in May 2010, Nemaska completed 2,780 m of mechanical stripping of the south contact of the main mineralized zone with (16 trenches and seven (7) contact zones) and collected 649 channel samples. The stripping also allowed the mapping of the surface geology. A 1.2 km access road from the Route du Nord main road was constructed in 2010.

In late 2010, 23 drill holes were completed. An additional 41 holes were drilled in 2011 including 26 for infill drilling, three (3) for metallurgical tests for a total of 9,500 m. In May 2011, a 50-tonne bulk sample was collected at surface for metallurgical testing purposes.

In 2013, 14 drill holes were added to better define the mineralization towards the Eastern boundary and also to increase the level of confidence of the 2011 in-pit mineral resources. A total of 1,815 m of drilling was completed and 351 samples were sent for Li<sub>2</sub>O assay.

In 2016, 51 drill holes were added to:

- Convert the inferred in pit inferred resources to indicated;
- Increase the confidence level of mineral resources from 0 m to 200 m; and
- Extend the mineral potential at depth.

A total of 17,424 m of drilling were completed and 4,039 samples were sent for Li<sub>2</sub>O% analysis.

A new zone name Doris was discovered to the Southeast of the known Whabouchi deposit. The drilling campaign was conducted by SGS Canada Inc. under the supervision of Jean-Philippe Paiement, P. Geo., M.Sc. The drilling contractor retained for that campaign was Forage Rouillier, a division of Groupe Rouillier ("Forage Rouillier"). The drilling took place from July 7, 2016 to September 16, 2016.

In 2017, Nemaska commissioned ASDR and its representative Louis Caron, geologist, to oversee a drilling campaign on 48 drill holes totaling 4,361 m on the Whabouchi Property. This campaign aimed to verify the extension of pegmatite veins from the Doris Zone and to better define the geological

continuity and lithium content in the main zone targeted to be mined during the first five (5) years of mining operation. Drilling was carried out by Forage Rouillier between April 4 and June 6, 2017.

In 2018, Nemaska Geological team geologists, supervised a drilling campaign on 14 drill holes totaling 2,070 m on the Whabouchi Property eastern portion of the measured area. This campaign aimed to verify the extension of mineralisation and to better define the geological continuity and lithium content in the main zone targeted to be mined during the first five (5) years of mining operation. Drilling was carried out by Forage Rouillier of Val-d'Or between September 13 and October 14, 2018.



## 10 DRILLING

A total 258 drill holes were completed by Nemaska to define the mineral deposit. In addition to the drilling, extensive mechanical stripping on surface permitted the completion of more than 140 channels. Tables 10.1 and 10.2 summarize the drilling and channel sampling completed by Nemaska to define the mineralized pegmatite intrusion.

**Table 10.1 – Drilling Completed by Nemaska at Whabouchi**

Year	Count	Metres Drilled
2009	8	999
2010	82	15,670
2011	41	9,257
2013	14	1,815
2016	51	17,424
2017	48	4,361
2018	14	2,070
<b>Total</b>	<b>258</b>	<b>51,596</b>

**Table 10.2 – Channel Sampling done by Nemaska at Whabouchi**

Year	Channels	Total Samples
2009	35	295
2010	108	649
<b>Total</b>	<b>143</b>	<b>944</b>

All the drilling done by Nemaska used NQ and HQ coring size. HQ size was used to collect material for metallurgical testing in 2011. The samples collected for analysis represent approximately 36% of the drill core material. The drill holes are generally spaced 25 m to 50 m apart with azimuth ranging between N312° and N340° with an average of N330°. The dips range from 43° to 75° and average 50°. The deepest hole reaches 640 m below collar location. The mineralized drill intersection ranges from near true thickness to 70% true thickness.

The geometry of spodumene-bearing pegmatites is defined as a series of stacked dyke-shaped intrusions which include a thicker principal intrusion. Some pegmatite contains local rafts or xenoliths of the host rock which can be a few metres thick and hundreds of metres in length.

Based on the information gathered from the drilling, the pegmatite intrusion is more than 1,300 metres in length and can be up to 90 metres thick. The intrusions are generally oriented N050° with dips varying from the southeast to the northwest at an angle ranging between 70° and 85° and are reaching depths of up to 530 metres below surface. Please refer to Section 14 for the interpretation of the drill results based on the update of the past mineral resources estimate (SGS Canada, 2016).

Figure 10.1 to Figure 10.5 show the drill holes in plan view, on longitudinal sections and on representative cross sections. Please note that the holes shown in red refer to the 2018 drilling program.

## 10.1 2018 Drilling

Core Drilling was planned by SGS. The drilling campaign was done under Mr. Patrick Laforest, P. Geo. and Clémence Maltais-Hardy, Geologists in Training of Nemaska Lithium. Drilling was surveyed by the Land surveying firm MYS. Drill holes of more than 100 m were surveyed by the REFLEX multishot method and those of less than 100 m by single-shot REFLEX method. REFLEX results were corrected ( $-15^\circ$ ) to the REFLEX readings for correction the geographic north (UTM Nad 83).

In 2018, 20 diamond drill holes were added. Out of which 14 drill holes totaling 2,070 m were infilling drilling between section 900 and 1100 and six (6) drill holes totaling 960 m were core oriented geotechnical holes. Drilling was done by Forages Rouillier of Val d'Or between September 13 and October 14, 2018.

These drill holes were intended to better define the geological and grade continuity of the pegmatite veins on a general thickness of 50 m below the surface.

The author completed verification programs of the Project's analytical data and considers that there are no known drilling, sampling or recovery factors that could materially impact the accuracy and reliability of the results. The data from the few historical drill holes reported on the Project could not be validated and were not considered as part of the current mineral resource estimate.

**Figure 10.1 – Plan View of the Drilling at Whabouchi**

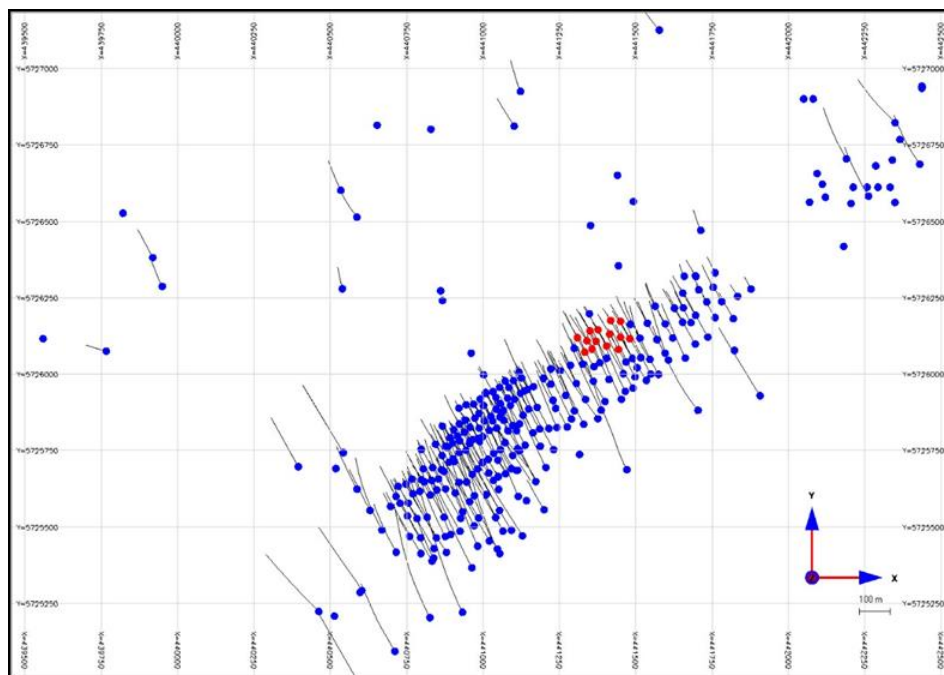


Figure 10.2 – Longitudinal view of the Drilling at Whabouchi

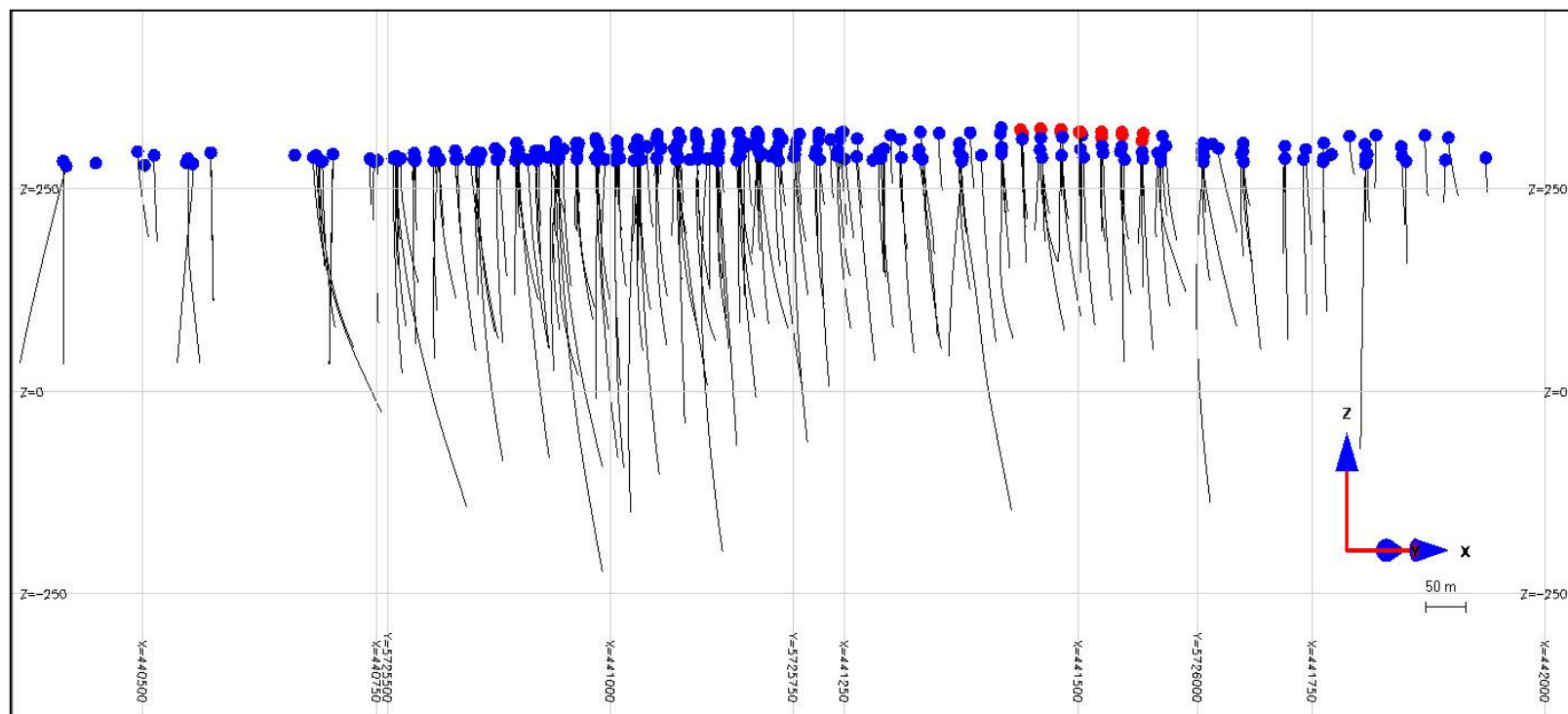


Figure 10.3 – Section 250E Showing Drill Holes and Mineralization Interpretations (Looking West)

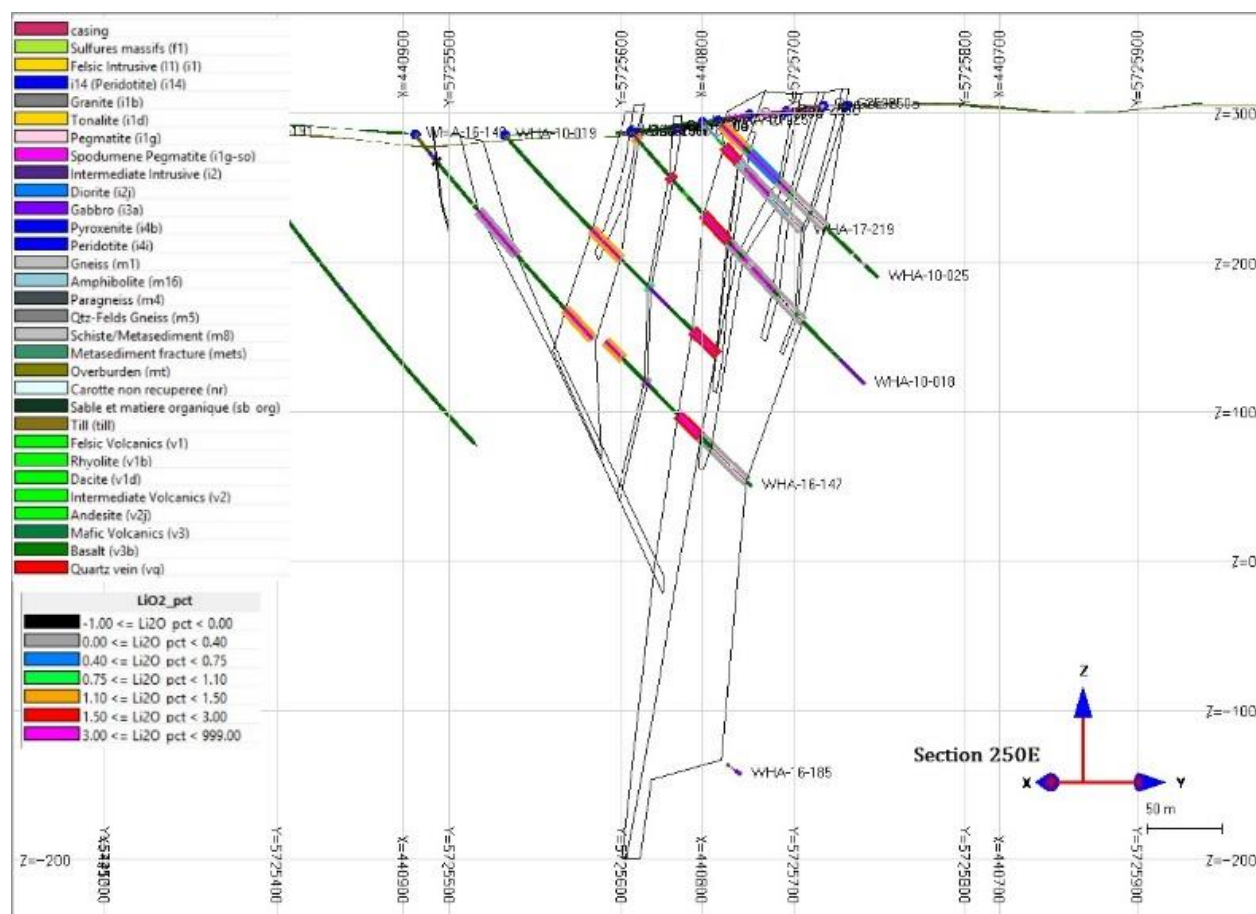
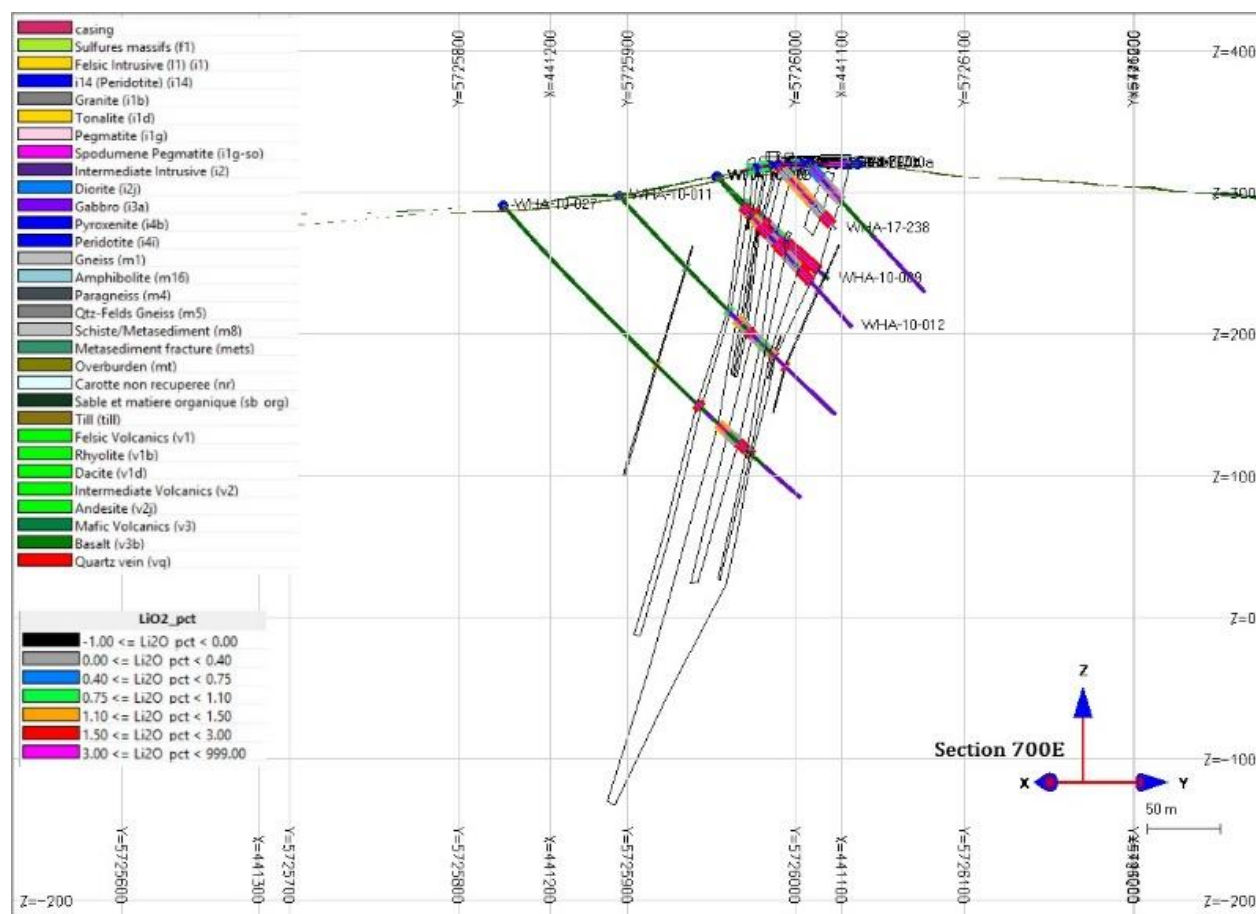
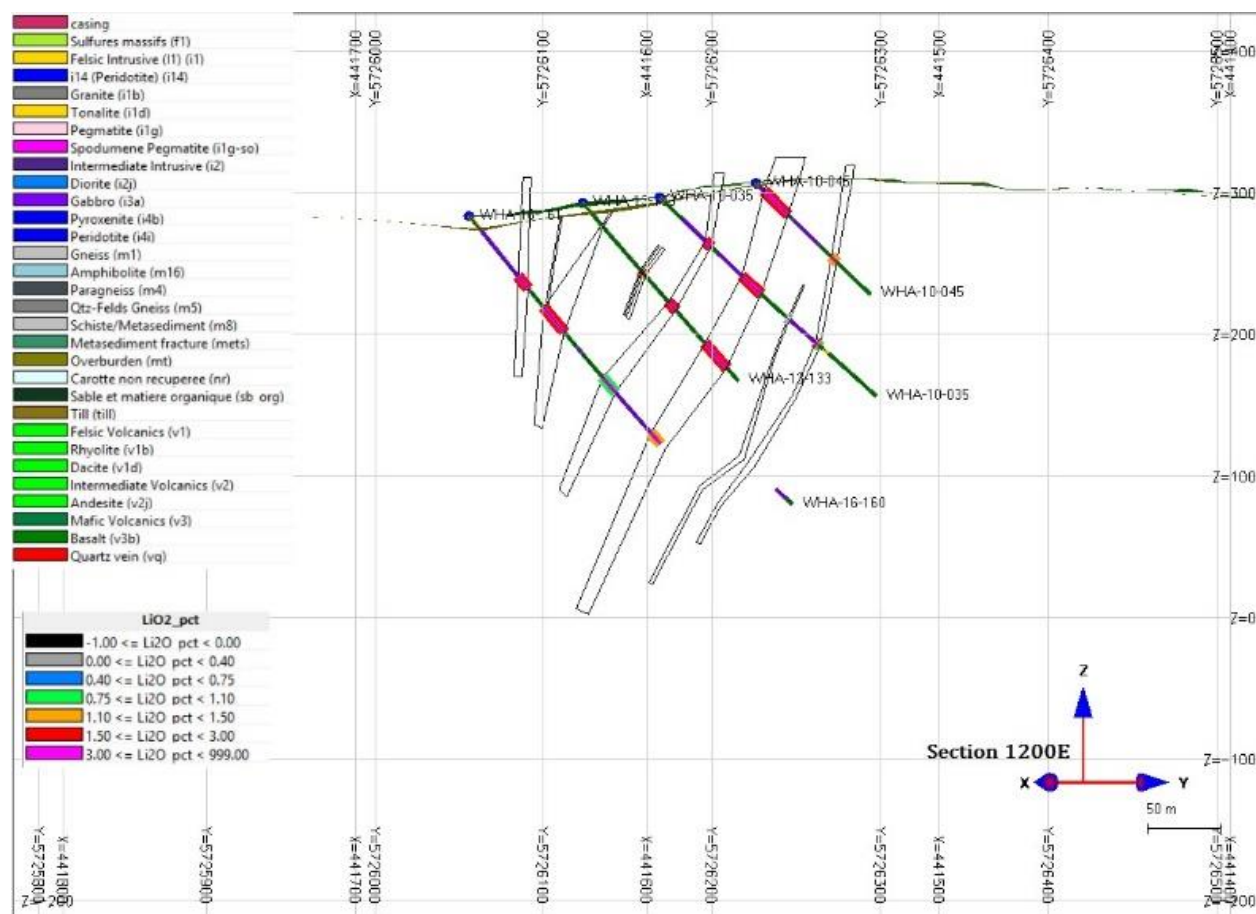


Figure 10.4 – Section 700E Showing Drill Holes and Mineralization Interpretations (Looking West)





**Figure 10.5 – Section 1200E Showing Drill Holes and Mineralization Interpretations (Looking West)**



## 11 SAMPLE PREPARATION, ANALYSIS AND SECURITY

This section is based on information supplied by Nemaska and observations made during the independent verification programs conducted at the Project site by SGS on November 27, 2013 and during the drilling program of the 2016 summer. Furthermore, the 2017, 2018 QA/QC and Drilling results were verified by SGS. Site visits were made by Maxime Dupéré on December 5, 2017 and on May 20 and 21, 2019.

### 11.1 Sample Procedure and Sample Security

The Whabouchi Project is located less than 12 km east of the Nemiscau Camp where the Project office and core logging facilities are located. The evaluation of the geological setting and mineralization on the Property is based on observations and sampling from surface (through geological mapping, grab and channel samples) and diamond drilling. The channel and drill core logging and sampling was conducted at the Property or at the nearby Project facilities. All samples collected by Nemaska during the course of the 2009, 2010 and 2011 exploration programs were sent to the *Table Jamésienne de Concertation Minière* (“**TJCM**”) preparation laboratory located in Chibougamau, QC.

The 2009 and 2010 sample pulps were shipped to SGS Canada Inc. – Mineral Services (“**SGS Minerals**”) laboratory in Don Mills, Ontario, for analysis. The 2011 and 2013 sample pulps were sent to ALS Canada Inc. – Chemex Laboratory (“**ALS Chemex**”) in North Vancouver, BC and Val d’Or, QC for analysis. The 2016 sample were shipped to SGS Canada Inc. – Mineral Services (“**SGS Minerals**”) laboratory in Quebec City, QC for preparation and to Lakefield, ON for analysis. The remaining drill core is stored at the Property site in covered metal core racks.

All channel samples and drill core handling were done on site with logging and sampling processes conducted by employees and contractors of Nemaska. The observations on lithology, structure, mineralization, sample number, and location were noted by the geologists and technicians on hardcopy and then recorded in a Microsoft Access digital database. Copies of the database are stored on external hard drive for security.

Channel samples were collected from two (2) diamond saw cuts (typically 4 cm in width and 4 cm in depth). Each sample is generally one (1) m long and broken directly from the outcrop, identified and numbered then placed in a new plastic bag. Drill core of NQ and HQ size was placed in wooden core boxes and delivered twice daily by the drill contractor to the Project core logging facilities at the Nemiscau Camp. The drill core was first aligned and measured by a technician for core recovery.

The core recovery measurements were followed by the RQD measurements. After a summary review, the core was logged and sampling intervals were defined by a geologist. Before sampling, the core was photographed using a digital camera and the core boxes were identified with Box Number, Hole ID, and by using “From” and “To” aluminum tags. Due to the hardness of the pegmatite units, the recovery of the channel material and the drill core was generally very good, averaging more than 95%.

Sampling intervals were determined by the geologist, marked and tagged based on observations of the lithology and mineralization. The typical sampling length is one (1) m but can vary according to lithological contacts between the mineralized pegmatite and the host rock. In general, one (1) host rock sample was collected from each side that contacts the pegmatite. The NQ drill core samples were split into two (2) halves with one (1) half placed in a new plastic bag along with the sample tag; the other half was replaced in the core box with the second sample tag for reference. The third sample tag was archived on site.

The HQ size drill core was collected for a portion of the 2011 program for metallurgical purposes. The first half of the HQ drill core was selected for metallurgical testing. The second half was split in two (2) quarters, one (1) quarter placed in a new plastic bag along with the sample tag and the remaining quarter was replaced in the core box with the second sample tag for reference. The samples were then catalogued and placed in rice bags or pails, for shipping. The sample shipment forms were prepared on site with one (1) copy inserted with the shipment, one (1) copy sent by email to TJCM, and one (1) copy kept for reference.

The samples were transported on a regular basis by Nemaska's employees or contractors by pick-up truck directly to the TJCM facilities in Chibougamau. At the TJCM laboratory, the sample shipment was verified, and a confirmation of shipment reception and content was emailed to Nemaska's project manager.

SGS validated the exploration processes and core sampling procedures (2011) used by Nemaska as part of an independent verification program. The author concluded that the drill core handling, logging and sampling protocols are at conventional industry standard and conform to generally accept best practices. The author considers that the samples quality is good and that the samples are generally representative. Finally, the author is confident that the system is appropriate for the collection of data suitable for the estimation of a NI 43-101 compliant mineral resource estimate.

## 11.2 Sample Preparation and Analysis

Channel and drill core samples collected during the 2009, 2010, 2011, and 2013 exploration programs were transported directly by Nemaska representatives to the TJCM laboratory facilities in Chibougamau, QC for sample preparation. The submitted samples were pulverized at the TJCM laboratory to respect the specifications of the analytical protocol and then shipped to SGS Minerals or ALS Chemex for analysis. The author of the 2011 Technical Report visited the TJCM facilities on March 10, 2010. In 2016, samples were pulverized at the SGS facilities in Quebec City, QC, following the same specification used by TJCM.

All samples received at TJCM were inventoried and weighted prior to being processed. Drying was done to samples having excess humidity. Sample material was crushed to 80-85% passing two (2) mm using jaw crushers. Ground material was split using a split riffle to obtain a 275-300 g sub-sample. Sub-samples were then pulverized using a 2-component ring mill (ring and puck mill) or a single component ring mill (flying disk mill) to 85-90% passing 200 mesh (75 µm). The balance of

the crushed sample (reject) was placed into the original plastic bag. The pulverized samples were finally sent to SGS Minerals or ALS Chemex using Canada Post secured delivery services.

All samples received at SGS Mineral, Quebec City, QC were inventoried weight and dry prior to being process. Sampling material was crushed to 75% passing two (2) mm using jaw crushers. Ground material was spilt to 250 g sub-samples and then pulverized using a 2-component ring mill (ring and puck mill) or a single component ring mill (flying disk mill) to 85% passing 200 mesh (75 µm). The pulverized samples were sent to SGS Minerals laboratory in Lakefield using Purolator secured delivery services.

The majority of the 2009 and 2010 analyses were conducted at the SGS Minerals Laboratory located in Don Mills, ON, which is an ISO/IEC 17025 laboratory accredited by the Standards Council of Canada. There are two (2) analytical methods used for the pulverized samples from the Whabouchi Project.

The first analytical method used by SGS Minerals is the 55-element analysis using sodium peroxide fusion followed by both Inductively Coupled Plasma Optical Emission Spectrometry (“**ICP-OES**”) and Inductively Coupled Plasma Mass Spectrometry (“**ICP-MS**”) finish (SGS code ICM90A). This method uses 10 g of the pulp material and returns different detection limits for each element and includes 10 ppm lower limit detection for Li. The ICM90A analytical method was conducted at the beginning of the 2009-2010 exploration program to verify the content of other elements in the mineralization.

The second method processed 20 g of pulp material and used the mineralization grade sodium peroxide fusion with ICP-OES finish methodology with a lower detection limit of 0.01% Li (SGS code ICP90Q). The ICP90Q analytical method was used at the beginning of the exploration program on samples analysed by ICM90A returning values greater than 0.30% Li. The ICP90Q method for Li was later used on a more systematic basis. Analytical results were sent electronically to Nemaska and results were compiled in an MS Excel spreadsheet by the project manager.

The 2016, 2017, and 2018 drill samples were analysed at the SGS Minerals Laboratory located in Lakefield, ON, accredited by the Standards Council of Canada. There used four-acid digestion with Inductively Coupled Plasma – Atomic Emission Spectrometry (“**ICP-AES**”) (SGS code GO ICP41Q) verified by a sodium peroxide fusion AAS (SGS code GC AAS93B).

The 2010 and 2016, pulp reanalysis and the 2011 and 2013 analyses were conducted at ALS Chemex using the mineralization grade lithium four-acid digestion with Inductively Coupled Plasma – Atomic Emission Spectrometry (“**ICP-AES**”) (ALS code Li-OG63). The Li-OG63 analytical method used four (4) g of pulp material and returned a lower detection limit of 0.01% Li.

The 2018, pulp reanalysis were conducted at Actlabs, Ancaster, ON, using the mineralization grade lithium four-acid digestion with Inductively Coupled Plasma –optical emission spectrometry or mass spectrometry (“**ICP-OES/ ICP-MS**”) (code 8-Li).

### 11.3 Quality Assurance and Quality Control Procedure

Above the laboratory quality assurance and quality control (“QA/QC”) routinely implemented by SGS Minerals and ALS Chemex using pulp duplicate analysis, Nemaska developed an internal QA/QC protocol consisting in the insertion of analytical standards, blanks and core duplicates on a systematic basis with the samples shipped to the analytical laboratories. In 2010, Nemaska also sent pulps from selected mineralized intersection to ALS Chemex for reanalysis. No pulp reanalysis was performed by Nemaska in 2011 and 2013. The author did not visit the SGS Minerals or ALS Chemex facilities or conduct an audit of the laboratories.

### 11.4 Analytical Standards

Two (2) different standards were used by Nemaska for the internal QA/QC program between 2009 and 2015: one (1) low grade lithium (“Li-LG”) and one (1) high grade lithium (“Li-HG”) standards. Both standards were custom made reference materials coming from historical drill core from the Whabouchi deposit itself. The preparation for the standards material has been conducted by TJCM using the same sample preparation protocol used for the regular Whabouchi samples. Each standard inserted weight between 90 and 120 g.

In order to evaluate their expected values, Li-HG and Li-LG standards have been analysed six (6) times, each at the SGS Mineral Services laboratory in Don Mills, Ontario, and five (5) times each at the ALS Chemex laboratory in North Vancouver, BC. Both facilities are accredited ISO/IEC 17025 laboratories. The analytical protocol used at SGS Minerals is the mineralization grade sodium peroxide fusion with ICP-OES finish (SGS code ICP90Q). The analytical protocol used at ALS Chemex is the mineralization grade lithium four-acid digestion with Inductively Coupled Plasma – Atomic Emission Spectrometry (“ICP-AES”) finish (ALS code Li-OG63).

For the Li-LG standard, the analytical results returned from SGS Minerals for the six (6) samples averaged 0.46% Li versus an average of 0.45% Li for the five (5) samples submitted to ALS Chemex. For the Li-HG standards, the average of the six (6) samples returned 0.72% Li versus an average of 0.71% Li for the five (5) samples processed at ALS Chemex.

Each laboratory showed relatively consistent analytical results from one sample to another for each standard analysed. The averages for each standard also showed a good correlation between SGS Minerals and ALS Chemex. The amount of data is not statistically significant to calculate standard deviation (“Std. Dev.”) parameters which can be used to determine the success/failure of standards. Table 11.1 shows the results for each standard using both analytical protocols.

The insertion of the analytical standards Li-LG and Li-HG did not begin until drill hole WHA 10-15. After that, one (1) standard was inserted in the sample series at a rate of one (1) every 25 regular samples, alternating between the Li-LG and Li-HG standards. A total of 185 Li-HG and 169 Li-LG standards were analysed during the 2010, 2011, and 2013 exploration campaigns, representing 3.8% of the samples analysed. In order to determine the QC warning ( $\pm 2x$  Std. Dev.) and QC failure



( $\pm 3 \times$  Std. Dev.) intervals for the Li-LG and Li-HG standards, the Std. Dev. parameters returned from the 185 Li-HG and 169 Li-LG analytical results are considered.

**Table 11.1 – Sets Values for the Li-LG and Li-HG Standards**

SGS Minerals - ICP90Q Analytical Method			
Low Grade Standard (Li-LG)		High Grade Standard (Li-HG)	
Sample	Li (%)	Sample	Li (%)
Li-LG 1	0.47	Li-HG 1	0.72
Li-LG 2	0.46	Li-HG 2	0.72
Li-LG 3	0.46	Li-HG 3	0.72
Li-LG 4	0.46	Li-HG 4	0.71
Li-LG 5	0.46	Li-HG 5	0.71
Li-LG 6	0.46	Li-HG 6	0.72
Average	0.46	Average	0.72
ALS Chemex - Li-OG63 Analytical Method			
Low Grade Standard (Li-LG)		High Grade Standard (Li-HG)	
Sample	Li (%)	Sample	Li (%)
Li-LG 1	0.44	Li-HG 1	0.72
Li-LG 2	0.44	Li-HG 2	0.69
Li-LG 3	0.45	Li-HG 3	0.71
Li-LG 4	0.47	Li-HG 4	0.72
Li-LG 5	0.44	Li-HG 5	0.72
Average	0.45	Average	0.71
Averages for Both SGS Minerals and ALS Chemex Methods			
Standard	Li (%)	Standard	Li (%)
Li-LG	0.46	Li-HG	0.71

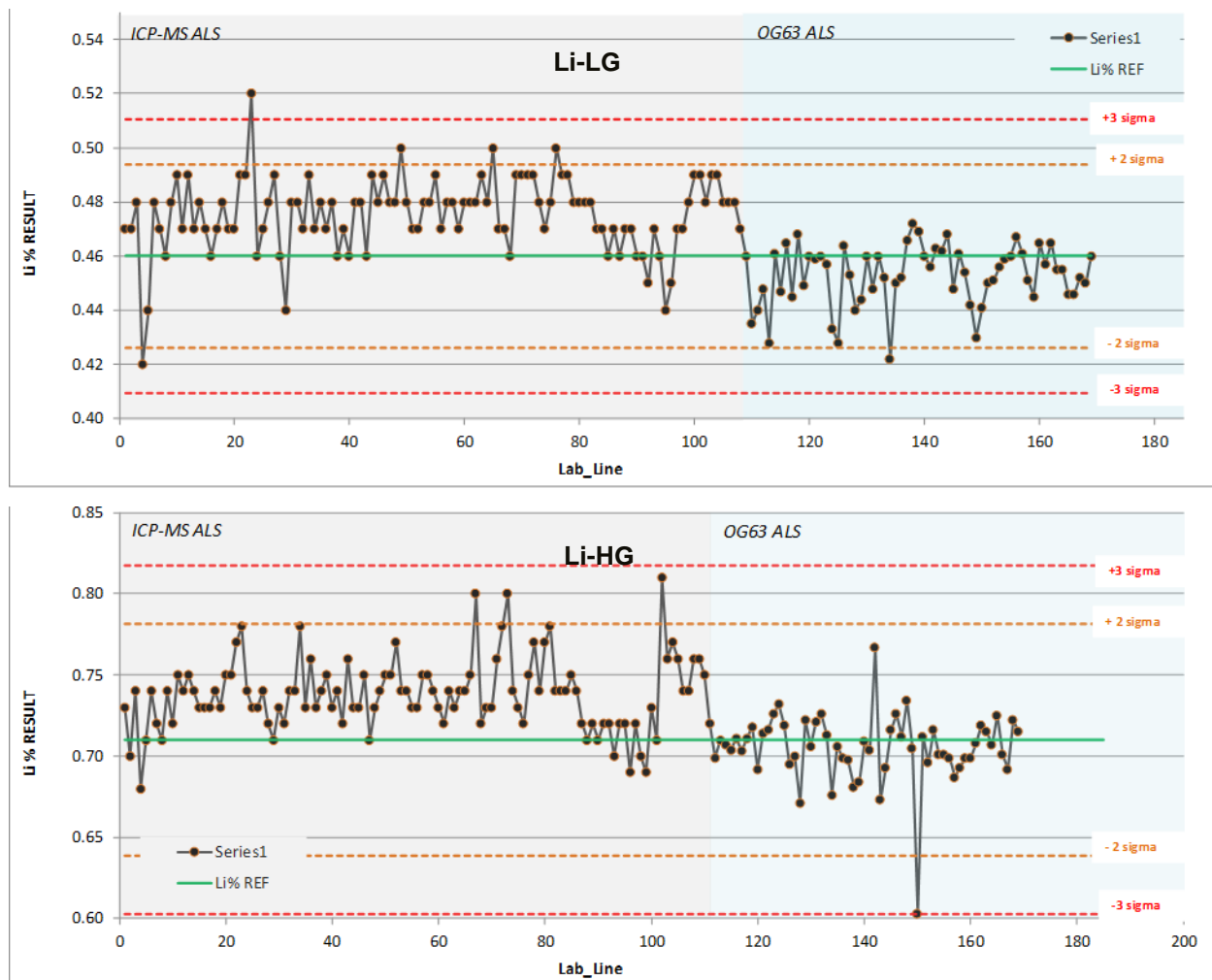
From the 185 Li-HG standards analysed, 19 standards fall outside the QC Warning interval and one (1) standards fall outside the QC Failure interval. After reviewing the five (5) failures, they are considered acceptable as the value falls within 12-15% of the expected value for Li-HG. From the 169 Li-LG standards analysed, seven (7) fall outside the QC Warning interval and one (1) is considered a failure as it falls outside the QC Failure interval. After reviewing the only failure, it is considered acceptable as it returned 13% of the expected value for Li-LG. Table 11.2 reports the

statistics of the Li-LG and Li-HG standards. Figure 11.4 shows plots of the variation of both standards with time.

**Table 11.2 – Summary Statistics of Li-LG and Li-HG Standards**

Standard	Count	Expected Li (%)	Observed Li (%)		Expected (%)	QC Warning	QC Failure
		Average	Average	Std. Dev.			
Li-LG	169	0.46	0.47	0.017	102%	7	1
Li-HG	185	0.71	0.73	0.04	103%	19	1

**Figure 11.1 – Plots of the Variation of the Li-LG and Li-HG Standards with Time**



In 2016 and 2017, two (2) new standards were used by Nemaska for the internal QA/QC program: one (1) low grade (“NCS DC 86303”) standard (0.46% Li<sub>2</sub>O) and one (1) high grade (“NCS DC

**86314”**) standard (3.89% Li<sub>2</sub>O). Both standards were made and certified by the China National Analysis Center for Iron and Steel in Beijing, China. This facility is accredited ISO 9001 laboratory.

Analytical protocol used by the Chinese Center for the low-grade standard NCS DC 86303 is Flame Atomic Absorption Spectrometry – Flame Photometry (**AAS FP**). The analytical protocol used for the high-grade standard NCS DC 86314 is Atomic Absorption Spectrometry (**AAS**) with Inductively Couple Plasma – Atomic Emission Spectrometry (**ICP-AES**) and Inductively Couple Plasma – Mass Spectrometry (**ICP-MS**).

Certified Li<sub>2</sub>O values for NCS DC 86303 is 0.46% with standard deviation of 0.01 and for NCS DC 86314 is 3.89% with standard deviation of 0.14. Certified values are calculated according to analytical results of 8 or 9 independent laboratories. Nemaska used the same insertion protocol in 2016 and 2017 of one (1) standard every 25-regular sample, alternating between NCS DC 86303 and NCS DC 86314.

From the 76 NCS DC 86303 standards analysed, 28 standards fall outside the 3 sigma error warning. Fifteen (15) standards fall outside the QC Failure interval. The results also show a systematic five percent (5%) bias. From the 79 NCS DC 86314 standards analysed, 3 standards fall outside the 3 sigma and one (1) of them outside the positive warning interval (standard insertion error). The analytical method bias is also observed in this standard, where a 5% systematic bias is also observed. Those results are considered acceptable (See conclusion in Section 11.9).

Table 11.3 reports the statistics of the NCS DC 86303 and NCS DC 86314 standards. Figure 11.2 shows plots of the variation of both standards with time.

**Table 11.3 – Summary Statistics of NCS DC86303 and NCS DC86314**

Standard	Count	Expected Li <sub>2</sub> O (%)		Observed Li <sub>2</sub> O (%)	Expected (%)	QC Warning	QC Failure
		Average	Average	Std. Dev.			
DC86303	76	0.46	0.44	0.02	106	28	15
DC86314	79	3.89	3.73	0.18	104	13	3

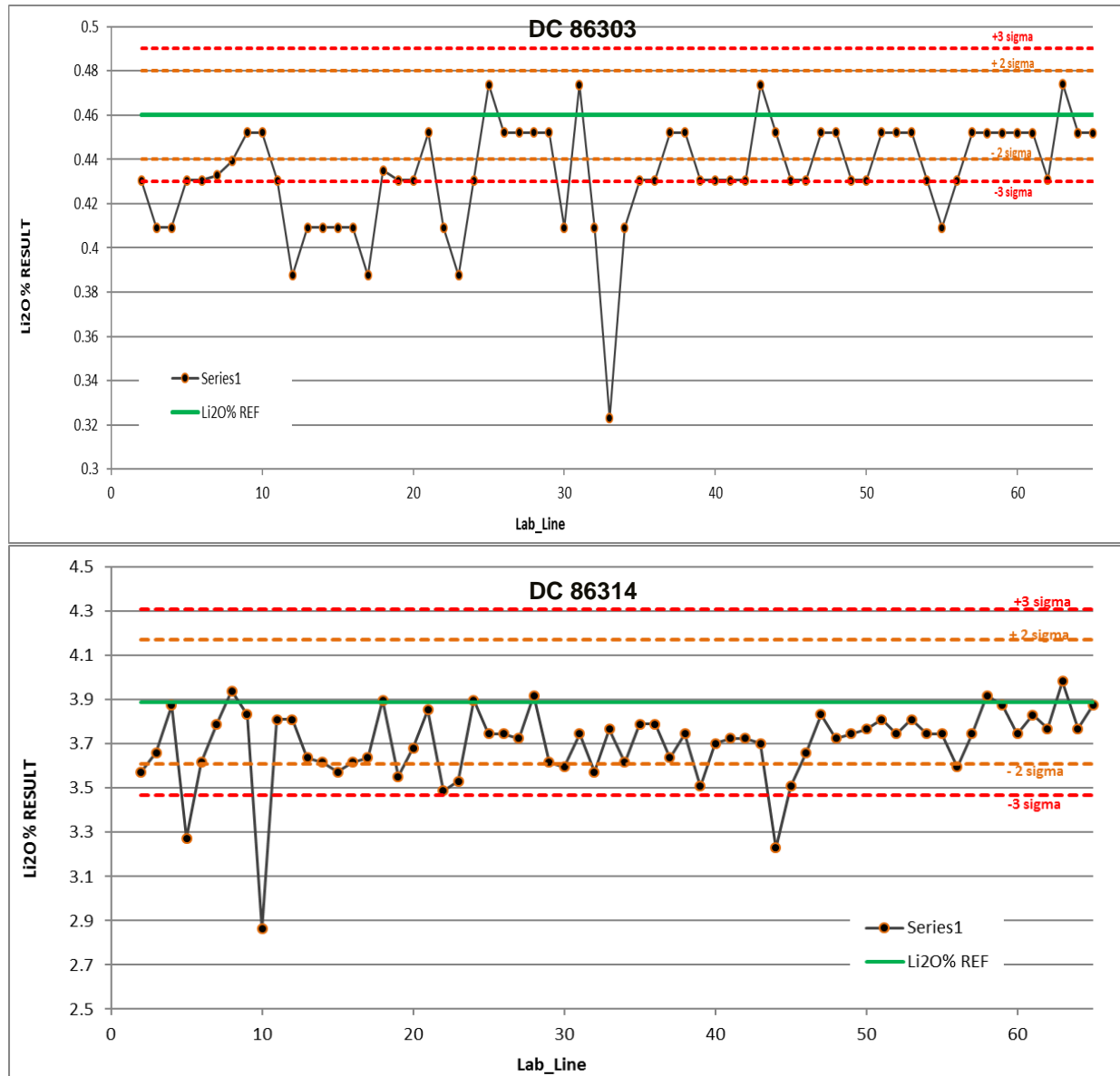
In 2018, two (2) new standards were used by Nemaska for the internal QA/QC program: one (1) low grade (“**OREAS-148**”) standard (1.03% Li<sub>2</sub>O) and one (1) high-grade (“**OREAS-149**”) standard (2.21% Li<sub>2</sub>O). Certified Reference Material has been prepared from spodumene LiAl (Si<sub>2</sub>O<sub>5</sub>) rich pegmatite ore blended with granodiorite and with minor additions of Sn oxide ore and Nb concentrate. Both standards were made and certified by OREAS (Ore research & exploration) based in Australia.

Twenty-two (22) commercial analytical laboratories participated in the program to certify these standards. The following methods were employed: Four (4) acid digestion for full ICP-OES and ICP-MS elemental suites (up to 22 laboratories depending on the element) except for one laboratory who used an AAS finish for Li only; Peroxide fusion for full ICP-OES and ICP-MS elemental suites (up to

21 laboratories depending on the element); Lithium borate fusion with XRF finish for whole rock package including Nb and Ta (up to 22 laboratories depending on the element). Thermogravimetry for LOI at 1,000° C; (nine (9) laboratories used a conventional muffle furnace and six (6) laboratories used a thermogravimetric analyser).

Nemaska's insertion protocol in 2018 is one (1) standard for every 20 regular samples, alternating between OREAS-148 and OREAS-149.

**Figure 11.2 – Plots of the Variation of the DC 86303 and DC 86314 Standards with Time**



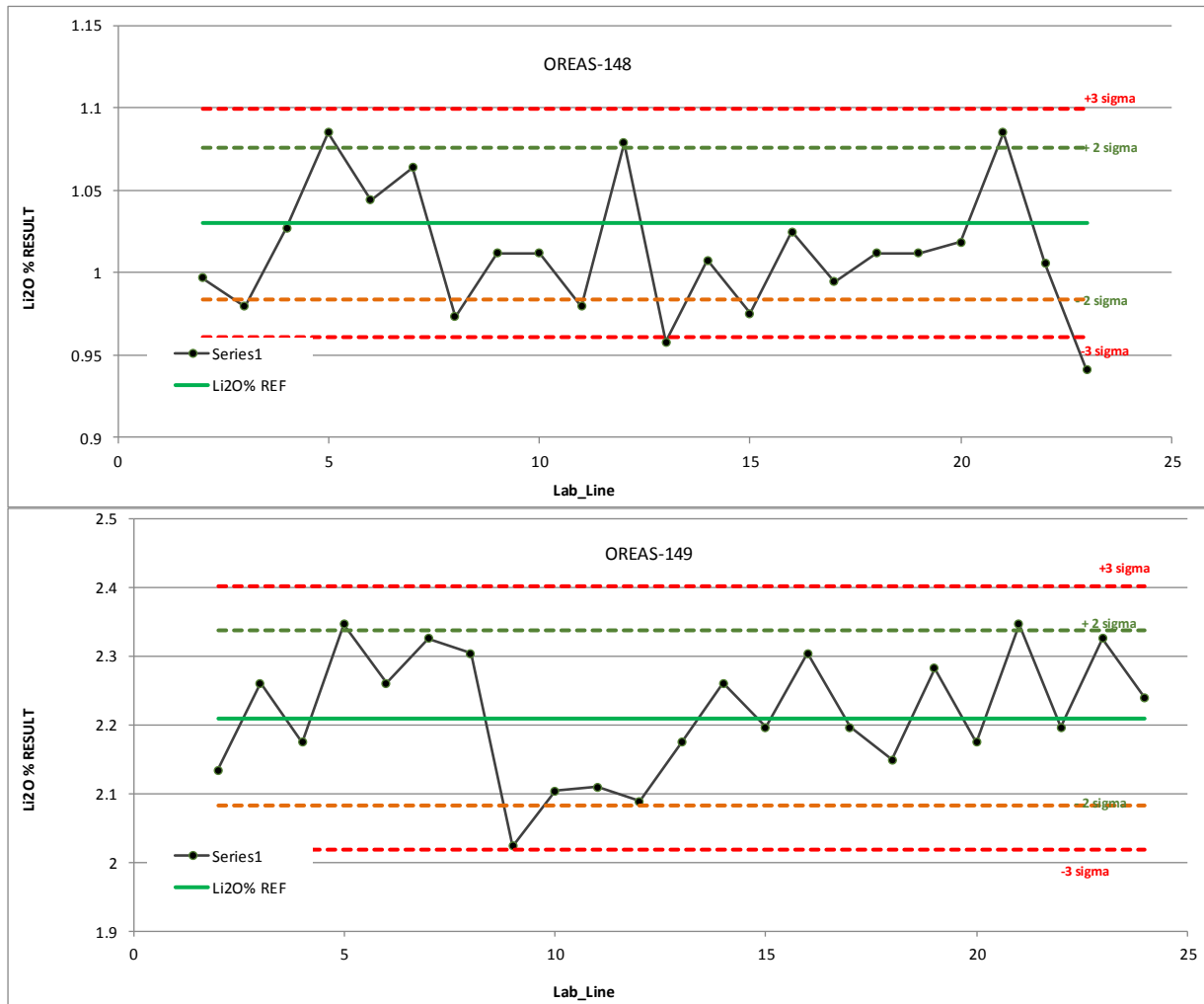
From the 22 OREAS-148 standards analysed, seven (7) standards fall outside the -3 sigma error warning. Two (2) standards fall outside the QC Failure interval. The results also show a

systematic -2% bias. From the 23 OREAS-149 standards analysed, three (3) standards fall outside the -3 sigma and zero (0) of them outside the positive warning interval (standard insertion error). There is no analytical method bias observed in this standard. Those results are considered acceptable for the same reasons as previously noted. Table 11.4 reports the statistics of the OREAS-148 and OREAS-149 standards. Figure 11.3 shows plots of the variation of both standards with time.

**Table 11.4 – Summary Statistics of NCS DC86303 and NCS DC86314**

Standard	Count	Expected Li <sub>2</sub> O (%)		Observed Li <sub>2</sub> O (%)	Expected (%)	QC Warning	QC Failure
		Average	Average	Std. Dev.			
OREAS-148	22	1.03	1.01	0.04	102	7	2
OREAS-149	23	2.21	2.22	0.09	100	3	0

**Figure 11.3 – Plots of the Variation of the OREAS-148 and OREAS-149 Standards with Time**



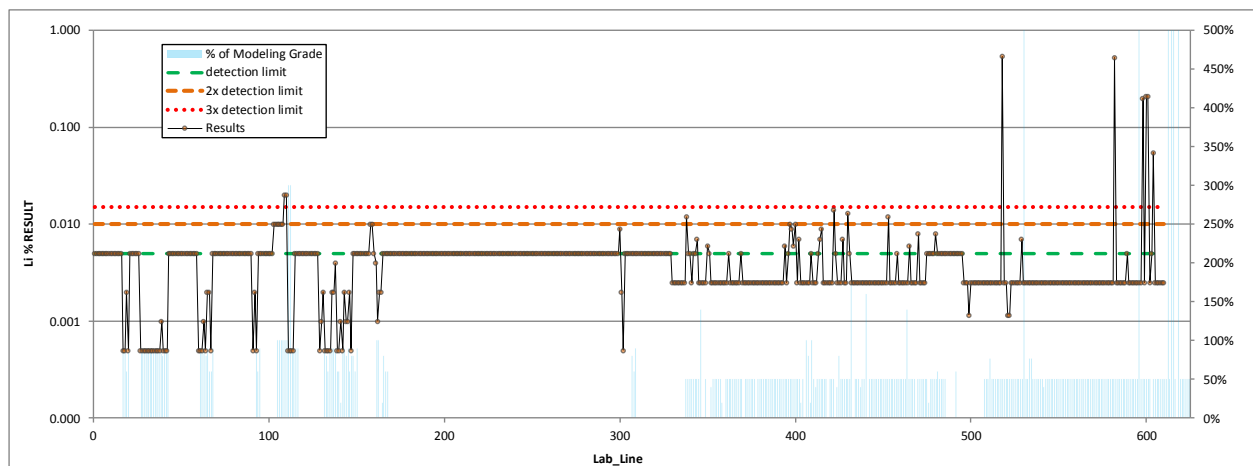


## 11.5 Analytical Blanks

Nemaska implemented the insertion of analytical blanks in the sample series as part of their internal QA/QC protocol. The blank samples, which are made of coarse silica lumps, are inserted at every 20 samples in the sample series, at the beginning of the sample preparation procedure by TJCM before shipping to ALS Chemex. The analytical blanks used in 2010 were made of pre-pulverized silica instead of coarse lumps. The 2010 procedure was not considered adequate since the analytical blanks were inserted by TJCM after the sample preparation procedure. The QA/QC procedure was updated by Nemaska from 2011 and is now considered adequate.

A total of 6,158 analytical blanks were analysed during the 2009, 2010, 2011, 2013, 2016, and 2017 exploration programs. From the 658 blanks analysed, 98.9% of them returned less than 0.05% Li, which is five (5) times the methods detection limit. Figure 11.4 shows a plot of the variation of the analytical blanks with time.

**Figure 11.4 – Plot of Variance of Analytical Blanks with Time**



In 2018 the blanks were inserted at every 15 samples. A total of 61 analytical blanks were analysed and 98.9% of them returned less than 0.05% Li, which is five (5) times the methods detection limit. Figure 11.5 shows a plot of the variation of analytical blanks with time in 2018.

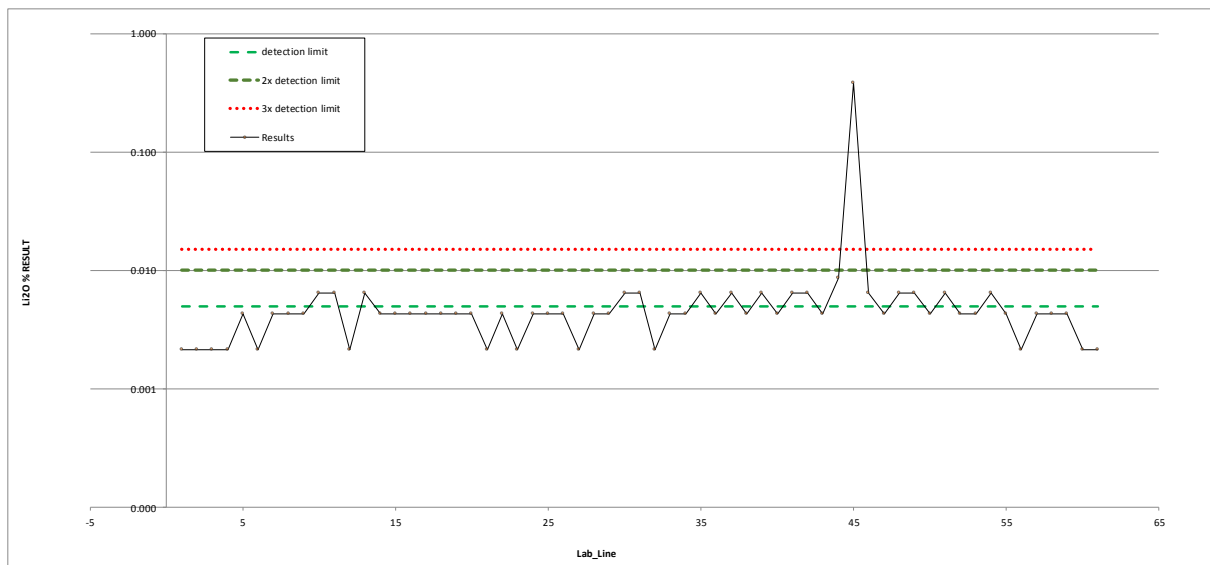
## 11.6 Core Duplicates

Sample duplicates were inserted at every 20 samples in the sample series as part of Nemaska's internal QA/QC protocol. The sample duplicates correspond to a quarter NQ or HQ core from the sample left behind for reference, or a representative channel sample from the secondary channel cut parallel to the main channel. Figure 11.6 shows correlation plots for the core duplicates.

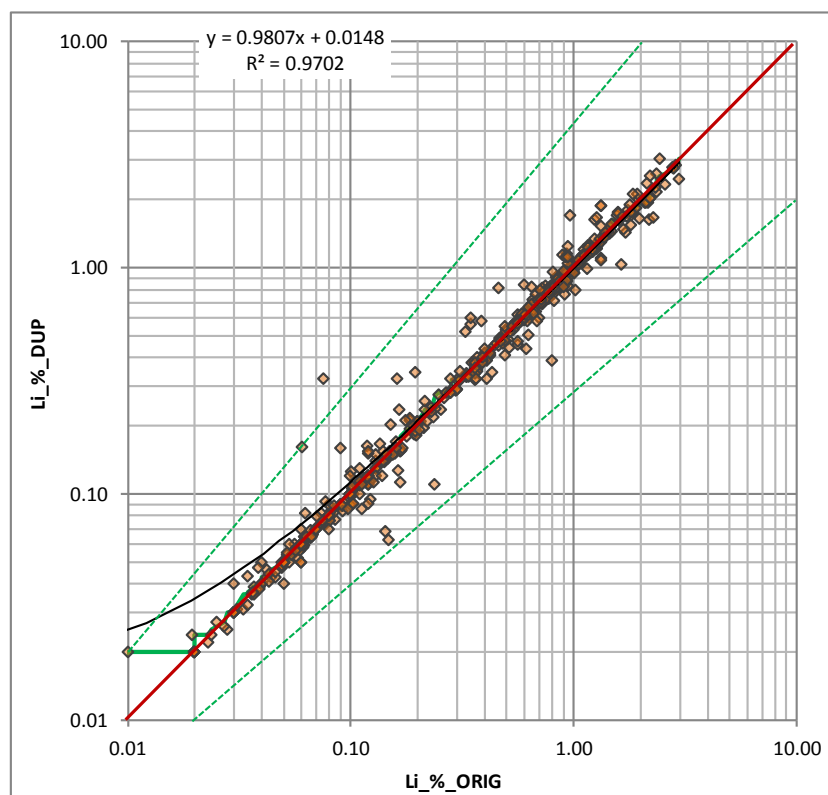
From 2010 to 2016, a total of 593 duplicates results analysed by SGS Minerals and ALS Chemex are available. From the 593 core duplicates analysed, only 41 or 6.8% of the samples fall outside the  $\pm 20\%$  range. The sign test for the duplicates does not show any bias (35% original < duplicate, 40% original > duplicate, and 25% original = duplicate).

No core duplicates were done during the 2017 drilling campaign.

**Figure 11.5 – Plot of Variance of Analytical Blanks with Time in 2018**

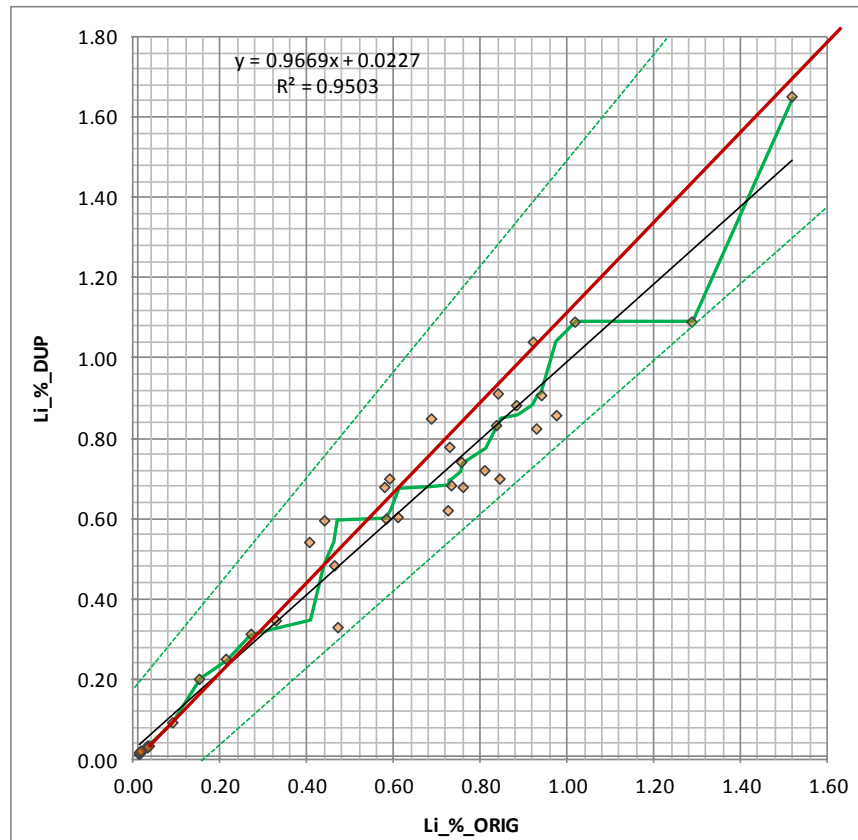


**Figure 11.6 – Correlation Plots for Core Duplicates**



In 2018, a total of 38 duplicates were inserted at every 25 samples as an internal QA/QC protocol. From the 38 core duplicates analysed, only 4 or 11% of the samples fall outside the  $\pm 20\%$  range. The sign test for the core duplicates does not show any bias (53% original < duplicate, 45% original > duplicate, and 3% original = duplicate).

**Figure 11.7– Correlation Plots for Core Duplicates in 2018**

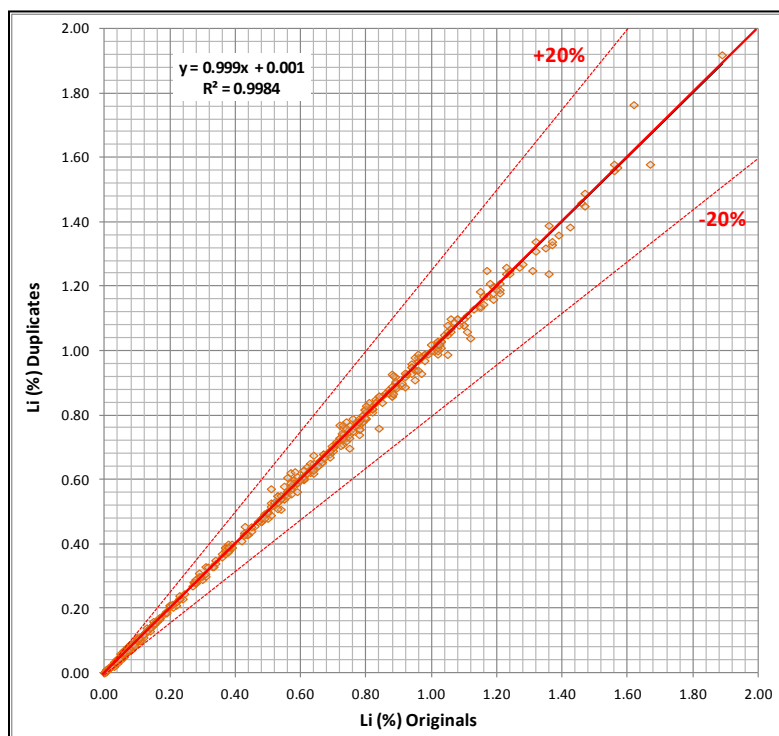


## 11.7 Nemaska Pulp Re-Analysis

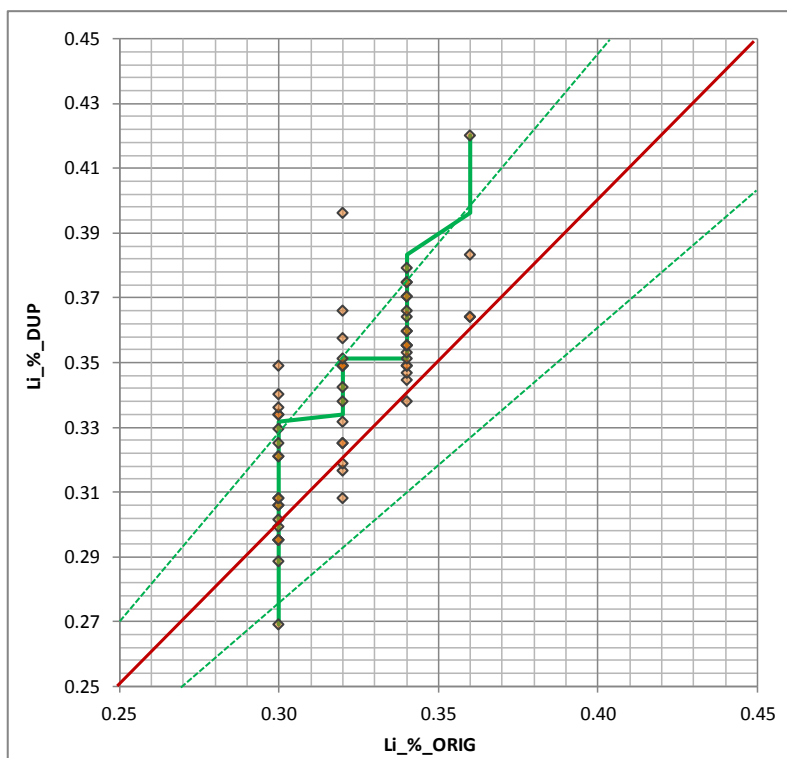
As part of Nemaska's 2010 and 2011 QA/QC protocol, pulps from 610 mineralized core samples were sent for re-analysis to ALS Chemex. Figure 11.8 shows a correlation plot of the re-analysed pulps for Original pulp values vs. Duplicate pulp values. The pulp re-analysis returned higher Li values for Duplicates for 183 samples (or 30% of the samples reanalysed) compared to 166 samples (or 27%) returning lower Li values. All other pulp duplicates (261 or 43%) returned value equal for the original and duplicate samples.

In 2016, the same exercise was conducted, where 61 pulp samples were sent to ALS for analytical verification. Following the reception of the results, it was observed that a bias exists between ALS results and SGS results (Figure 11.9). The bias is evaluated a 5% difference, 53 times out of 61.

**Figure 11.8 – 2010-2011 Correlation Plot of the Pulps Re-Analysis**



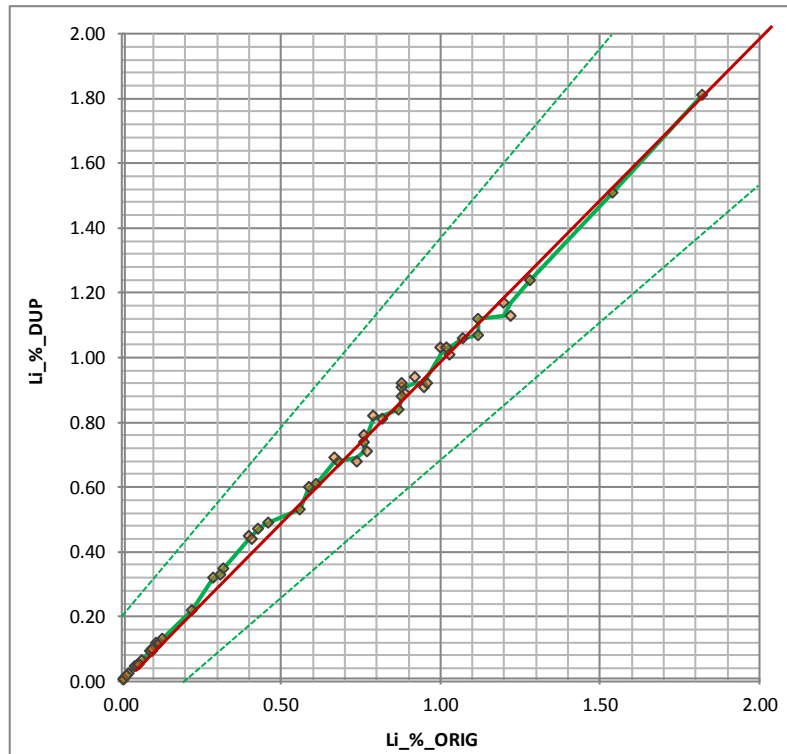
**Figure 11.9 – 2016 Correlation Plot of the Pulps Re-Analysis**



In 2017, the same exercise was conducted, where 54 pulp samples were sent to SGS for analytical verification. Following the reception of the results, no bias has been detected between re-assay (Figure 11.10).

In 2018, the same exercise was conducted, where 54 pulp samples were sent to Actlab for analytical verification. Following the reception of the results, no bias has been detected between re-assay (Figure 11.11).

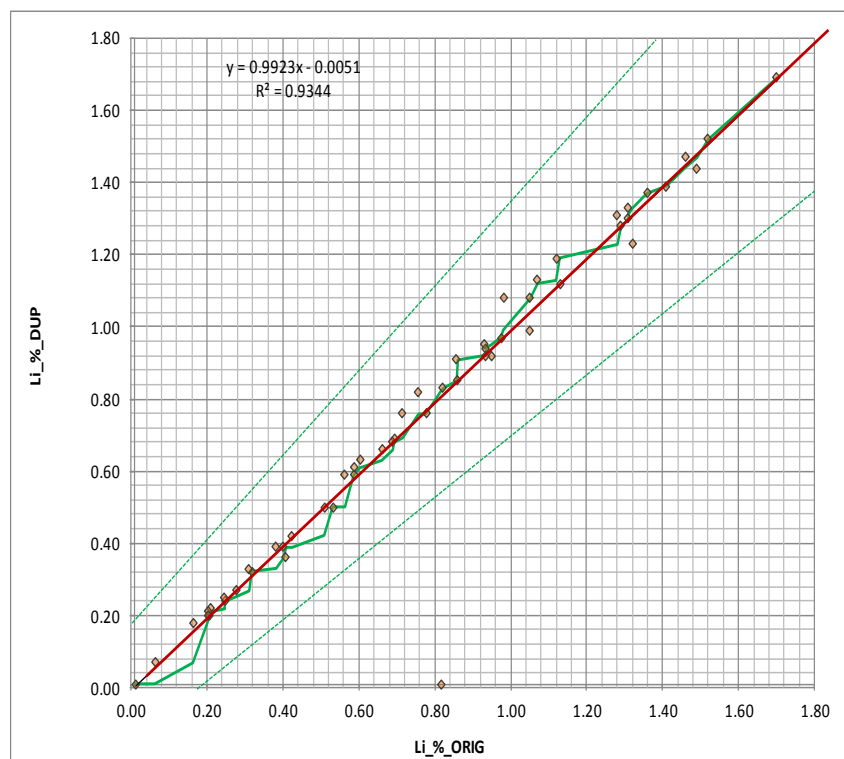
**Figure 11.10 – 2017 Correlation Plot of the Pulps Re-Analysis**



## 11.8 Specific Gravity

As part of the 2010 and 2011 independent data verification programs, SGS conducted specific gravity (“SG”) measurements on the 74 mineralized core samples collected from drill holes WHA-09-007, WHA-10-25, WHA-10-79, and WHA-11-96. The measurements were performed by the water displacement method using a graduated cylinder (SG = weight in air in kg/volume of water displaced in litre) on representative half NQ core and quarter HQ core pieces weighting between 0.42 kg and 2.28 kg with an average of 0.53 kg. The resulting measurements reported an average SG value of 2.70 t/m<sup>3</sup> (Table 11.5).

**Figure 11.11 – 2018 Correlation Plot of the Pulps Re-Analysis**



In 2011, Nemaska also conducted SG measurements of mineralized core samples. The measurements were conducted at TJCM laboratory in Chibougamau, QC, by the water displacement method using weight in air vs. weight in water. The SG measurements were done on samples from 24 different drill holes from 2009, 2010, and 2011. The resulting measurements reported an average SG value of 2.72 t/m<sup>3</sup> (Table 11.6).

Based on the available SG measurement datasets, a SG value of 2.71 t/m<sup>3</sup> was selected as the average SG for the mineralization for the Whabouchi deposit (Table 11.7).

**Table 11.5 – SGS Geostat SG Measurements Statistical Parameters**

	SG Measurements (t/m <sup>3</sup> )
Mean (t/m <sup>3</sup> )	2.70
Count	73
Standard Deviation	0.08
Rel Std Deviation (%)	2.80
Minimum (t/m <sup>3</sup> )	2.55
Median (t/m <sup>3</sup> )	2.70
Maximum (t/m <sup>3</sup> )	2.88



**Table 11.6 – 2011 Nemaska (TJCM) SG Measurements Statistical Parameters**

	<b>SG Measurements (t/m<sup>3</sup>)</b>
Mean (t/m <sup>3</sup> )	2.72
Count	73
Standard Deviation	0.03
Rel Std Deviation (%)	1.18
Minimum (t/m <sup>3</sup> )	2.65
Median (t/m <sup>3</sup> )	2.72
Maximum (t/m <sup>3</sup> )	2.87

**Table 11.7 – Summary SG Measurements Statistical Parameters**

	<b>SG Measurements (t/m<sup>3</sup>)</b>
Mean (t/m <sup>3</sup> )	2.71
Count	147
Standard Deviation	0.06
Rel Std Deviation (%)	2.17
Minimum (t/m <sup>3</sup> )	2.55
Median (t/m <sup>3</sup> )	2.72
Maximum (t/m <sup>3</sup> )	2.88

## 11.9 Conclusion

Nemaska implemented an internal QA/QC protocol by regularly inserting reference materials (standards and blank) and core duplicates in the samples stream. Nemaska also conducted in the 2010 and 2011 re-analysis of selected pulps in a second laboratory, as part of their QA/QC protocol.

SGS completed a review of the sample preparation and analysis including the QA/QC analytical protocol implemented by Nemaska for the Project. SGS visited the Whabouchi Property on November 27, 2013 and numerous times in the summer of 2016 to review Nemaska sample preparation procedures, local infrastructure and in order to conduct an independent sampling program. The author visited the site on December 5, 2017.

The QA/QC data from previous campaigns and up to 2017 was reviewed. A review of the QA/QC analytical results for blanks and core duplicates did not highlight any analytical issues. However, the observations for the 2016 standard material and pulp duplicates suggest the presence of a bias in the analytical data between SGS and ALS laboratories of about 5%, SGS Laboratory having the higher average grade. SGS verified the effect of a 5% grade added value on the 2016 assay results in the resources estimates and found the results to be negligible.

SG measurements were completed in 2010 and 2011 on mineralized core samples to estimate an average bulk density value for the Whabouchi deposit and are considered acceptable for the present report.

The author is of the opinion that the sample preparation, analysis, and QA/QC protocol used by Nemaska for the Whabouchi Project follow generally accepted industry standards and that the Project data is of a sufficient quality, SGS recommends continuing its internal QA/QC protocol for blanks, duplicates (core and pulp), and standards (reference materials).

## 12 DATA VERIFICATION

As part of the 2013 data verification programs, SGS completed independent analytical checks of drill core duplicate samples taken from Nemaska 2011 and 2013 diamond drilling programs. SGS also conducted verification of the laboratories analytical certificates and validation of the Project digital database supplied by Nemaska for errors or discrepancies.

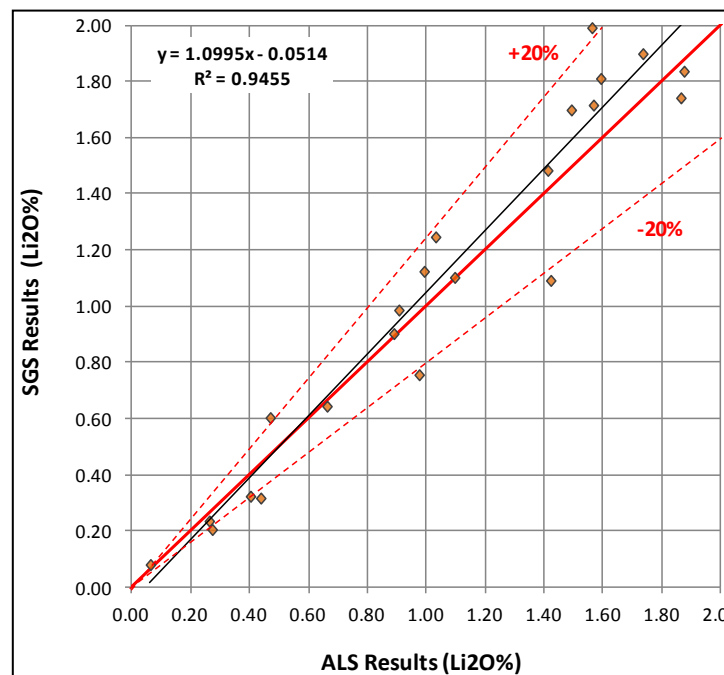
### 12.1 Independent Control Sampling

During a site visit by SGS conducted on November 27, 2013, a total of 39 mineralized core duplicates were collected from holes WHA-11-105, WHA-11-90, WHA-13-144, WHA-13-132, WHA-13-143 and WHA-11-96 by SGS and submitted for Li analysis at the SGS Minerals Laboratory in Lakefield, Ontario. The core duplicates were processed using the same analytical protocol used by Nemaska during the 2009 and 2010 drilling programs (code ICP90Q) except that the sample preparation has been done directly at the SGS Mineral Services and not at the TJCM laboratory.

The comparative results for the individual control samples are displayed in the correlation graph in Figure 12.1. Table 12.1 shows the comparative statistics for the control samples. Table 12.2 reports the control sampling weighted average results for continuous mineralized intervals sampled for each drill hole.

The average relative grade differences between the original and the control samples range between 1% and 12%, which can be considered acceptable for core duplicates, considering the coarse nature of the spodumene mineralization generally observed at Whabouchi. The weighted average grades between the original and the control samples outline similar results.

**Figure 12.1 – Correlation Plot of Independent Control Samples**



**Table 12.1 – Comparative Statistics for the Control Sampling Results**

Hole ID	Count	Original > Control	Original < Control	Original = Control	Average Relative Percent Difference
WHA-11-105	8	50%	50%	0%	-1%
WHA-11-90	7	43%	57%	0%	-5%
WHA-13-144	7	71%	29%	0%	9%
WHA-13-132	4	25%	75%	0%	-12%
WHA-13-143	7	0%	100%	0%	-12%
WHA-11-96	6	0%	100%	0%	-12%

**Table 12.2 – Control Sampling Comparison by Drill Hole Mineralized Intervals**

Hole ID	From (m)	To (m)	Length (m)	Weighted Average		Relative Grade
				Original Li <sub>2</sub> O (%)	Control Li <sub>2</sub> O (%)	Relative Difference (%)
WHA-11-105	194.0	202.0	8.0	1.80	1.82	-1.00%
WHA-11-90	53.0	60.0	8.0	1.81	1.90	-5.07%
WHA-13-144	161.0	171.2	10.2	0.60	0.54	8.98%
WHA-13-132	195.6	201.6	6.0	2.48	2.77	-11.89%
WHA-13-143	4.6	15.1	10.5	1.85	2.07	-12.16%
WHA-11-96	237.0	243.0	6.0	1.54	1.72	-12.00%

## 12.2 Database Validation

The digital drill hole database supplied by Nemaska has been validated for the following data field: collar location, azimuth, dip, hole length, survey data, lithology and analytical values. The validation returned only minor discrepancies located in lithology and assay data, which were communicated to Nemaska and corrected in the final drill hole database.

As part of the data verification of the Project, the analytical data from the database has been validated with the values from the laboratories analytical certificates. No errors were noted during the validation.

The final revised database includes the channel samples collected in 2009 and 2010 from surface trenches and the drilling data from the 2009, 2010, 2011, 2013, 2016, 2017, and 2018 drilling programs. The final drill hole with reported analytical results included in the database is WHA-18-257. The few historical drill hole and channel analytical data were considered for the current mineral resource estimate and were kept for modeling purposes. Table 12.3 lists the data contained in the

final drill hole database. The author is in the opinion that the final drill hole database is adequate to support a mineral resource estimate.

**Table 12.3 – Final Drill Hole Database**

Type	Count	Metres Drilled	Survey Records	Lithology Records	Assays Records	% Assayed Metres
Channel	344	6,806	0	855	937	14%
Drill Hole	273	53,985	9,222	5,367	14,797	29%
<b>Total</b>	<b>617</b>	<b>60,792</b>	<b>9,222</b>	<b>6,222</b>	<b>15,734</b>	

## 13 MINERAL PROCESSING AND METALLURGICAL TESTING

Mineral processing testing was performed to evaluate the potential of spodumene concentrate production and lithium hydroxide monohydrate (LHM) production separately. The spodumene concentrate production test work is presented in Section 13.1. The electrochemical production of LHM is presented in Section 13.2.

### 13.1 Spodumene Concentration

Preliminary metallurgical investigation of the Whabouchi deposit was first carried out in 2010 and 2011 by SGS at Lakefield, Ontario.

Some of the bench scale and pilot plant test work results were reported in previous Technical Reports in 2012, 2013, 2016, and 2018.

This Section provides a summary on the most relevant work that was performed over the years to develop the actual process flow sheet used to concentrate the spodumene. This involves ore sorting, hydro-classification, dense media separation (“DMS”) and flotation methods. It also includes summaries from screening, settling, filtration, freezing, drying, and magnetic separation tests performed by various laboratories and suppliers.

#### 13.1.1 ORE SORTING TESTING

##### 13.1.1.1 TOMRA Test Work Program

Nemaska provided TOMRA with 1.8 tonnes of feed ore ranging in size from 40 mm to 9.5 mm to conduct testing program to remove black rock (amphibolite) from white rocks (pegmatite). The material was sent to the TOMRA test center in Wedel, Germany.

For the first tests of the Nemaska ore, several TOMRA sorting technologies and several approaches were considered to select the ones that responded best. The data collected according to the characteristics of the rocks present in the ores made it possible to show the potential for sorting of each sensor type for a specific task. Two (2) technologies were targeted for sorting trials: surface color differentiation sorting technology and X-ray transmission (“XRT”). XRT uses atomic density difference separation technology.

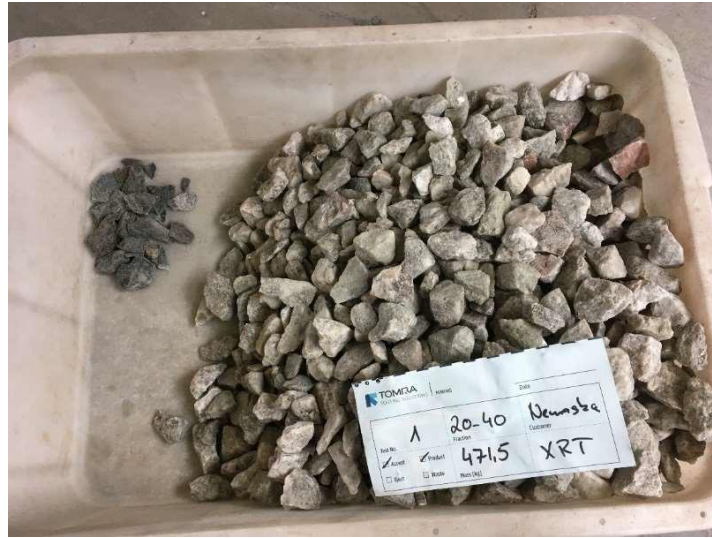
Below the best results of the two (2) size fractions are discussed.

##### a. Ore Sorting on - 40 mm + 20 mm, Amphibole Removal

Using XRT, the accepted material white rocks recovery was 95.8%, with white rock at 98.7% concentration. The photo in Figure 13.1 illustrates the visual results. There is very little displaced material in the accepted stream.



**Figure 13.1 – TOMRA Ore Sorting Test #1**



Source: TOMRA test center in Wedel, Germany March 2017

b. Ore Sorting on - 20 mm + 9.5 mm, Amphibole Removal

Using XRT, the accepted material white rocks recovery was 96.8%, with white rock at 99.2% concentration.

13.1.1.2 *Steinart Test Work Program*

Steinert US was approached to test Nemaska Whabouchi ore with sensor-based sorting techniques to beneficiate/upgrade the ore by removing waste rock consisting mainly of amphibolite. The test sample provided consisted of pegmatite and dark amphibolite waste rocks.

The objective was test sorting efficiency of Steinert ore sorting equipment. The sorting sensor selected was X-Ray Transmission or XRT. X-ray sensitive line-scan sensor provides high resolution X-ray absorption images. An X-ray scintillation crystal sensor can capture up to 2,500 lines per second.

Nemaska had prepared two (2) tonnes of sample. The sample was screened at 10 mm to remove the fines which is not suitable for this sorting application. The first set of three tests were performed on - 50mm + 15mm material. This size range is good ore sorter feed material, about ratio 1:3 sorting size. The next three (3) tests were done on - 15mm + 10mm material. Finally, the last three (3) tests were done on - 50 + 10mm size range, outside the ideal size ratio.

a. Ore Sorting on - 50 mm + 15 mm

The coarse sample - 50 mm + 15 mm yielded excellent results. Test #1 yielded the best result at 99.4% separation efficiency of the white ore and was separated from the dark amphibolite. The photos in Figure 13.2, illustrate the visual results. There is very little misplaced material in the accepted and rejected streams.

**Figure 13.2 – Steinert Ore Sorting Test #1**



Source: Steinert US Test Laboratory April 2017

b. Ore Sorting on - 15 mm + 10 mm

The finer sample - 15 mm + 10 mm was processed through the same equipment and also produced very good results, but noticeably less than the coarse separation. The best separation efficiency obtained was 96.7%.

c. Ore Sorting on - 50 mm + 10 mm

For the combined sample - 50 mm + 10 mm, the best separation efficiency obtained was 94.5%.

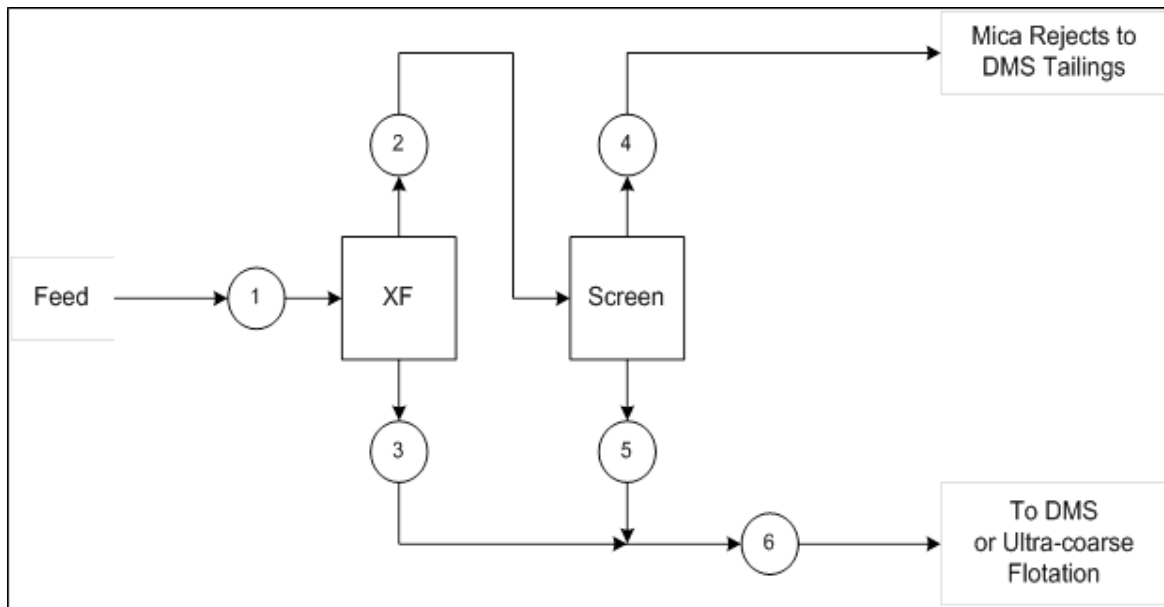
### 13.1.2 ERIEZ HYDRAULIC SEPARATION TEST WORK

Hydraulic separation was performed at Eriez Central Test Laboratory in Erie, PA. Eriez received spodumene ore from Nemaska for testing. Hydraulic separation test work was done with two (2) different size fractions (- 8 mm + 0.85 mm) and (-0.85 mm). The tests were aimed to remove mica from the ore.

#### 13.1.2.1 Hydraulic Separation on - 8 mm + 0.85 mm, Mica Removal

The coarser sample - 8 mm + 0.85 mm was processed using a CrossFlow separation equipment, following the flow sheet shown in Figure 13.3. The material was processed in 9 × 16 in. Eriez CrossFlow Separator. The teeter water up flow as 1.83 cm/s.

**Figure 13.3 – Flow Sheet CrossFlow Test #6**



Source: Eriez Flotation Division Test Laboratory 2017.

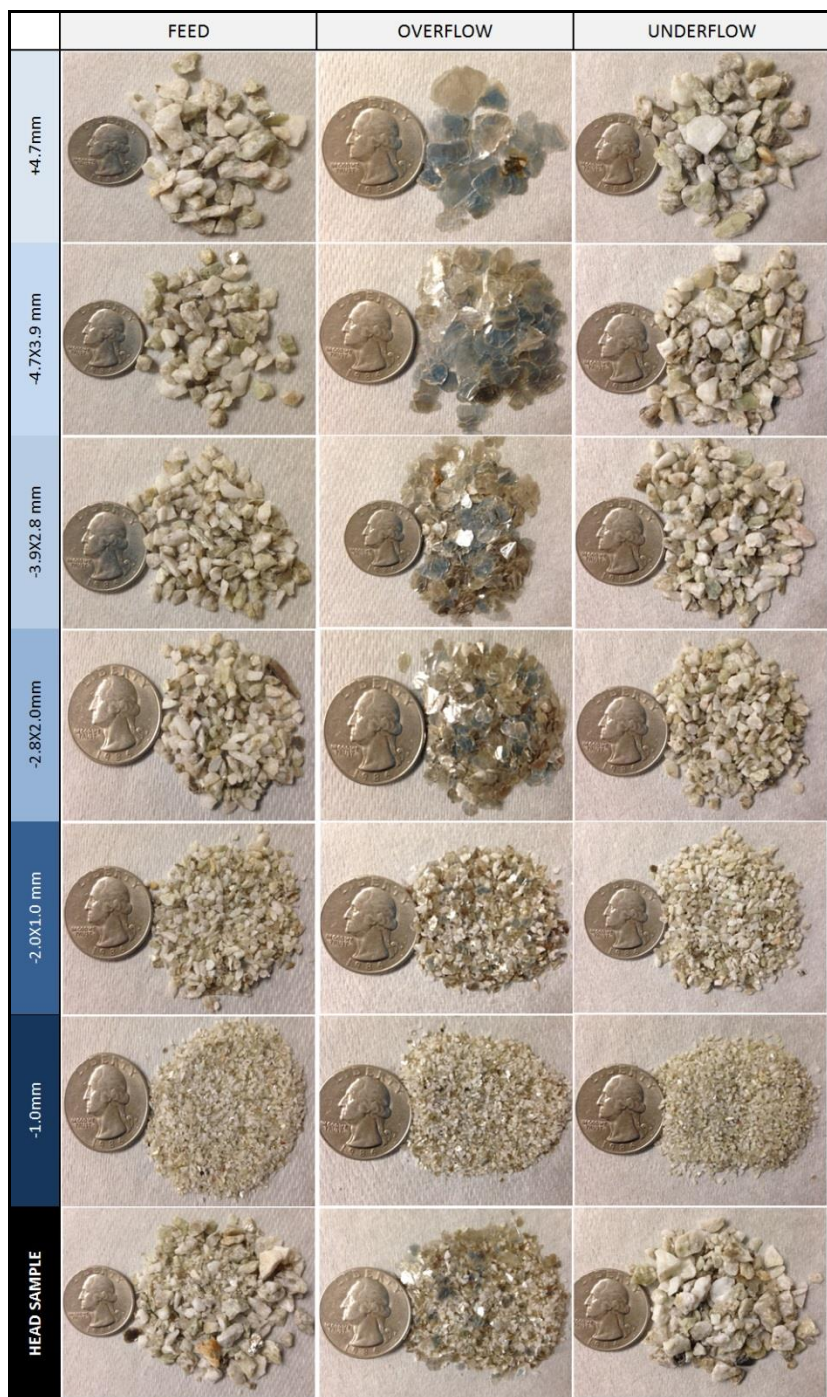
The photos shown in Figure 13.4 illustrate the effectiveness of the CrossFlow separator on coarse muscovite particles.

To a certain extent, the K<sub>2</sub>O concentration can be related to the muscovite concentration in the head samples. However, it is not the only potassium bearing mineral. In the case of Whabouchi ore, the presence of K-Feldspar does not allow to evaluate the muscovite recovery based on the K<sub>2</sub>O analyses. The CrossFlow separator overflow, which contains mainly coarse muscovite flakes and fines particles entrained with the upward current was screened at 2.0 mm. This allowed the recovery of mainly muscovite and the return of entrained particles into the flotation circuit. The analytical results are presented in Table 13.1.



Pure muscovite is about 11.8% K<sub>2</sub>O. It can be seen that the screen oversize contains a very high concentration of muscovite as the other potassium bearing minerals are not retained by the screen because of their size and shape.

**Figure 13.4 – Photographs Classified CrossFlow Test #6**



Source: Eriez Flotation Division Test Laboratory 2017.

**Table 13.1 – CrossFlow Separation Test #6**

ID	Stream	Weight (%)	Li <sub>2</sub> O (%)	Dist. Li <sub>2</sub> O (%)	K <sub>2</sub> O (%)	Dist. K <sub>2</sub> O (%)
1	Feed	100.00	1.70	100.00	2.97	100.00
2	XF6 Overflow	16.88	0.64	6.32	5.28	30.03
3	XF6 Underflow	83.12	1.91	93.68	2.50	69.97
4	Screen Overflow	0.69	0.44	0.18	10.02	2.32
5	Screen Underflow	16.19	0.64	6.14	5.07	27.71
6	DMS Feed	99.31	1.71	99.82	2.92	97.67

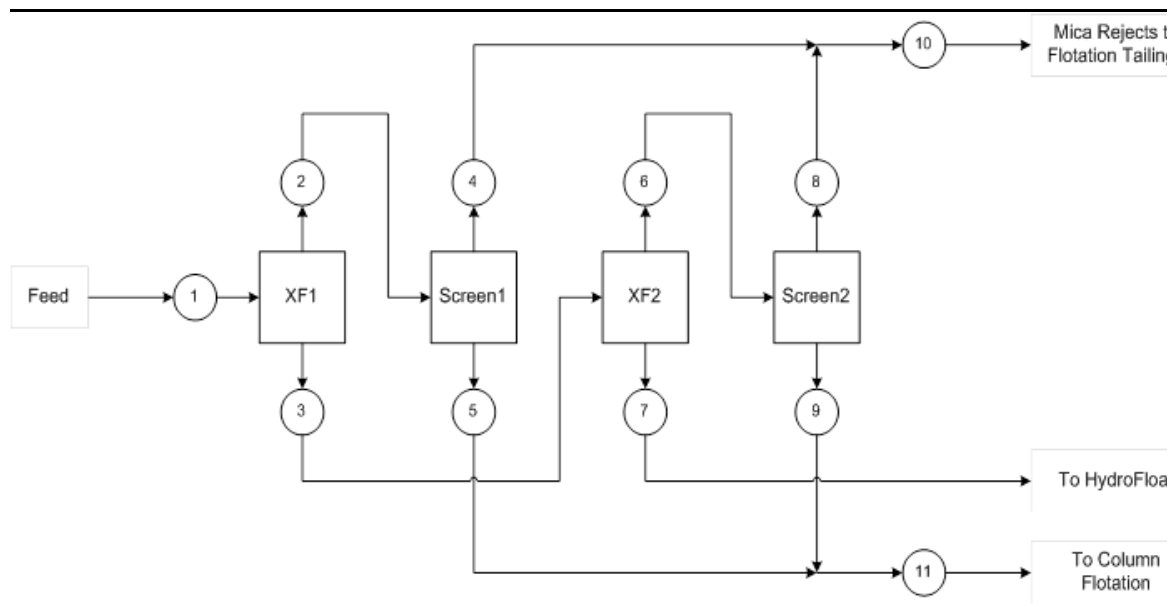
Source: Eriez Flotation Division Test Laboratory 2017.

In the table 13.1, the Li<sub>2</sub>O concentration in the screen overflow corresponds to the natural content in the muscovite. The loss in spodumene is negligible.

#### 13.1.2.2 Hydraulic Separation on - 0.85 mm Mica Removal

The finer sample - 0.85 mm was processed using CrossFlow separation equipment, following the flow sheet shown in Figure 13.5. Two (2) CrossFlow separators in series with screens were used. The screen oversize is considered mica waste and the remainder will be flotation feed.

**Figure 13.5 – Flow Sheet CrossFlow Test #1 and #2**



Source: Eriez Flotation Division Test Laboratory 2017.

Both CrossFlow overflows were screened at 212 microns. The analytical results are presented in Table 13.2.

As can be seen, the weight rejection at the second CrossFlow, which used much more water, was very high. This is considered too high and cannot be accepted by the process as a high loss of lithium was observed. The CrossFlow operation will have to be adjusted to make a slightly finer cut which will be sufficient to reject entrained muscovite since its shape factor allows it to be rejected at lower water flows.

**Table 13.2 – CrossFlow Separation Test #1 and #2**

ID	Stream	Weight (%)	Li <sub>2</sub> O (%)	Dist. Li <sub>2</sub> O (%)	K <sub>2</sub> O (%)	Dist. K <sub>2</sub> O (%)
1	Feed	100.00	1.39	100.00	2.32	100.00
2	XF 1 Overflow	34.87	0.85	21.24	2.55	38.35
3	XF 1 Underflow	65.13	1.68	78.76	2.20	61.65
4	Screen 1 Overflow	2.10	0.34	0.52	5.72	5.19
5	Screen 1 Underflow	32.76	0.88	20.73	2.35	33.15
6	XF 2 Overflow	18.19	1.06	13.86	2.68	20.98
7	XF 2 Underflow	46.94	1.92	64.90	2.01	40.67
8	Screen 2 Overflow	12.70	0.58	5.27	3.18	17.43
9	Screen 2 Underflow	5.49	2.18	8.59	1.50	3.55
10	Mica Rejects	14.81	0.54	5.78	3.55	22.63
11	Combined Screen U/F	38.25	1.07	29.32	2.23	36.70

Source: Eriez Flotation Division Test Laboratory 2017.

### 13.1.3 DMS TEST WORK

#### 13.1.3.1 DMS Test Work at SGS – 2011

Four (4) composites were prepared as pilot plant feed. Two (2) composites were prepared for the flotation pilot plant and were labelled as “Outcrop Sample for flotation” and “Mine Representative Sample for Flotation”. Two (2) more composites were prepared for DMS pilot plant test work and were labelled as “DMS Outcrop Composite” and “DMS-Mine Representative Composite”. The mine representative sample was composed of outcrop material and drill core rejects. A detailed description of these composite is given in the SGS report titled: “A pilot plant investigation into The Recovery of Spodumene from the Whabouchi Property, Project 12486-003 – Final Report, April 2, 2012”. The chemical analyses of these composites are presented in Table 13.3.



**Table 13.3 – Chemical Analysis of the Flotation Pilot Plant Composites**

	Composite	Unit	Outcrop	Mine Representative	DMS Outcrop Middlings	DMS Mine Rep. Middlings
Elemental Analysis	Li	%	0.76	0.72	0.68	0.86
	Li <sub>2</sub> O	%	1.64	1.55	1.47	1.85
	BE	ppm	178	156	---	---
	Beryl	%	0.27	0.24	---	---
Whole Rock Analysis	SiO <sub>2</sub>	%	74.4	74.4	76.1	76
	Al <sub>2</sub> O <sub>3</sub>	%	15.9	15.9	14.9	15.7
	Fe <sub>2</sub> O <sub>3</sub>	%	0.78	0.9	0.85	0.88
	MgO	%	0.09	0.18	0.09	0.08
	CaO	%	0.26	0.43	0.3	0.3
	Na <sub>2</sub> O	%	3.36	3.34	3.42	3.05
	K <sub>2</sub> O	%	2.45	2.63	2.08	2.08
	TiO <sub>2</sub>	%	0.01	0.03	0.01	0.01
	P <sub>2</sub> O <sub>5</sub>	%	0.1	0.12	0.1	0.1
	MnO	%	0.08	0.1	0.1	0.08
	Cr <sub>2</sub> O <sub>3</sub>	%	0.03	0.03	0.03	0.03
	V <sub>2</sub> O <sub>5</sub>	%	< 0.01	< 0.01	< 0.01	< 0.01
	LOI	%	0.72	0.84	0.57	0.84
	Sum	%	< 98.5	98.9	98.6	99.1

**Source:** SGS Mineral Services; Project 12486-003 – Final Report, April 2, 2012

Semi quantitative XRD analyses of composites are provided in Table 13.4. The results indicate that the outcrop and DMS mine representative samples are very similar in make-up. The Mine Representative sample has less spodumene than the two (2) others. The mineral spodumene content is slightly over 20%.

The Mine Representative sample was crushed and screened, and the liberation of Li-minerals was assessed at 91.4%.

**Table 13.4 – Semi –Quantitative XRD Analyses of the Composite**

Mineral	Outcrop Sample (Weight%)	DMS Mine Rep Sample (Weight%)	Mine Rep Sample (Weight%)
Quartz	26.1	26.9	33.4
Spodumene (Monoclinic)	22.6	22.3	20.8
Albite	31.1	31.2	29.3
Microcline	14.9	17.7	11.5
Magnesiohornblende	-	-	1.0
Muscovite	5.3	1.9	4.0
Total	100.0	100.0	100.0

Source: SGS Mineral Services; Project 12486-003 – Final Report, April 2, 2012

The DMS pilot plant test work was carried out on two (2) samples, the blasted sample and the mine representative sample, from the Whabouchi deposit by SGS at Lakefield in 2011. The flow sheet used during the pilot plant, consisting of several unit operations, includes crushing, scrubbing, screening, several dense media separation stages, magnetic separation and dewatering. The DMS test plant was equipped with a 150-mm dense media cyclone. Up to eight (8) DMS stages were used for the blasted sample, whereas only four (4) stages were used in test work on the mine representative sample. Magnetic separation was conducted by using a high intensity rare earth roll magnetic separator to upgrade DMS sinks on previously dried feed.

The results of the DMS pilot plant were reported in an addendum by SGS (12486-004) entitled “An Investigation into DMS Plant Testing on Material from the Whabouchi Lithium Deposit” issued November 11<sup>th</sup>, 2011 and incorporated in the November 16, 2012 NI 43-101 Technical Report Preliminary Economic Assessment.

The main findings from these results were that for mine representative sample, the 4-stage DMS flow sheet rejects 40% of the feed mass as tailings at a top size of 9.5 mm, at a loss of 10% Li. At a top size of 9.5 mm, approximately 11% of the feed mass is recovered as spodumene concentrate grading 6.4% Li<sub>2</sub>O and 45% Li distribution. The combined middlings, 49% of the feed mass, represent the remaining 45% Li distribution.

#### 13.1.3.2 Met-Solve Laboratories Test Program – 2013-2014

In 2013, Nemaska contracted Met-Solve Laboratories to carry out DMS pilot plant test work.

DMS testing was investigated as the costs of this form of processing will be considerably lower as compared to flotation.

DMS pilot plant testing was carried out using a single 250 mm separator to simulate multi-stage separations. The primary objective of this test program was to determine the overall grade and recovery of lithium using a DMS system.

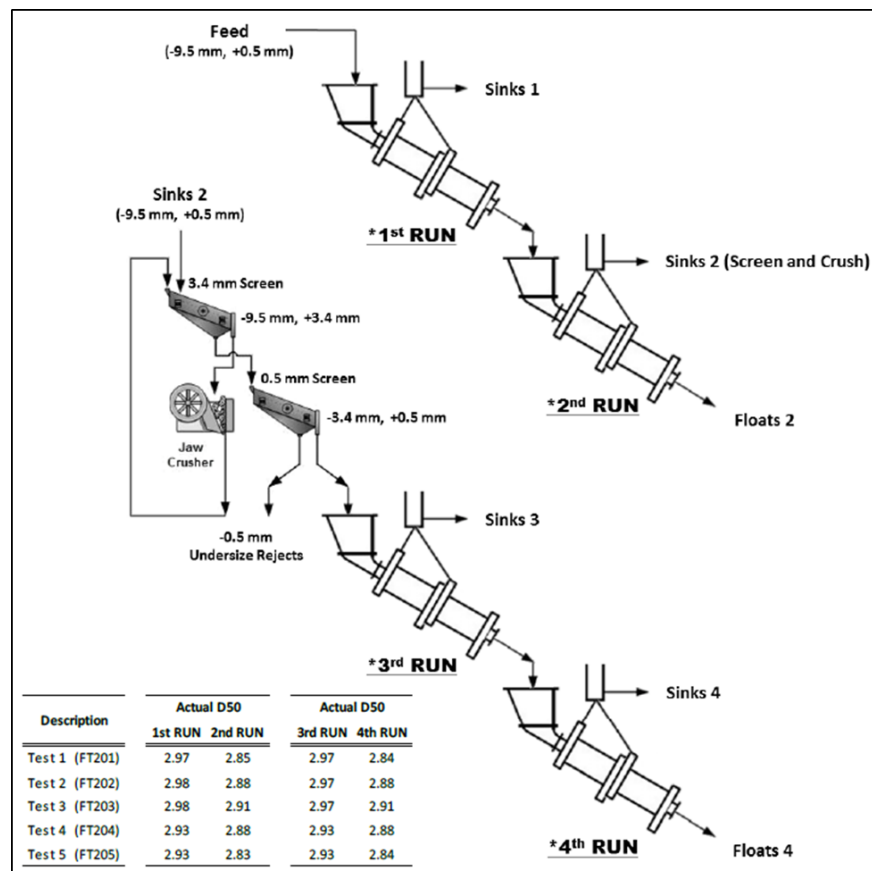
The multi-stage separator has been shown to offer better performance compared to single stage, two (2) products and other conventional dense medium cyclone separators. The following section is a summary of the report issued by Met-Solve titled: "Nemaska Lithium Inc., Dense Media Separation, MS 1467 issued August 13, 2013".

Four (4) drums of pre-crushed sample (- 9.5 mm + 0.5 mm) weighing approximately 900 kg were sent from SGS at Lakefield to Met-Solve laboratories in Langley, BC. Only half of the sample (approximately 450 kg) was used for these DMS tests.

A total of seven (7) DMS tests (FT201 to FT207) were carried out on these pre-crushed samples. Approximately 65 kg of representative sample was used for each test.

The initial five (5) DMS tests (FT201 to FT205) were aimed to simulate a 4-stage DMS concentrator with a re-circulated test on the crushed middlings (Figure 13.6). Each run consisted of passing the floats through the single media separator twice to simulate a 2-stage concentrator. The total sinks (combined Sinks 1, Sinks 3 and Sinks 4) can be considered final concentrate, while Floats 2 is final tailings. Floats 4 and the -0.5 mm rejects could be sent to the flotation circuit to improve the lithium recovery.

**Figure 13.6 – General Process Flow Sheet for Initial DMS Test Work (Tests FT201-FT205)**



Source: MS1467; Nemaska Lithium Inc., Dense Media Separation Final Report – August 13<sup>th</sup>, 2013

Table 13.5 lists the results of the five (5) tests. In each test, propensity of the spodumene ore to dense media separation was confirmed.

**Table 13.5– Process Flow Sheet for Initial DMS Test Work Results**

Test	Mass (%)			Li <sub>2</sub> O Distribution (%)			Li <sub>2</sub> O Assay (%)			
	Total Sinks	Floats 2	Floats 4	Total Sinks	Floats 2	Floats 4	Calc. Head	Total Sinks	Floats 2	Floats 4
FT201	17.9	78.9	1.6	59.9	35.6	1.6	1.61	5.39	0.73	1.61
FT202	16.2	79.1	2.4	56.7	35.3	3.6	1.62	5.67	0.72	2.39
FT203	14.9	81.7	1.7	53.3	40.6	2.7	1.59	5.67	0.79	2.52
FT204	17.5	78.2	2.4	59.0	34.2	3.3	1.68	5.56	0.72	2.32
FT205	17.6	77.9	2.0	59.2	34.3	2.1	1.68	5.66	0.74	1.73

Source: MS1467; Nemaska Lithium Inc., Dense Media Separation Final Report – August 13<sup>th</sup>, 2013

Two (2) additional tests, FT206 without and FT207 with crushing middlings, were carried out to simulate a dynamic 3-stage DMS circuit, in order to assess the effectiveness of adding more separation stages. Test FT206 yielded a higher recovery of 66.8%, but with a lower concentrate grade of 5.17% Li<sub>2</sub>O. The tailings grade was 0.74% Li<sub>2</sub>O, which is comparable to the initial tests. The results of test FT206 are listed in Table 13.6.

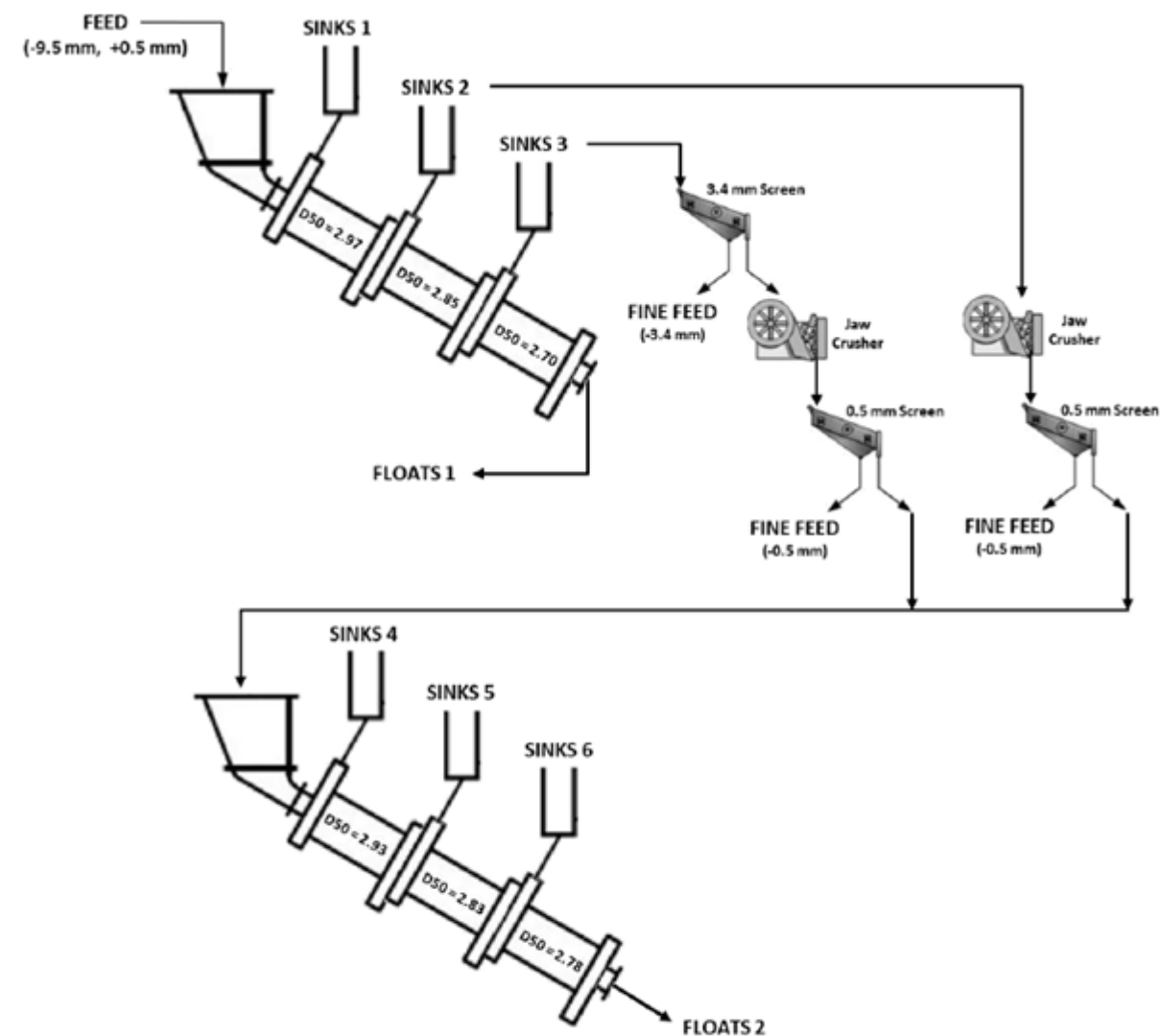
**Table 13.6 – FT206 3-Stage DMS Test**

Description:			FT206 (3-Stage DMS)					
			1 <sup>st</sup> Stage	2 <sup>nd</sup> Stage	3 <sup>rd</sup> Stage			
*D50 (Specific Gravity):			3.00	3.00	2.87			
Specific Gravity of Dense Media:			2.84	2.84	2.44			
Medium Inlet Pressure (psi):			28	28	28			
			*Based on tracer tests					
Feed Particle Size:			(- 9.5 mm + 0.5 mm)					
Description	Weight		Assay			Distribution		
	kg	%	Li <sub>2</sub> O %	Si %	Al %	Li <sub>2</sub> O %	Si %	Al %
Sinks 1	4.27	6.8	6.16	29.6	11.60	24.2	6.1	10.3
Sinks 2	1.67	2.7	5.89	31.0	11.55	9.0	2.5	4.0
Sinks 3	8.07	12.9	4.50	32.8	9.86	33.5	12.7	16.5
<b>Total Sinks</b>	<b>14.01</b>	<b>22.4</b>	<b>5.17</b>	<b>31.6</b>	<b>10.59</b>	<b>66.8</b>	<b>21.3</b>	<b>30.8</b>
Floats	48.48	77.6	0.74	33.7	6.89	33.2	78.7	69.2
Calc Head	62.48	100.0	1.74	33.2	7.72	100.0	100.0	100.0
Calc Head (SFA)			1.65	33.7	7.81			

Source: MS1467; Nemaska Lithium Inc., Dense Media Separation Final Report – August 13, 2013

The flow sheet of test F207 with the crushing step is shown in Figure 13.7. Test FT207 yielded the best results, based on recovery and final concentrate grade. This indicates that lower density settings with less coarse feed may yield even improved results.

**Figure 13.7 – General Process Flow Sheet for Initial DMS Test Work (Tests FT207)**



Description	1st Stage	2nd Stage	3rd Stage	4th Stage	5th Stage	6th Stage
	<i>(Initial 3-Stage DMS)</i>			<i>(3-Stage Re-circulated on Crushed Middlings)</i>		
Test 7 (FT207) *Actual D50	2.97	2.85	2.69	2.93	2.83	2.78

Source: MS1467; Nemaska Lithium Inc., Dense Media Separation Final Report – August 13<sup>th</sup>, 2013

The results of test FT207 indicate that using the 3-stage DMS the Floats 1 lithium content can be reduced with a lower dense media pulp specific gravity. The sinks grade can be improved by using some sinks as middlings to be crushed and re-circulated. In conclusion, test FT207 had a low loss

of lithium while producing a relatively large quantity of DMS concentrate. The low tailings part is important as the lower grade sinks can be reprocessed as middlings in the flotation circuit. The results from FT207 are listed in Table 13.7.

**Table 13.7 – Results of Test FT207**

Description	Weight		Assay			Distribution		
			Li <sub>2</sub> O	Si	Al	Li <sub>2</sub> O	Si	Al
	(kg)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Sink 1	7.40	10.9	5.87	29.6	11.55	37.6	9.4	15.7
Sink2 (–0.5 mm)	2.16	3.2	3.52	32.1	9.28	6.6	3.0	3.7
Sink3 (–3.4 mm)	4.76	7.0	1.85	36.1	8.03	7.6	7.4	7.0
Sink3 (–0.5 mm)	2.74	4.1	1.30	32.6	7.27	3.1	3.8	3.7
Sink 4	1.69	2.5	6.32	30.9	11.95	9.3	2.2	3.7
Sink 5	3.37	5.0	5.02	32.7	10.55	14.7	4.7	6.5
Sink 6	4.30	6.3	2.38	34.8	8.26	8.9	6.4	6.5
Total Sinks	26.42	39.0	3.83	32.6	9.65	87.7	36.9	46.7
Floats 1	37.36	55.2	0.31	35.7	7.08	10.0	57.1	48.4
Floats2	3.91	5.8	0.69	35.5	6.77	2.3	5.9	4.8
Calc. Head	67.69	100.0	1.71	34.4	8.06	100.0	100.0	100.0
Calc. Head (SFA)			1.65	33.7	7.81			

Source: MS1467; Nemaska Lithium Inc., Dense Media Separation Final Report – August 13<sup>th</sup>, 2013

In 2014, test FT700 was carried-out to re-visit the FT207 test, without crushing and re-circulation of the lower grade Sinks. FT700 indicates that when using the 3-stage DMS, the Floats lithium content can be reduced with a low dense media pulp specific gravity, similar to FT207. Test FT700 had the lowest loss of lithium for the standard test; the latter is of prime importance as the lower grade sinks can be reprocessed as middlings in the flotation circuit. The results from FT700 are listed in Table 13.8.

#### 13.1.3.3 COREM Heavy Liquid Separation Test Work Program

To confirm the cut points for DMS heavy liquid separation tests were conducted on Whabouchi feed, with a grade 1.77% Li<sub>2</sub>O. The tested samples were crushed into three size fraction ranges, –12.5 mm +0.85 mm, –9.5 mm +0.85 mm and –6.3 mm +0.85 mm. The separation cut points were 2.96 and 2.70. The results were presented in a Power Point presentation “*Résultats préliminaires – Caractérisation minéralogique des roches concassées du dépôt de Whabouchi*” or (Preliminary Results - Mineralogical Characterization of Crushed Rocks from the Whabouchi Deposit). The results are presented in Table 13.9.



**Table 13.8 – Results of Test FT700**

Description:	FT700 (3-Stage DMS)		
	1 <sup>st</sup> Stage	2 <sup>nd</sup> Stage	3 <sup>rd</sup> Stage
*D50 (Specific Gravity):	2.940	2.855	2.700
Specific Gravity of Dense Media:	2.670	2.370	2.700
Medium Inlet Pressure (psi):	25	23	24
Back Pressure (mm):	200		

Description	Weight		Assay			Distribution		
	(kg)	(%)	Li <sub>2</sub> O	Si	Al	Li <sub>2</sub> O	Si	Al
			(%)	(%)	(%)	(%)	(%)	(%)
Sinks 1	33.23	9.67	5.88	33.0	11.80	33.5	8.7	14.2
Sinks 2	46.10	13.42	4.30	35.9	10.16	34.1	13.1	16.9
Sinks 3	68.37	19.91	1.85	37.6	8.03	21.8	20.3	19.8
<b>Total Sinks</b>	<b>147.69</b>	<b>43.00</b>	<b>3.52</b>	<b>36.0</b>	<b>9.54</b>	<b>89.3</b>	<b>42.1</b>	<b>50.9</b>
Floats	195.75	57.00	0.32	37.4	6.95	10.7	57.9	49.1
<b>Calc Head</b>	<b>343.44</b>	<b>100.0</b>	<b>1.70</b>	<b>36.8</b>	<b>8.06</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>
Calc Head (SFA)			1.65	33.7	7.81			

Source: MS1467; Nemaska Lithium Inc., DMS Update – April 4, 2014

**Table 13.9 – HLS Mineralogical Study**

Size Fractions	Sinks — 2.96		Sinks — 2.70		Floats — 2.70		–0.85 mm
	Weight (%)	Li <sub>2</sub> O (%)	Weight (%)	Li <sub>2</sub> O (%)	Weight (%)	Li <sub>2</sub> O (%)	Weight (%)
–12.5 +0.85 mm	7.5	6.63	35.2	2.83	43.0	0.33	14.3
–9.5 +0.85 mm	8.6	6.43	26.6	2.84	45.0	0.24	19.8
–6.3 +0.85 mm	12.6	6.47	22.3	2.78	41.1	0.17	24.0

Source: COREM, Project T2081; Prelim results, Caractérisation minéralogique des roches concassées du dépôt de Whabouchi, 02 Nov. 2017.

The fraction - 0.85 mm will go to fine ore processing. HLS Floats are final tailings and the - 12.5 mm has the highest tailings grade. The finest fraction (- 6.3 mm) has the lowest tailings indicating that Spodumene was better liberated in the finer fractions. Since Nemaska elected to use –9.5 mm, these results have been listed in Table 13.10.

**Table 13.10 – Size Fraction –9.5 mm HLS**

Stream –9.5 mm	Weight (%)	Li <sub>2</sub> O (%)	Li Rec. (%)
Sinks — 2.96	10.7	6.43	38.8
Sinks — 2.70	33.2	2.84	53.6
Float — 2.70	56.1	0.24	7.6
Feed (Calc.)	100.0	1.77	100.0

Source: COREM, Project T2081; Preliminary results, Caractérisation minéralogique des roches concassées du dépôt de Whabouchi, November 2, 2017.

#### 13.1.4 DERRICK TEST WORK PROGRAM – FINE SCREENING TESTING

Derrick received samples produced by SGS Minerals during the Pilot plant operation (2017). 200 kg drums of CrossFlow overflow and flotation feed were sent to Derrick's Buffalo facility. Most of the tests were done on the flotation feed to split the material between coarse and fine flotation.

##### 13.1.4.1 Fine Screening at 212 microns

Tests #1 was performed on overflow from the Fine Muscovite Removal CrossFlow separator and the screening yielded good results with near 94% efficiency.

Flotation feed screening using screen openings of 0.21 mm was done in Test #2, Test #3 and Test #9. There is a significant quantity of fines in the oversize which may interfere with the Hydro-Float separation. The results are listed in Table 13.11.

**Table 13.11 – Fine Screening Tests at 212 Microns**

Test Number	Test Screen Opening (mm)	Feed Rate (t/h)	Feed Solids (%)	Wash Water, (m <sup>3</sup> /h)	Cumulative Percentage at 0.212 mm			Screening Efficiency
					Feed	Oversize	Undersize	
1	0.21	34.0	8.75	0.0	5.58	47.0	1.64	93.9
2	0.21	67.3	35.4	0.0	39.9	69.1	6.94	80.4
3	0.21	67.3	35.4	28.4	39.9	74.1	7.45	83.6
9	0.21	68.0	25.3	28.4	40.3	82.9	9.63	87.2

Source: Derrick Corporation, Buffalo, NY. September 2017

##### 13.1.4.2 Fine Screening at 250 Microns

The flotation feed fine screening tests using 0.25 mm screen openings were done in Test #4, Test #5 and Test #10. Again, there is a significant quantity of fines in the oversize which may interfere with the Hydro-Float separation. The results are listed in Table 13.12.

**Table 13.12 – Fine Screening Tests at 250 Microns**

Test Number	Test Screen Opening (mm)	Feed Rate (t/h)	Feed Solids (%)	Wash Water, (m <sup>3</sup> /h)	Cumulative Percentage at 0.212 mm			Screening Efficiency
					Feed	Oversize	Undersize	
4	0.25	59.5	35.4	0.0	39.9	70.8	8.68	81.0
5	0.25	59.5	35.4	28.4	39.9	78.2	9.85	84.9
10	0.25	68.0	25.3	28.4	40.3	85.1	11.94	87.3

Source: Derrick Corporation, Buffalo, NY. September 2017

#### 13.1.4.3 Fine Screening at 300 Microns

The flotation feed fine screening tests using 0.30 mm screen openings were done in Test #6, Test #7 and Test #8. Even with the larger screen openings, too many fines are present in the oversize and may interfere with the Hydro-Float separation. The results are listed in Table 13.13.

**Table 13.13 – Fine Screening Tests at 300 Microns**

Test Number	Test Screen Opening (mm)	Feed Rate (t/h)	Feed Solids (%)	Wash Water, (m <sup>3</sup> /h)	Cumulative Percentage at 0.212 mm			Screening Efficiency
					Feed	Oversize	Undersize	
6	0.30	67.3	35.4	0.0	39.9	72.6	10.9	81.4
7	0.30	67.3	35.4	28.4	39.9	79.0	12.6	83.9
8	0.30	68.0	25.3	28.4	40.3	86.1	14.9	85.5

Source: Derrick Corporation, Buffalo, NY. September 2017

#### 13.1.5 FLOTATION TEST WORK

##### 13.1.5.1 SGS Flotation Pilot Plant Test Work – 2011

In January 2011, Nemaska contracted SGS to carry out a pilot plant and bench scale testing program as part of a second phase of the Whabouchi lithium Project. The objectives of the second phase were:

- To produce two (2) tonnes of spodumene concentrate with a grade of six percent (6%) or higher for electrochemical test work;
- To confirm and optimize previous bench test work;
- To generate engineering data for concentrator design.

Findings from the pilot plant program were reported by SGS in the report “Project 12486-003”, April 2, 2012, and are summarized in the following Sections.

Pilot plant flotation tests were performed on four (4) composites, the flotation outcrop (blasted composite), flotation mine representative composite, combined DMS middlings and undersize

fractions from outcrop and finally combined DMS middlings and undersize fractions from mine representative composite. Mine representative composite was composited of outcrop material and drill core assay reject samples. The detailed description of these composites is given in the previously mentioned SGS report.

Material from the four (4) composites were processed through the flotation pilot plant in a sequential manner, 21 pilot plant tests were performed.

Various flow sheet configurations were tested in the pilot plant campaigns. The objectives were to find the best and optimal operating conditions for spodumene separation and recovery.

In total, more than 40 tonnes of material were processed through this pilot plant. The final flow sheet of the last run of the pilot plant PP21 is shown in Figure 13.8. Pilot plant test PP21, yielded the most efficient processing results.

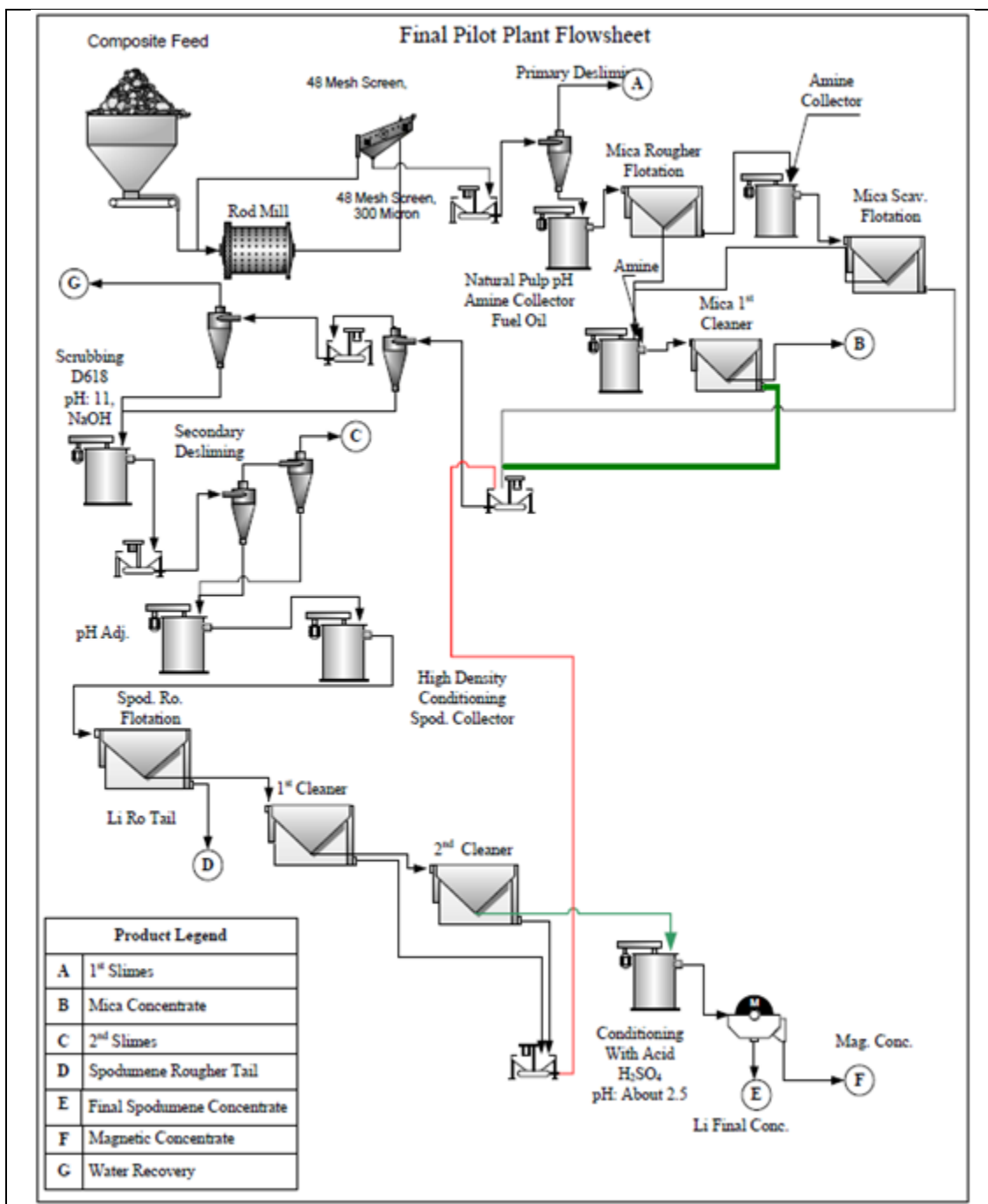
The final flow sheet consists of the following circuits:

- Grinding and screening;
- Primary de-sliming and mica flotation;
- Dewatering, scrubbing and secondary desliming;
- Spodumene flotation;
- Magnetic separation circuit.

The crushed composite feed was ground using a rod mill and screened at 300 µm. The screen oversize (+300 µm), was sent back to rod mill, while the screen undersize (-300 µm) was subjected to primary de-sliming in a cyclone where the overflow exited as slimes. The primary de-sliming cyclone underflow was conditioned with AERO 3030C or Armac collector prior to subjecting to mica rougher flotation stage followed by scavenger stage.

The rougher and scavenger concentrates were combined and transferred to a cleaner stage. Mica cleaner concentrate was collected in 200 L plastic drums, while mica cleaner tailings were dewatered in 2-stage cycloning and then underwent a scrubbing stage where dispersant D618 and NaOH were added. The scrubbed slurry was then subjected to a secondary de-sliming stage before pH adjustment and high-density conditioning with spodumene collector (LR19). The spodumene rougher flotation concentrate was subjected to 2-stage cleaning while spodumene rougher tailings were sent to final tailings.

Figure 13.8 – Final Flotation Pilot Plant Flow Sheet



Source: SGS Mineral Services; Project 12486-003 – Final Report, April 2,, 2012

The first and second cleaner tailings were recycled back and combined with mica flotation tailings. The final spodumene concentrate was conditioned with acid before magnetic separation to remove iron impurities. Pilot Plant test PP21 yielded the most significant results. These metallurgical results for test PP21 are summarized and presented in Table 13.14.

**Table 13.14 – Optimal Pilot Plant Performance for PP21 Test**

Composite	PP No	Products	Mass (%)	Assay (Adj)		Distribution (% Li)
				(% Li)	(% Li <sub>2</sub> O)	
DMS-Mine Representative Composite	PP21	Feed	100	0.88	1.85	100
		Cyclone O/F	2.65	0.66	1.42	2.03
		Mica 1 <sup>st</sup> Clnr Conc	9.2	0.34	0.73	3.63
		2 <sup>nd</sup> Slimes	2.89	0.9	1.94	3
		Spod Rghr Tail	63.	0.19	0.4	13.7
		Spod Mag Conc	0.18	0.23	0.5	0.05
		Spod Final (Non-Mag) Conc	22.1	3.02	6.5	77.5

Source: SGS Mineral Services; Project 12486-003 – Final Report, April 2, 2012

The conclusions from these pilot plant results were that using flotation a spodumene final concentrate grade of 6.0% Li<sub>2</sub>O or higher with more than 77% lithium recovery representing 22.1% weight could be obtained consistently.

These results show also that the lithium losses depend on the nature of the feed composite. For the DMS-Mine representative middling composite (PP21), the majority of lithium losses occurs in the spodumene tailings (13.7%), followed by slime removal (5.0%), mica concentrate (3.6%) and spodumene magnetics (0.05%) for a total of 22.4%. According to the results, the majority of the losses in the rougher tailings occur in the 100 meshes fraction. Coarse grain spodumene can be difficult to float thus the grinding size should be controlled to keep the K<sub>80</sub> of the flotation feed to about 200 µm.

These results highlight the importance of mica flotation circuit ahead of spodumene flotation; by eliminating the mica flotation step, significant increase in muscovite grade was observed. The lithium oxide concentration in spodumene concentrate increased from 5.6% in PP19 as compared to 6.5% in PP21, which confirmed that removing mica ahead of spodumene flotation helped to increase final spodumene concentrate grade.

About three (3) tonnes of concentrate grading 6.0% Li<sub>2</sub>O was generated by combining concentrates from pilot plant campaigns PP12 to PP21.

Low magnetic intensity separation (about 800 Gauss) was used to separate iron contaminant particles from the flotation concentrate. The iron grade of the lithium concentrate was about 2.11% Fe<sub>2</sub>O<sub>3</sub>.

#### 13.1.5.2 SGS Minerals Test Work Program – 2017

SGS Minerals Lakefield received an estimated 500 tonnes of pre-screened fines (< 850 µm) from the Nemaska Whabouchi mini-DMS operation. The aim of this test work program was to produce



flotation concentrate for the electrochemical demonstration plant (P1P) at Shawinigan. Half of this material was processed using the flow sheet as shown in Figure 13.9.

Muscovite (Mica) was removed using Hydraulic separation (CrossFlow) and was screened. The screen oversize was considered mica waste and the undersize was reground to < 430 µm, deslimed and processed in wet magnetic separation. Before flotation, an attrition scrubbing stage was done on the material before a final desliming step to prepare the particles for the conditioning stage. The flotation was split in coarse hydroflotation (for + 0.18 – 0.43 mm) and fine conventional flotation (on – 0.18 mm) with separate conditioning stages for each.

a. Pilot Plant Test #1 to Test #17

This period was mainly commissioning of the equipment and process optimisation. After a few extended continuous runs, it became clear that:

- / CrossFlow separator feed had to be introduced with less energy;
- / Magnetic separation was effective in removing residual iron rich particles;
- / Flotation conditioning is critical;
- / To achieve no fines in the coarse after fine screening was not possible;
- / HydroFloat separation was going to be very sensitive to feed variations;
- / Vacuum filtration of the concentrate produced a dry product by touch.

CrossFlow separation required a high percent solids and laminar flow into the separator. This was accomplished with the introduction of cyclones prior to CrossFlow separators. It became clear that the second separator was superfluous.

The magnetic separator mass pull is very low at 2.2%. However, the important aspect that needs to be monitored in the magnetic separation stage is to maximize rejection while preventing spodumene loss. Operating conditions can be adjusted to meet this criterion.

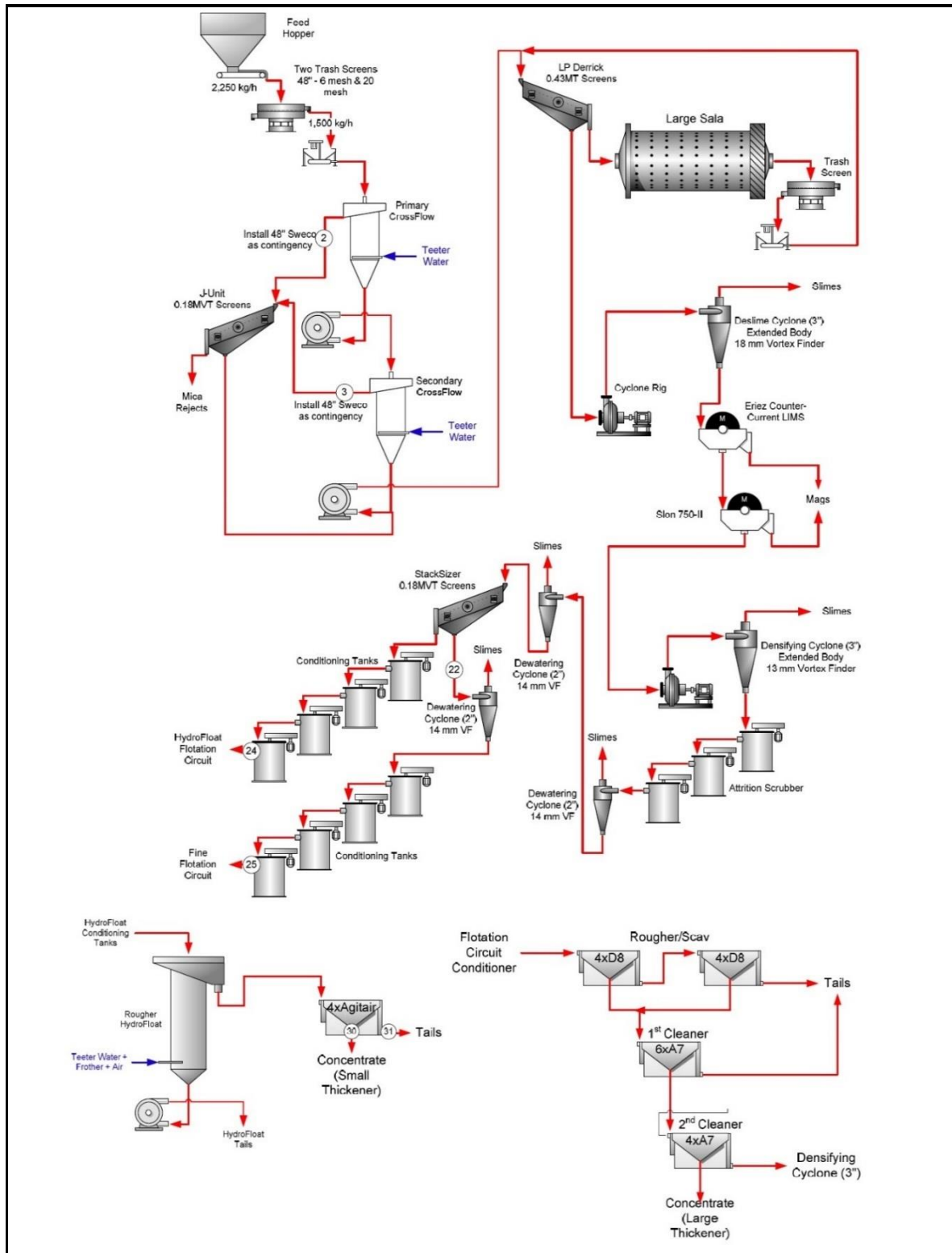
Hydro-Float separation was not successful at SGS, probably due to screening fines in the screen oversize. The finer material soaks up the reagents disproportionately and most finer material are unselectively removed during Hydro-Float separation resulting in poor grade and poor recovery.

The lithium losses in slimes are about 3.5%.

b. Pilot Plant Test #18 to Test #23

The Hydro-Float was replaced by mechanical cells and later a flotation column for cleaning. Very high grades up to 7.1% Li<sub>2</sub>O were achieved using the flotation columns, however, the recovery grades were still low.

Figure 13.9 – Pilot Plant Flow Sheet Test #1 to Test #17



Source: SGS Minerals Canada Inc.; Test Laboratory, Lakefield, ON. December 2017.

c. Pilot Plant Test #24 and Test #25

A hydraulic separator was introduced to remove the fines from the rougher flotation tailings of 0.86%  $\text{Li}_2\text{O}$ . The hydraulic separator underflow (1.16%  $\text{Li}_2\text{O}$ ) was re-floated using the Hydro-Float separator after reconditioning. The Hydro-Float concentrate grade was only 3.55%  $\text{Li}_2\text{O}$ . The upgrading ratio of the Hydro-Float unit is limited. To produce an acceptable concentrate, it must be provided with a feed of sufficient grade. This test provided an upgrading ratio on 3 to 1.

d. Pilot Plant Test #26 and Test #30

These tests involve the successful upgrading of earlier subpar concentrate grade to above 6%  $\text{Li}_2\text{O}$ . The old concentrate was re-conditioned and re-floated using mechanical cells.

e. Pilot Plant Test #31 and Test #40

These tests involve the use of mica flotation between grinding and magnetic separation and spodumene flotation using mechanical cells. A greater than 6%  $\text{Li}_2\text{O}$  concentrate was produced with a recovery above 80%. For these tests, all the ore was ground to less than 300 microns. The Lithium losses due to de-sliming was 6.8% or about double the amount compared when ground to 500 microns.

#### 13.1.5.3 COREM Flotation Test Work – 2017

a. Bench Scale Flotation Test Work

COREM performed bench scale flotation test with the aim to determine the most influential flotation parameter. Four main parameters are collector dosage rate, flotation alkalinity, conditioning pulp density, flotation time. The results are presented in Table 13.15.

The results indicated that a minimum five (5) minutes of conditioning time is required. The other parameters are not statistically significant due to interactions. However, Test 22 delivered the best results and these parameters are, therefore, assumed to be superior.

b. Pilot Plant Flotation Test Work

The pilot scale circuit was based on the proposed flow sheet and included: magnetic separation, attrition scrubbing, de-sliming, conditioning and flotation. The flotation steps consist of rougher, scavenger and cleaner flotation using 3-inch flotation columns. The flotation feed sample was pre-screened to less than 212 microns.

**Table 13.15 – Main Flotation Parameters Test**

Test	Collector (kg/t)	pH	Cond. Time (min)	Cond. Solids (%)	Weight Rec. <sup>1</sup>	Li <sub>2</sub> O (%)	Li <sub>2</sub> O Rec. <sup>2</sup>
18	3.6	9	5.0	50	13.3	6.01	72.8
19	2.4	9	5.0	50	19.7	5.34	92.4
20	1.2	9	5.0	50	9.4	5.77	50.7
21	2.4	10	5.0	50	17.3	5.45	86.9
22	2.4	8	5.0	50	16.9	5.96	91.8
23	2.4	9	5.0	70	18.3	5.42	90.4
24	2.4	9	5.0	60	19.3	5.34	92.2
25	2.4	9	5.0	40	17.2	5.60	87.1
26	2.4	9	2.5	50	13.4	5.70	70.7
27	2.4	9	1.0	50	8.6	5.62	43.5
28	2.4	9	2.5	70	11.5	5.81	56.6
29	2.4	9	1.0	70	9.9	5.92	55.8

Source: COREM, Preliminary Report, Project T2181; 3 inches column flotation optimization for Whabouchi spodumene ore, August 2, 2017.

1 Weight recovery = concentrate weight / flotation feed weight × 100%.

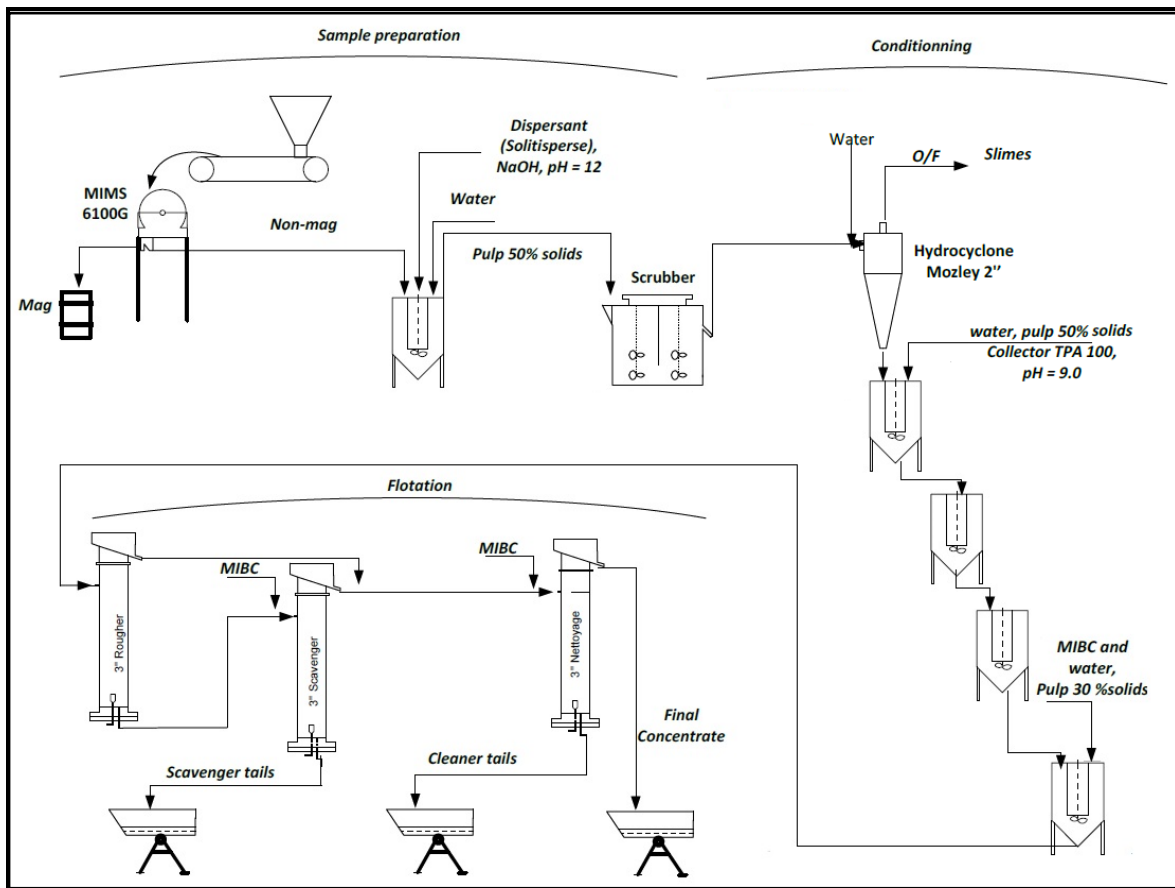
2 Li<sub>2</sub>O recovery = weight of Li<sub>2</sub>O in concentrate / weight of Li<sub>2</sub>O in flotation feed × 100%.

Medium Intensity Magnetic Separation (MIMS) was performed on dry ore and was used to remove the residual ferrosilicon found in the provided sample which comes from the dense media separator circuit (mini-DMS operation 2017). A final magnetic separation was performed on the final concentrate.

In total three (3) pilot plant flotation tests were conducted using the flow sheet shown in Figure 13.10.

Table 13.16 is the pilot plant results. COREM endeavored to simulate the proposed fine flotation part of the flow sheet. The aim was to confirm the column flotation performance in the flow sheet. The rougher flotation time estimate and recoveries are listed in Table 13.16. The performance of the test done at COREM did not meet expectations. However, the flotation feed to these tests was less than 1% Li<sub>2</sub>O which is an important factor in the flotation performance. Another important observation is that the reagent scheme differed significantly from the optimized parameters that were recently developed at SGS Lakefield and used by Eriez in the next Section.

**Figure 13.10 – General Process Flow Sheet for COREM Column Flotation Pilot Plant**



Source: COREM, Preliminary Report, Project T2181; 3 inches column flotation optimization for Whabouchi spodumene ore, 02 August 2017.

**Table 13.16 – Pilot Plant Flotation Test**

Pilot Plant Test	Collector (kg/t)	pH	Cond. Time (min)	Rougher Float. Time (min)	Rougher Weight Rec.	Cleaner Li <sub>2</sub> O (%)	Cleaner Li <sub>2</sub> O Rec.
1	4.8	8	25	17.5	10.7	5.33	59.3
2	4.8	8	25	17.1	8.5	5.16	47.1
3	4.8	8	12	7.5	8.3	4.77	27.9

Source: COREM, Preliminary Report, Project T2181; 3 inches column flotation optimization for Whabouchi spodumene ore, August 2, 2017.

#### 13.1.5.4 Eriez Flotation Test Work – 2017

Eriez Flotation Division (EFD) was provided with one (1) bulk bag of minus 850 microns (" $\mu\text{m}$ ") low grade ore from the SGS test work program 2017, and one (1) bulk bag of DMS circuit middlings ( $D_{80} = 682 \mu\text{m}$ ) from Nemaska to study the laboratory-scale split feed flotation response. This test work was a continuation of recent pilot testing efforts performed at SGS-Lakefield. The patented Hydro-Float technology and flotation columns, inclusive of proprietary Eriez Cavitation-Tube

sparging technology, were used to treat 497×212 µm and 212×27 µm size fractions, respectively. This split feed flotation approach provides the maximum separation efficiency.

a. Hydro-Float Tests

Coarse flotation tests were conducted on both an independent low-grade ore, as-received from SGS, and a blend of DMS circuit middlings and fresh flotation feed. During treatment of the coarse size fraction using Eriez Hydro-Float fluidized bed flotation, optimal upgrade ratios of approximately 1.90-2.0 were achieved at Li<sub>2</sub>O recoveries of 92-95%. A 5.8-6.0% Li<sub>2</sub>O product was yielded at Li<sub>2</sub>O recoveries of nearly 95-97% during treatment of a 3.07% Li<sub>2</sub>O feed.

The Hydro-Float feed was nearly 40% passing 300 µm. Size-by-size assays of the Hydro-Float overflow indicate Li<sub>2</sub>O grades of the plus 300 µm particle size fractions are greater than 6.3%. The lower grade concentrates are within the minus 300 µm size fractions. Although a coarse 6% Li<sub>2</sub>O Hydro-Float concentrate is achievable without classification of the overflow, it is recommended that the circuit be designed such that the Hydro-Float concentrate can be scalped to remove fines floated unselectively and re-process them in a fine flotation circuit to improve global spodumene recovery. This is especially important if the feed grade decreases below 2.4% Li<sub>2</sub>O, as demonstrated in preliminary coarse flotation testing.

b. Column Flotation Tests

Sixteen (16) rougher column flotation tests were conducted on a de-slimed 212 × 27 µm blend of the SGS Lakefield and DMS samples at varying operating conditions. Optimal upgrade ratios of approximately 2.4 were achieved at Li<sub>2</sub>O recoveries of 88.5-92.5%, as a concentrate grade of over 6.1% was achieved in rougher column flotation. A concentrate grade of 6.6% was realized at 88.2% Li<sub>2</sub>O recovery and 34.4% concentrate mass yield in a rougher-cleaner open circuit.

Such results were ascertained following a 10-minute scrubbing period using 104 g/t NaOH pH modifier and 250 g/t soltisperse dispersant at 65% solids, by weight. In addition to scrubbing, the rougher and cleaner flotation feed were conditioned for 15 and 2 minutes, respectively, using a cumulative 146 g/t H<sub>2</sub>SO<sub>4</sub> (return slurry to neutral pH), 32 g/t Na<sub>2</sub>SiO<sub>3</sub>, 350 g/t FA-2, and 150 g/t TP-100. Throughout rougher-cleaner column flotation testing, maximum rougher and cleaner carrying capacities of approximately 4.1 tph/m<sup>2</sup> and 3.9 tph/m<sup>2</sup>, respectively, were achieved at a total circuit retention time of nearly 14.7 minutes (6.3 minutes in rougher and 8.4 minutes in cleaner).

The use of wash water in column flotation significantly improved the spodumene concentrate grade and flotation upgrade ratios. This is because wash water efficiently rids the froth of entrained gangue minerals such as quartz, mica and feldspar etc., pushing those minerals back into the pulp phase. The use of a minimal sodium silicate dosage (32 g/t) also increased flotation selectivity throughout spodumene flotation testing. However, when added in



excessive quantities, sodium silicate can render the froth brittle. As a result, careful monitoring of its addition is necessary to optimize the flotation performance.

### 13.1.6 SETTLING, FILTRATION AND FREEZING TESTS

Various design tests have been done to size dewatering equipment and evaluate freezing of the final concentrate. Settling, filtration and freezing test work was done, which can be used for the sizing of concentrate and tailings thickeners and filters.

#### 13.1.6.1 *Settling Test Work*

SGS performed static settling test to determine the optimal feed densities and type of flocculant. Thereafter they performed dynamic thickening testing. The results for thickening tests are listed in Table 13.17. The most important tests involved spodumene concentrate and final tailings. The thickening hydraulic test data was used by suppliers for thickener sizing. The dynamic thickening obtained results with a spodumene concentrate thickener underflow between 61 and 63 weight percent solids. This was as expected. The final tailings underflow density was 61%. Both test samples had low turbidity overflows with total suspended solids (“TSS”) of ten (10) ppm.

**Table 13.17 – Dynamic Thickening Test Work Results**

Stream Description	Flocculant Type	Flocculant addition rate (kg/t)	Feed Pulp (% w/w)	Underflow Pulp (% w/w)	Dynamic Settling Rate (t/m <sup>2</sup> /h)
Spodumene Concentrate	Ciba Magnafloc 10	0.010	19	61 to 63	0.62
Combined Final Tailings	Ciba Magnafloc 10	0.028	17.8	61	0.5

Source: SGS Mineral Services; Project 12486-005A – Final Report, June 5, 2012.

#### 13.1.6.2 *Filtration Test Work*

##### a. SGS Filtration Test Work on the Spodumene Concentrate and the Final Tailings

The vacuum filtration test had good results for the spodumene concentrate producing a cake of 8.3% moisture by weight at minus 0.4 g bar vacuum, while the lower vacuum of minus 0.7 g bar yielded a higher cake moisture content of 12.2%. The final tailings did not have similar results and ended up with wet cakes of 13.9% and 12.8% at minus 0.4 g bar and minus 0.7 g bar vacuum levels respectively.

The pressure filtration test produced good results for the spodumene concentrate with a cake of 7.7% moisture by weight at a pressure of 4.1 bar, while the higher pressure 6.9 bar yielded a higher cake moisture content of 9.1%. The final tailings had similar results and ended up with dry cakes of 6.2% and 6.6% at 4.1 bar and 6.9 bar respectively as shown in Table 13.18.

**Table 13.18 – Filtration Test Work Results**

Stream Description	Vacuum Filtration			Pressure Filtration		
	Throughput rate (kg/m <sup>2</sup> /h)	Vacuum Level (barg)	Cake Moisture (% w/w)	Throughput rate (kg/m <sup>2</sup> /h)	Pressure Level (bar)	Cake Moisture (% w/w)
Spodumene Concentrate	497	-0.4	8.3	561	4.1	7.7
	463	-0.7	12.2	541	6.9	9.1
Combined Final Tailings	425	-0.4	13.9	486	4.1	6.2
	486	-0.7	12.8	670	6.9	6.6

Source: SGS Mineral Services; Project 12486-005A – Final Report, June 5, 2012.xc

SGS reports that the spodumene concentrate filtration test results were as expected and were considered normal behaviour for fast settling coarse material.

b. Bokela Tailings Filtration Testing

Bokela performed six (6) filtration tests. Three (3) different filtration rates and two (2) different air flows were tested at two (2) differential pressures. The tailings were of fast sedimentation and high filtration speed, a pan filter with a filter area of 25 m<sup>2</sup> was recommended.

The pan filter is able to handle throughput of 37.8 t/h.

In Table 13.19, two (2) layout cases are shown for a higher moisture content (7,200 m<sup>3</sup>/h vacuum demand) and for a lower moisture content (13,000 m<sup>3</sup>/h).

**Table 13.19 – Tailing Filtration Test at 200 Micron**

Item	Filter Area (m <sup>2</sup> )	Filter Rate (dry t/h)	Diff. Pressure (bar)	Airflow (m <sup>3</sup> /h)	Expected Moisture (%)	Guaranteed Moisture (%)
1	25	26.5	0.55 to 0.6.	13,000	13.5 to 14.0	
2	25	37.8	0.6	13,000	14.0	15.0
3	25	47.2	0.60 to 0.65	13,000	14.0 to 14.5	
4	25	26.5	0.35 to 0.40	7,200	14.5 to 15.2	
5	25	37.8	0.35 to 0.45	7,200	15.2	16.2
6	25	47.2	0.40 to 0.45	7,200	15.2 to 15.7	

Source: BOKELA Ingenieurgesellschaft fuer Mechanische Verfahrenstechnik mbH Karlsruhe, Germany. November 2017

13.1.6.3 Freeze Test Work

SGS performed two (2) freezing tests on spodumene fine concentrates containing 3% and 5% moisture. SGS placed 750 grams samples on trays and exposed those -18°C temperature for 24 hours.

Neither of the two (2) samples indicated major freezing problems as none of the samples froze as one solid block. The frozen 3% moisture sample contained many very small fragile lumps. The frozen 5% moisture sample had larger lumps, but these were also fragile crumbling on slight contact.

#### 13.1.7 DMS CONCENTRATE DRYING TESTING

ThermoPower received Nemaska Whabouchi DMS concentrate to perform drying testing. The aim was to find out the temperature at which the material would be free flowing.

##### 13.1.7.1 *Complete Drying of DMS Concentrate*

To determine the residence time for completely drying a sample of DMS concentrate in an indirectly heated rotary tube furnace. It took an average of 7 minutes and 2 seconds for the product to reach a temperature of 110°C and thus to complete drying. 110°C is well above the boiling temperature of water ( $\approx 94^{\circ}\text{C}$ ) of the test location.

##### 13.1.7.2 *Drying DMS Concentrate at 80°C*

The average residual moisture was 3.4% after drying. Figure 13.11 shows product that was cooled from 80°C to 60°C and then inspected for moisture and adhesion properties before being dried in the Convection Oven. The material was mixed and inspected by hand in the drying tray and can be seen to still stick to contact surfaces (Figure 13.11).

##### 13.1.7.3 *Drying DMS Concentrate at 85°C*

The average residual moisture was 1.3% after drying at 85°C. This material is reasonably free flowing.

#### 13.1.8 MAGNETIC SEPARATION TEST

##### 13.1.8.1 *Eriez Test Work Program Magnetic Separation*

Magnetic separation was performed at Eriez. Eriez Central Test Laboratory received two (2) samples of spodumene concentrate containing hornblende from Nemaska for testing. Dry magnetic separation on Sample #1 was less than 3 mm, and wet magnetic separation on Sample #2 less than 0.85 mm. The objective of the test work was to remove iron impurities from the Spodumene concentrate through both dry and wet magnetic separation processes. Later, another sample was sent to Eriez for Dry Magnetic Separation test optimization.

##### a. Dry Magnetic Separation

The coarser sample 3 mm  $\times$  0 was processed using dry magnetic separation equipment, while the other underwent wet magnetic separation.

The dry 3 mm  $\times$  0 feed was processed on a Ceramic Magnetic Drum Separator to remove any residual ferromagnetic debris present. A feed rate of 2 tonnes per hour per foot ( $\text{t/h}\cdot\text{ft}^{-1}$ ) was used. This produced a Reject #1 and non-magnetic product #1.

**Figure 13.11 – ThermoPower Drying Test #2, 80° Discharge Temperature**



Source: ThermoPower Furnaces, Olfantsfontein, Gauteng, SA. June 2017

The non-magnetic #1 fraction was reprocessed on the Salient Pole-2 Rare Earth Magnetic Drum Separator. The drum surface speed was set to a feed rate of approximately  $2 \text{ t/h}\cdot\text{ft}^{-1}$ , producing Reject #2 and corresponding non-magnetic product.

Again, the non-magnetic fraction was reprocessed on a Rare Earth Magnetic Roll Separator. This part of the sample was processed in three steps; reprocessing the non-magnetic fraction each time. For the first step, the feed rate was set to 100 pounds per hour per inch of feed width ( $\text{lb/h}\cdot\text{in}$ ), the other two (2) steps were processed at  $75 \text{ lb/h}\cdot\text{in}$ . The sample fractions of dry magnetic separation were weighed, and the percentages are presented in Table 13.20.

**Table 13.20 –Magnetic Separation Test**

Stream	Dry Magnetic weight (%)	Wet Magnetic 1.0 T- weight (%)	Wet Magnetic 1.3 T- weight (%)
Feed	100.0	100.0	100.0
Reject #1	0.8	7.0	7.0
Non-magnetic #1	99.2	93.0	93.0
Reject #2	13.0	0.3	0.3
Non-magnetic #2	86.2	92.7	92.7
Reject #3, #4 & #5	15.8	32.3	37.9
Final non-magnetic	70.4	60.4	54.8

Source: Eriez Magnetics Central Test Laboratory Spodumene & Hornblende – Report Project MTR# 17-033; February 23, 2017.

b. Wet Magnetic Separation

The 0.85 mm × 0 sample was first processed on the Low-Intensity Magnetic Separator (LIMS) to remove ferromagnetic debris. The sample was mixed with water to produce a slurry of approximately 20 percent solids and processed through the LIMS with a nominal field intensity of 950 Gauss.

The non-magnetic fraction from the LIMS was reprocessed through a Salient Pole Rare Earth Magnetic Wet Drum Separator (SP WDS) to remove additional weakly-ferromagnetic particles. The magnetic fraction was dried for mass yields.

Two (2) batches of the non-magnetic fraction from the SP WDS were reprocessed on the Wet High Intensity Magnetic Separator, (WHIMS). One batch was processed at a background field intensity of 1.0 Tesla and the other was processed at 1.3 Tesla. For both batches, a 2-mm rod matrix was used to collect the magnetic fraction, and low intensity jigging was used to agitate the slurry during processing.

c. Dry Magnetic Separation (second Eriez Test)

A new sample of DMS concentrate was provided to Eriez in early 2018. The objective was to optimize the dry magnetic separation for the coarse DMS material. Four (4) tests were done. The first three were open circuit test where a non-magnetic concentrate, a magnetic reject and a middling product were recovered. For the last test, the middling material was reprocessed and a non magnetic concentrate was recovered and added to the first stage non magnetic product. The second stage magnetic material was rejected with the magnetic tailings of the first stage.

After analyzing the results and discussing with Eriez, it was determined that the best separation arrangement is to perform a first separation stage that produces a final non-

magnetic concentrate and an intermediate product that will be reprocessed in a second stage. The second stage non magnetic material is combined with the first stage concentrate and the magnetic product is the final tailings.

**Table 13.21 –Dry Magnetic Separation Test (Second Eriez Test)**

	Test 1			Test 2			Test 3			Test 4		
	Wt%	Li <sub>2</sub> O (%)	Rec (%)	Wt%	Li <sub>2</sub> O (%)	Rec (%)	Wt%	Li <sub>2</sub> O (%)	Rec (%)	Wt%	Li <sub>2</sub> O (%)	Rec (%)
Feed	100.0	4.58	100	100.0	4.76	100	100.1	3.92	100	100.0	5.69	100
Concentrate	70.1	5.96	91.3	71.7	5.98	90.0	63.8	5.91	96.2	94.1	5.98	98.9
Middlings	8.0	4.11	7.2	7.5	5.42	8.5	9.3	1.05	2.5	1.6	3.20	0.9
Tailings (magne tics)	21.9	0.32	1.5	20.8	0.34	1.5	27.0	0.19	1.3	4.3	0.28	0.2
							Stage 2 magnetics			0.78	0.82	0.1
							Stage 2 concentrate			0.79	5.68	0.79
							Combined concentrate			94.9	5.98	99.7

#### 13.1.8.2 PhySep Dry Magnetic Separation Testing

Four tests were conducted during on August 16, 2017. An impact of the feed temperature, and feed rate on the separator performance were evaluated. To prorate the results, the laboratory vibrating feeder feed rate was then converted to equivalent feed rate for the industrial size unit based on the lab unit feed rate.

Test #1 was conducted at the ambient temperature of 27°C (in the lab), and Test #2, Test #3, and Test #4 modelled the actual temperatures of the dryer discharge around 100°C. For three (3) latter tests the feed material was preheated to about 120-130°C in the oven, and then fed to the feed hopper of the magnetic separator test unit.

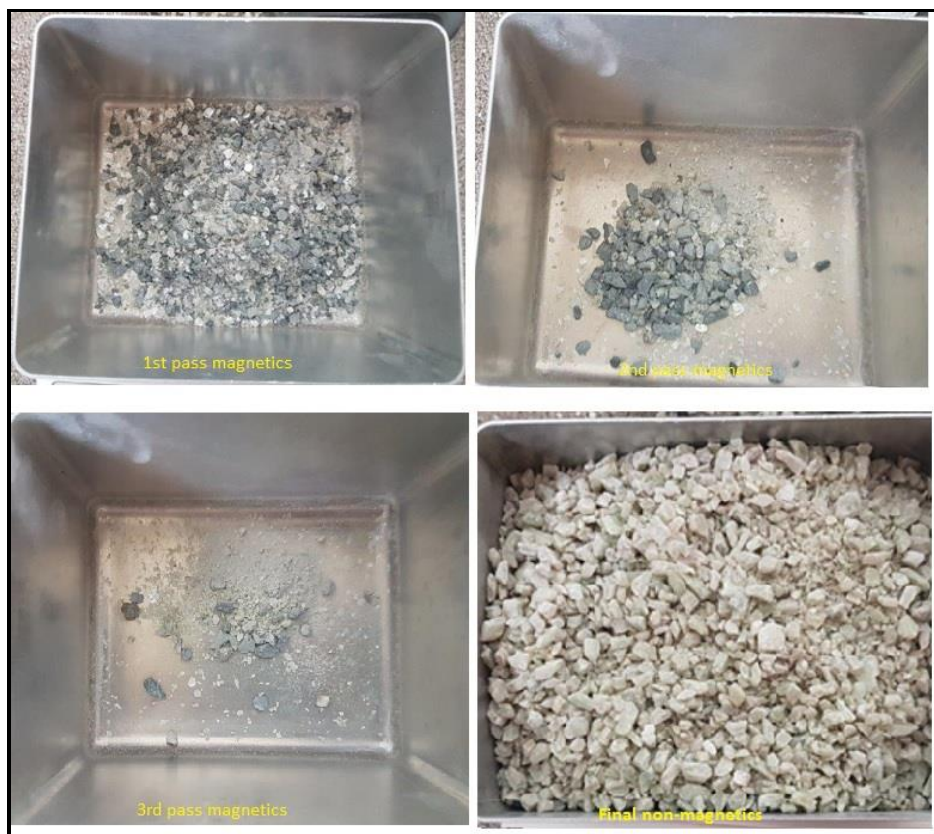
The non-magnetics of the Tests # 2, 3, and 4 were collected and re-heated to about 100°C at magnetic separator feed. After the third (and final) pass magnetic reject and non-magnetics were cooled, weighed and packaged for assaying elsewhere.

The least rejects occurred in Test #3 with a feed rate of five (5) t/h and a weight recovery of 93.9%. There are visually no dark minerals in the non-magnetic stream (Figure 13.12).

The assay results showed that the higher temperature of material did not negatively impact the separation performance. However, suppliers indicated it could deteriorate the magnets properties and some cooling should be applied to operate under 85°C. The higher processing rate resulted in a lower separation performance (less contaminant rejection), but the separation does not need to be perfect as long as the majority of hornblende is removed to prevent issues in the roasting process. Lithium losses must be minimized.



**Figure 13.12 –Hot Dry Magnetic Separation Test #3, 99°C Feed Temperature**



Source: DRA pictures taken at PhySep Components and Service, Jacksonville, FL. August 2017

The technical results are listed in Table 13.22.

**Table 13.22 – Dry Magnetic Separation Results**

Stream	Test #1	Test #2	Test #3	Test #4
Feed temperature, °C	27	100	99	99
Feed rate, t/h	2.5	2.5	5.0	5.0
1 <sup>st</sup> pass mag rejects	8.1%	6.6%	4.2%	6.9%
2 <sup>nd</sup> pass mag rejects	1.4%	1.1%	1.0%	2.5%
3 <sup>rd</sup> pass mag rejects	0.6%	0.7%	0.8%	2.0%
Total magnet rejects	10.1%	8.5%	6.1%	11.4%
Final non-magnetics	89.9%	91.5%	93.9%	88.6%

Source: PhySep Components and Service, Jacksonville, FL. August 2017

## 13.2 Electrochemical Process Test Work

This Section of the Report summarizes the process and electrochemical testing conducted on the Nemaska Whabouchi spodumene concentrate. This summary is based on reports provided by multiple independent testing laboratories, pilot facilities, research centers, and specialized equipment manufacturers.

Test work was performed to fix or optimize the process flow sheet for the production of high-quality battery-grade Lithium Hydroxide Monohydrate (“LHM”) and provide engineering data for all the major equipment selection and sizing, including:

- Concentrate Crushing and Screening (now performed at Whabouchi concentrator);
- Calcination;
- Acid Bake;
- Leaching;
- Impurity Removal;
- Electromembrane Process;
- LHM Crystallization;
- LHM Drying;
- Acid Concentration.

The following Sections give an overview of the test work performed. They are organized by plant area when possible.

### 13.2.1 CRUSHING AND SCREENING TEST WORK – 2018

Concentrate produced at Whabouchi is a mix of DMS (P100 < 9 mm) and Flotation (P100 < 850 microns) concentrates. Based on Calcination requirements, the DMS spodumene concentrate must be crushed to less than 1 mm.

Spodumene crushing and screening test work was conducted by several suppliers in 2018 to confirm technology selection and final sizing of equipment.

SGS Canada was first contracted to evaluate the grindability characteristics of the concentrate (Bond, Rod Mill and Abrasion Indices), as well as laboratory scale investigation of HPGR technology using a LABWAL unit.

Based on SGS results, HPGR was selected as the preferred technology for crushing the DMS concentrate. More samples were sent to technology suppliers, namely Metso, Weir and TKIS for pilot test work to determine the HPGR sizing parameters, as well as evaluating rolls wear life.

All tests were conclusive and confirmed that HGPR is an appropriate technology for this application.

Screening test work was also performed at several technology providers to confirm that screening dry concentrate at 1 mm is feasible and to evaluate the impact of humidity on screening performances.

Note that following these tests, the spodumene crushing sector was transferred to the Whabouchi site.

#### 13.2.2 CALCINATION AND ACID BAKE TEST WORK – FALL 2011

Spodumene calcination and acid bake test work was conducted by Feeco in the fall of 2011.

##### 13.2.2.1 *Sample Preparation*

Fine and coarse concentrates from the original concentration flow sheet were shipped from SGS to Feeco in Green Bay, Wisconsin. The coarse material was generated in the DMS process while the fine material was produced through flotation.

Two (2) blends of concentrates were prepared using the as-received coarse material and the dried fine material. Approximately 1.7 tonnes of a first blend were prepared, containing 75% fines and 25% coarse. A second blend (1.5 tonnes) was prepared, containing 50% fines and 50% coarse.

##### 13.2.2.2 *Spodumene Conversion (Calcination)*

Calcination converts the spodumene's crystalline structure from alpha to beta. The conversion occurs at a temperature of about 1,025 °C. The beta phase is reactive with sulfuric acid and produces lithium sulfate, which is amenable to leaching while the alpha crystalline structure remains unreactive.

The test work was carried out over three (3) days using a 760 mm (30") diameter by 6 m (20') long parallel flow gas-fired rotary kiln. The feed rate was maintained at 50 kg/h and a thermocouple was inserted in the discharge end hood to monitor the product temperature.

##### 13.2.2.3 *Acid Baking (Sulphation)*

A paddle mixer was used to blend the beta-spodumene with 93% sulfuric acid. The acidified material was returned to the kiln after the kiln had cooled to about 200°C. The kiln feed rate was between 135 and 180 kg/h. The retention time for the acid bake was 32 minutes.

##### 13.2.2.4 *Additional Information*

The following observations were made by Nemaska while attending the test work program. This information was not published by Feeco.

Coarse alpha-spodumene concentrate was easily converted to beta-spodumene but required a longer residence time in the kiln.

The presence of iron in the concentrate affected the conversion temperature. A higher temperature could be reached without causing the formation of glass beads when the iron was removed from the concentrate before conversion.

Sulfuric acid was used with approximately 30% stoichiometric excess.

The acid bake kiln temperature of 200°C was thought to be sufficient for the acid bake step as it was expected that the exothermic reaction would raise the material temperature to 250°C.

### 13.2.3 CALCINATION AND ACID BAKE TEST WORK – WINTER 2013

A second round of spodumene conversion and acid bake test work was performed by SGS in the winter of 2013. The objectives of these tests were to produce a water leach residue from the two (2) types of concentrate (DMS concentrate and flotation concentrate) and to perform batch calcination optimization tests.

#### 13.2.3.1 *Sample Preparation*

DMS (coarse) and flotation (fine) concentrates were used to perform the test work. The different concentrates were tested separately to assess the impact of particle size on conversion and acid bake.

#### 13.2.3.2 *Spodumene Conversion*

Twenty-nine (29) samples varying in weight from one to two kilograms (1 to 2 kg) were tested in a muffle furnace at 1,050°C. Average sample SG was 3.15. The first 14 samples were flotation concentrate and the subsequent 15 samples were DMS concentrate. Retention times were varied between 20 minutes and 165 minutes. Full conversion was deemed to have been achieved when the sample specific gravity dropped below 2.50.

Ten (10) additional optimization tests were performed using a 15.2 cm diameter by 193.5 cm long parallel flow rotary kiln with thermocouples inserted in the sample bed. Seven (7) tests were performed on flotation concentrate and three (3) on the DMS concentrate. Sample size for each test was three (3) kg. Retention times were varied between 30 minutes and 120 minutes and reaction temperatures were varied between 950°C and 1,050°C.

#### 13.2.3.3 *Acid Baking*

The same muffle furnace was used to perform the acid baking step. Samples of one to two kilograms (1 to 2 kg) were placed in the furnace along with 30% excess sulfuric acid for 30 minutes after the temperature reached 250°C. Temperature was monitored by a thermocouple placed in the center of the feed.

Further, newly transformed beta-spodumene concentrate from ten (10) additional conversion optimization tests were acid baked using 30% excess sulfuric acid for 30 minutes at a temperature of 250°C.

#### 13.2.3.4 *Concentrate Leaching*

Two (2) water leaching tests were performed. One (1) on the calcined DMS concentrate (a total of 32.31 kg) and one (1) on the calcined flotation concentrate (a total of 21.50 kg). Assays results of

the concentrate leach residues determined that a lithium extraction of 98.6% was achieved for the calcined DMS concentrate and a lithium extraction of 95% was achieved for the calcined flotation concentrate.

#### 13.2.3.5 *Additional Information*

The following observations were made following the described test work:

- Using a rotary kiln at an operating temperature of 1,050°C with a retention time of 30 minutes was sufficient to achieve complete phase conversion.
- Extractions of 98.6% lithium were achieved on the DMS concentrate and 95.0% on the flotation concentrate.
- A conversion temperature of 950°C is too low as only 69.4% lithium extraction was achieved.
- Both fine and coarse particles become very friable during conversion, with coarser particles becoming much finer.

#### 13.2.4 CALCINATION TEST WORK – 2017

Calcination tests were performed with two (2) reputable flash calciner system suppliers (FLS and TKIS). Different types of spodumene concentrate were tested:

- DMS spodumene concentrate prepared from Whabouchi ore by Nemaska's pilot unit in 2017.
- Float spodumene concentrate prepared from Whabouchi ore by SGS in 2012
- Market concentrate, a concentrate from the market.

##### 13.2.4.1 *FLSmidth – Flash Calcination Test Work - May 2017*

In May 2017, FLSmidth ("FLS") performed a 4-day test program (approximately 15 tonnes) using a pilot scale gas suspension flash calciner at their facility. The objectives were to confirm that suitable conversion level could be achieved, to determine the potential for coating formation in the flash calciner and to generate data required for the design of a commercial flash calciner system.

Test work was performed with Whabouchi DMS or DMS/Float mix concentrate, as well as purchased market concentrate.

Purchased market concentrate was used to debug the pilot unit, minimize the amount of Whabouchi concentrate that needed to be used, and provide a comparison point. Due to the restricted amount of flotation concentrate available, certain tests were only performed with DMS feed.

The market concentrate and the DMS samples were crushed to less than one (1) mm using a closed-circuit roll crusher. The float sample was processed in flash dryer and then blended with crushed DMS using a 1:1 ratio in a V blender.

The conversion test to beta-spodumene was performed over a period of 82 hours. The temperature was maintained around 1,100°C. The product particle specific gravity was used to evaluate



conversion performance. This was then later followed by controlled acid bake and leach tests to determine the lithium and impurity level extraction rates.

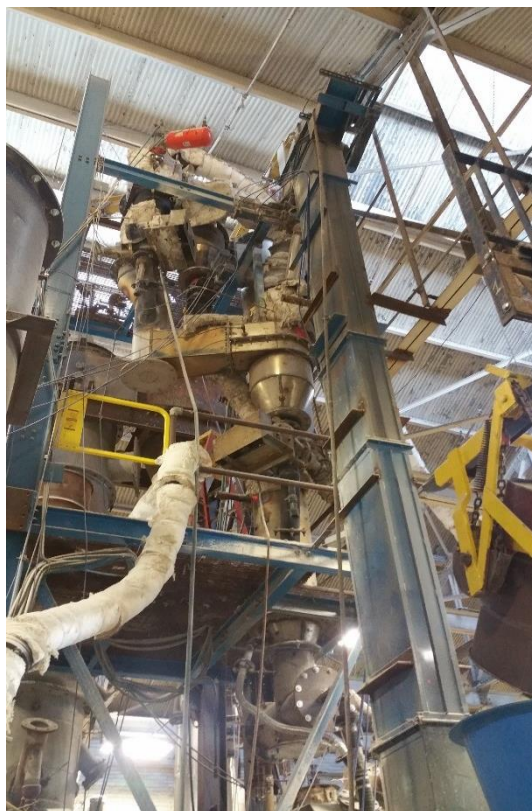
The test work highlighted the importance of residence time and temperature. Good spodumene conversion of over 95%, as determined by Nemaska's standardized lithium extraction test, could be achieved with both the Whabouchi DMS and the Whabouchi DMS/float mix concentrate under the correct operating conditions.

Risks of accretion and wear remain present, and learnings from the test work were included in the final equipment design.

In September/October 2017, a more substantial test campaign took place, involving approximately 55 tonnes of material (mostly DMS). This material was milled to < 1 mm calciner feed material using a ball mill.

This campaign allowed for study of longer term accretion and wear potential, as well as testing of auxiliary equipment and/or process conditions potentially present in the flow sheet.

**Figure 13.13 – FLS Pilot Flash Calciner**





**Table 13.23 – May 2017 Calcination Test Work Feed Composition**

Element	Greenbushes (%)	Whabouchi DMS (%)	Whabouchi Float (%)
SiO <sub>2</sub>	67.9	68.2	63.4
Al <sub>2</sub> O <sub>3</sub>	24.7	24.1	24.7
Li <sub>2</sub> O	5.94	6.05	6.07
Fe <sub>2</sub> O <sub>3</sub>	0.76	1.6	2.22
MgO	0.15	0.23	0.23
CaO	0.42	0.39	0.5
Na <sub>2</sub> O	0.55	0.53	0.55
K <sub>2</sub> O	0.87	0.31	0.69
TiO <sub>2</sub>	0.04	0.04	0.04
P <sub>2</sub> O <sub>5</sub>	0.37	0.05	0.15
MnO	0.08	0.18	0.36
Cr <sub>2</sub> O <sub>3</sub>	0.03	0.03	0.03
V <sub>2</sub> O <sub>5</sub>	<0.01	<0.01	<0.01
LOI	0.65	0.65	1.14
Sum	102.46	102.36	100.08

**Table 13.24 – May 2017 Calcination Test Work Product Quality**

Sample	Specific Gravity (g/cm <sup>3</sup> )	Lithium Extraction (%)
Condition 1 (Greenbushes)	2.57	73.1
Condition 2 (DMS)	2.53	95.4
Condition 3 (DMS)	2.6	70.8
Condition 4 (DMS/Float mix)	2.5	97.5
Condition 5 (DMS/Float mix)	2.61	91.9
Condition 6 (Greenbushes)	2.57	84.7
Condition 7 (Greenbushes)	2.58	86.0
Condition 8 (Greenbushes)	2.86	32.1

#### 13.2.4.2 TKIS Flash Calcination Test Work - May 2017

In May 2017, a 3-day test was performed by a second reputable flash calciner supplier, ThyssenKrupp Industrial Solutions (“TKIS”). The primary objective was to determine if the material was suitable for thermal treatment in a flash calcination system to achieve high conversion from

alpha to beta spodumene. The test also aimed to determine the operational parameters of a commercial unit.

The samples received were dried. All the DMS and some of the Greenbushes was ground to less than 500 microns in a vertical mill, with the balance of Greenbushes milled to 1,500 microns in a HPGR. The float concentrate was mixed with DMS concentrate using a 1:1 ratio.

In total, ten (10) trials were performed during the campaign. A minimal temperature of 1,050°C was necessary to achieve the mineral transformation process from alpha to beta spodumene. The conversion was however limited by the short retention time (0.5 s) in the test unit. The supplier noted that higher conversion rates are expected with longer retention time in a commercial unit (2.5 s). This was demonstrated via re-feeding material into the system. Particle densities, which are correlated to the level of conversion, were successfully reduced after being processed multiple times in the flash calciner test unit.

Information related to accretion risk was gathered, allowing for input to engineering solutions.

#### 13.2.5 TKIS FLASH CALCINATION TEST WORK – OCTOBER/NOVEMBER 2018

From October 28 to November 2, 2018, TKIS proceeded with a large-scale test at their semi-industrial test flash calciner (“POLCAL1”) located at their research center in Beckum, Germany.

**Figure 13.14 – TKIS POLCAL1 Building**



The main objectives were as follows:

- Verify findings from small scale POLCAL2 tests (September 2017) on calcining temperature and product quality;

- Testing of material processing at longer production times and evaluation of the formation of accretions;
- Optimization of process operation to reduce formation of material build-ups at critical points inside the gas duct and testing of the ability of blasters to dislodge the build-up;
- Testing of product quality depending on longer residence time as in the previous small-scale campaign, including testing of mechanical methods to increase the residence time;
- Definition of product quality after calcination.

As with the smaller unit tested in 2017, the flash calciner reflected the commercial configuration of three (3) preheating cyclones and one (1) material capture cyclone. Flash tube internal diameter is 320 mm. Calcined material was cooled after capture in two (2) sequential cooling screws, while the hot gases reporting to the flash tube, generated from pneumatic cooling in the commercial unit, were simulated by way of a hot gas generator. Energy addition to the base of the flash tube was at two (2) locations, from a sub-stoichiometric burner (same principle as the commercial unit), and feed introduction was done through a dispersion box analogous to the commercial unit. Off-gas dust, captured in a baghouse, was continuously returned to the process.

Total flash tube length was 20 m, of which 16 m could be maintained at operation temperature, resulting in a retention time of between 1 and 1.13 seconds in the hot zone (as compared to >2 seconds for the commercial unit). Material refeed was used to simulate residence times similar to the commercial unit (note: a re-feed is actually equivalent to less than twice the retention time, as some of that second-pass time is “lost” to heating of the material to the conversion temperature).

Whabouchi DMS was milled to < 2 mm in a hammer mill and <1 mm in an HPGR. The final product was mostly <500  $\mu$ m material. Whabouchi Float material was dried in a flash drier. The commercial target ratio (42%/58% DMS/Float) was achieved by continuous use of two gravimetric dosing devices, followed by a pug mixer to ensure full blending. Both coarser and finer DMS were tested separately, though the focus of the work was the <1 mm material. Greenbushes material was used for commissioning of the unit, but only Whabouchi material for the actual test work.

A feed rate of 200 kg/h was set over the complete trial. Some non-feeding periods occurred due to switching of material and special events (blockages etc.). Fourteen (14) different settings were tested.

The primary mean of spodumene conversion determination was XRD analysis. Linear correlation with true density measurements (pycnometer) was validated.

#### Results:

- For the tested material mixtures gas temperatures of approx. 1070°C were needed within the calciner to achieve conversion rates from  $\alpha$ - to  $\beta$ -spodumene above 80% on the first pass;
- The first pass (single pass through the calciner) results in high conversion rates up to 95.3% at 1,100°C average calciner temperature;

- The second pass (refeeding of calcined product) was done to simulate the longer residence time of the industrial calciner and results in the highest conversion rate of 98.6% at 1,100°C average calciner temperature. Worst recorded conversion with prolonged exposure to the heat was 92.3%, at 1,070°C;
- In general, higher gas temperatures and longer residence times resulted in higher conversion rates;
- Blaster effect could not be validated, as build up was minimal. Location of buildup was close to the direct NG addition points (these addition points are only present in the test unit and not present in the commercial unit);
- Effect of using a mechanical method for increasing the holding time on spodumene conversion was generally good. The test work also showed that the material remained free flowing after being maintained hot, motionless and deaerated for up to 60 seconds.

#### 13.2.6 ACID BAKE AND LEACH TEST WORK – 2016-2017

In 2016, a lab test program was initiated with COREM in Quebec City. The purpose of this program was to evaluate the impact of several parameters on the performance of the lithium extraction: acid concentration and impurity levels, mixing temperature and time, acid bake temperature and residence time, particle size, etc. A standardized test was developed that allowed comparison of small changes in operating conditions on lithium and impurity extraction rates. This activity allowed the selection of optimal operational parameters for the commercial plant.

The tests used a representative beta-spodumene sample as feed and a synthetic acid based on the expected recycled acid composition. The beta-spodumene sample elemental composition is provided in the Table 13.25. This sample was generated from a flash calcination pre-test in 2014.

A standardized lab test method was developed that allowed comparison of small changes in operating conditions on lithium and impurity extraction rates. This method includes the following steps:

- Heating of the synthetic acid to the expected commercial plant operating temperature;
- Heating of the beta-spodumene feed sample to the expected commercial plant operating;
- Mixing of the acid and beta-spodumene for a duration predetermined in the test plan;
- Heating of the mixture at temperature and for the duration predetermined in the test plan;
- Water leach at 50% solids at ambient temperature;
- Filtration and washing.

**Table 13.25 – Acid Bake Test Work Beta-Spodumene Feed Composition**

Component	Composite #5 (% w/w)
Li <sub>2</sub> O	6.03
SiO <sub>2</sub>	66.70
Al <sub>2</sub> O <sub>3</sub>	23.10
Fe <sub>2</sub> O <sub>3</sub>	1.40
MgO	0.10
CaO	0.20
Na <sub>2</sub> O	0.80
K <sub>2</sub> O	0.40
TiO <sub>2</sub>	0.01
P <sub>2</sub> O <sub>5</sub>	0.10
MnO	0.20
Cr <sub>2</sub> O <sub>3</sub>	<0.01
V <sub>2</sub> O <sub>5</sub>	<0.01
ZrO <sub>2</sub>	<0.02
ZnO	0.03
LOI	0.14

The test results demonstrated that the lithium recovery levels were affected by the acid strength and composition, excess acid, mixing time and temperature of acid and spodumene prior to acid bake, time and temperature in acid bake, spodumene size distribution, etc. The extraction rates from a wide variety of samples of different chemical or mineral compositions were not investigated. Lithium recoveries between 96 and 97% were achieved for the optimal operating parameters.

The major impurities extracted were aluminum and iron. The aluminum in the final solution varied between 3,600 and 5,000 mg/L and the iron varied between 1,200 and 1,700 mg/L.

In addition to the actual operating parameters of the acid bake and leach, the degree of conversion in the preceding calcination step was determined to be critical to achieving target extraction rates.

#### 13.2.7 LEACHING AND IMPURITY REMOVAL TEST WORK – PHASE 1 – 2011

The Phase 1 test program was carried out in November 2011 by SGS. Phase 1 consisted of concentrate leaching, primary impurity removal, secondary impurity removal and final purification by ion exchange.

### 13.2.7.1 Sample Preparation

Approximately 2,600 kg of acid baked beta-spodumene (solid lithium sulfate) were processed during the first phase of the pilot plant.

The two (2) blends tested were used to feed the pilot plant (75/25 and 50/50). Table 13.26 shows the chemical analysis of the samples.

**Table 13.26– Phase 1 Pilot Plant Feed Analysis**

Sample	Li (%)	Si (%)	Al (%)	Fe (%)	Na (%)	S (%)	Cr (g/t)	Zn (g/t)	Mn (g/t)	Mg (g/t)	Ca (g/t)	K (g/t)
75/25	2.24	25.0	10.5	1.04	0.39	6.09	167	134	1,962	1,186	3,431	3,653
50/50	2.29	24.4	10.4	0.96	0.36	6.06	163	103	1,755	905	2,311	3,376

Source of the table: SGS Report

### 13.2.7.2 Concentrate Leach and Primary Impurity Removal

The objectives of the concentrate leach and the Primary Impurity Removal (“**PIR**”) were to dissolve the lithium sulfate from the acid baked beta-spodumene and remove the major impurities. Approximately 1,200 kg of 75/25 and 1,400 kg of 50/50 were processed in 85 hours.

In the concentrate leach step, solids were mixed with site water at 50% solids by weight and agitated. Lithium and contaminants (Fe, Al, Si, Mn and Mg) were leached and the final pH of the slurry was around 1.7. The lithium sulfate contained in the acid baked beta-spodumene was 100% leached.

In the PIR step, the pH of the slurry was elevated by adding hydrated lime. The major impurities (Fe, Al and Si) were precipitated as insoluble metal hydroxides. Air was sparged into the PIR tanks to maintain the oxidative potential of the slurry.

The slurry coming from PIR step was filtered on pan filters and the filtrate proceeded to Secondary Impurity Removal (“**SIR**”).

Vacuum filtration testing was carried out on direct PIR discharge and thickened underflow. At 0.7 bar vacuum level the direct discharge sample filter cake moisture was 26.7%.

### 13.2.7.3 Secondary Impurity Removal

The objective of the secondary impurity removal was to precipitate Ca, Mg and Mn impurities from the PIR filtrate.

The pH of the solution was increased by adding sodium hydroxide (NaOH) in the first two (2) tanks. Sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) was added in the third tank to convert all the remaining divalent impurities to insoluble carbonates.

Impurity levels at the discharge averaged one (1) mg/L Mn, 14 mg/L Mg and 241 mg/L Ca in the pilot plant runs. Concentrations as low as two (2) mg/L Mg and 200 mg/L Ca were attained by optimizing key parameters such as retention time and reagent addition. The overall lithium recovery was 99.1%.



#### 13.2.7.4 Ion Exchange

The objective of the Ion Exchange ("IX") circuit is to further reduce the calcium and magnesium tenors from the SIR discharge to ten (10) mg/L each.

The IX circuit consisted of three (3) columns packed with a cationic resin, which is selective towards divalent and trivalent ions.

The process consisted in a lead/lag/regeneration operation. At any time, two (2) columns would be removing Ca and Mg while the third column would be in resin regeneration mode.

One (1) cycle consists of the following steps: loading, feed wash, acid strip, acid wash, regeneration and regeneration wash.

The magnesium tenors varied between 0.07 and 0.2 mg/L and 99.0% removal efficiency was achieved. The calcium tenors varied between 2.4 and 5.7 mg/L and 97.6% removal efficiency was achieved. Lithium losses in the IX circuit were minimal at 2.7%.

#### 13.2.8 ELECTROMEMBRANE AND LHM CRYSTALLIZATION TEST WORK – PHASE 2 – 2011

Phase 2 of the test program was carried out in December 2011 by SGS. Phase 2 consisted of membrane electrolysis and crystallization test work.

##### 13.2.8.1 LiOH Membrane Electrolysis

The objective of the electrolysis process is to produce a lithium hydroxide solution from a high purity lithium sulfate solution. The pilot plant was carried out in a 3-compartment membrane electrolysis cell.

The central compartment was separated from the cathodic compartment by a cationic membrane and from the anodic compartment by an anionic membrane.

Under the influence of an electric field, lithium ions from the central compartment were transported through the cationic membrane. In parallel, the sulfate ions were moved to the anodic compartment. The anodic reaction generates protons and sulfuric acid is produced.

The pilot plant was run for two (2) 5-day campaigns and samples were taken every four to six (4 to 6) hours. The 3-compartment cell successfully produced lithium hydroxide at a 14.6 g/L Li concentration and a 20-30 g/L sulfuric acid solution. Overall, the pilot plant operated for a total of 228 hours.

##### 13.2.8.2 LiOH-H<sub>2</sub>O Crystallization

The objective of the crystallization process is to produce high quality solid lithium hydroxide monohydrate from the lithium hydroxide solution generated through membrane electrolysis. Atmospheric and vacuum evaporation were tested in three (3) steps.

The water evaporation rate was between 6.0 and 6.8 mL/min during the atmospheric evaporation tests and the product concentration ranged between 18.2 and 19.9% Li. The crystals were filtered, washed with distilled water and dried in an inert gas environment.

Vacuum evaporation was tested at two (2) different conditions: at 78-82 kPa (vacuum) and 62-70 °C and also at 62-70 kPa (vacuum) and 79-81 °C. The evaporation rate was approximately 7.7 mL/min for both conditions and the final purity of the product was similar to the one that underwent atmospheric evaporation (17.9% Li).

### 13.2.9 ACID BAKE, LEACH AND IMPURITY REMOVAL TEST WORK – 2017

In June and July 2017, the acid bake, concentrate leach, and impurity removal circuits were piloted at COREM's laboratory facilities in Quebec City. The primary objective was to generate test material representative of the future commercial plant operations for solid/liquid separation testing. The test work also permitted the confirmation and optimization of the commercial plant design parameters, particularly for the purification circuit. The purification circuit was designed based on the results obtained from the pilot test work described below.

#### 13.2.9.1 *Acid Bake*

In total 290 kg of beta-spodumene was sulfated: 95 kg of beta-spodumene was sourced from flash calcination test work conducted in 2017 and 200 kg from a previous calcination campaign in 2014. The material was homogenized and mixed with 93% sulfuric acid in a V blender with a stoichiometric acid excess of 30%. Then, the temperature was maintained at 290°C for 45 minutes in a pilot scale rotary furnace operating in continuous mode.

#### 13.2.9.2 *Concentrate Leach*

The concentrate leach was performed at 65-70°C. Water was added to achieve a solids pulp concentration of 50% and good agitation was provided through the test duration of one (1) hour. The resulting slurry was then filtered and the solution was used to test the downstream impurity removal steps.

Lithium extraction was 94.2%, which is less than the 96% observed during lab scale test work under similar conditions also performed at COREM. The reasons for this difference are subject to ongoing investigation but are possibly due to leach temperature, differences in the feed material, or differences in the acid composition. Laboratory extraction rates of 96% form the basis for the plant design.

#### 13.2.9.3 *Primary Impurity Removal*

The objective of Primary Impurity Removal ("PIR") is to precipitate the aluminum and iron impurities from the concentrate leach solution. Three (3) reactors provided a combined reaction time of one (1) hour at a temperature of approximately 65 to 70°C. A recycled lithium sulfate solution from a third-

party provider was added (representing 6% of the total volume) to the concentrate leach solution. Then lime was added to increase the pH step-wise to the desired setpoint.

**Figure 13.15 – Pilot Acid Bake Kiln at COREM**



Three (3) PIR tests were undertaken and the results of all three tests are provided to demonstrate repeatability.

**Table 13.27 – Pregnant Leach Solution vs. PIR Treated Pregnant Leach Solution**

Element	PLS Feed (mg/L)	PIR 1 (mg/L)	PIR 2 (mg/L)	PIR 3 (mg/L)
Aluminum	4,350	<0.5	<0.5	<0.5
Iron	2,065	<0.3	<0.3	0.4
Magnesium	169.5	225	285	326
Calcium	437.5	455	519	536
Silica	200.5	12	30	33
Manganese	213	138	170	178

The results show that aluminum and iron were successfully removed in PIR.

#### 13.2.9.4 Secondary Impurity Removal

The objective of Secondary Impurity Removal (“SIR”) is to precipitate the impurities manganese, silica, and a fraction of the magnesium from the PIR treated solution.

Six (6) SIR tests were conducted batch-wise at approximately 65°C. A single, baffled, vigorously agitated reactor was used for each test. The pH was raised in the first hour of the test, and then was maintained for the balance of the test, which was an additional 13 hours. Retention time was provided to determine the extent of impurity removal as a function of time. Neutralization was achieved by the addition of a 7% w/w solution of sodium hydroxide, saturated with lithium.

The results of all six (6) tests are provided to demonstrate repeatability. Although SIR tests 1 through 4 were conducted over a 14-hour duration, the data presented represents the sample taken at five (5) hours as the reaction was considered to be essentially complete by this time. The data presented for SIR tests 5 and 6, which were conducted in a second SIR campaign, represent the sample taken at four (4) hours.

**Figure 13.16 – Pilot PIR Circuit at COREM**



**Table 13.28 – PIR Treated Pregnant Leach Solution vs. SIR Treated Pregnant Leach Solution**

Element	SIR Feed (mg/L)	SIR 1 (mg/L)	SIR 2 (mg/L)	SIR 3 (mg/L)	SIR 4 (mg/L)	SIR 5 (mg/L)	SIR 6 (mg/L)
Magnesium	225	180	247	161	166	282	293
Calcium	455	544	540	545	580	618	519
Silica	12	<5	<5	<5	<5	<5	<5
Manganese	138	<0.05	<0.05	<0.05	<0.05	0.13	<0.05

It is evident that treatment by SIR eliminates the manganese and silica impurities to below their respective targets of one (1) mg/L and five (5) mg/L for feed to electrolysis within a five (5) hour reaction time.

#### 13.2.9.5 Tertiary Impurity Removal

The objective of Tertiary Impurity Removal (“TIR”) is to remove magnesium and calcium from the pregnant leach solution prior to polishing with ion exchange.

Three (3) independent TIR tests were conducted batch-wise at 60°C. A single, baffled, vigorously agitated reactor was used. The pH was raised by the addition of a 7% w/w solution of sodium hydroxide, saturated with lithium hydroxide. Other reagents were added to aid in the removal of impurities. The test conditions chosen for TIR replicate the planned commercial plant operation and are representative of that operation.

The results of all three (3) TIR tests are presented below.

**Table 13.29 – SIR Treated Pregnant Leach Solution vs. TIR Treated Pregnant Leach Solution**

Test	Element	TIR Feed (mg/L)	TIR Treated (mg/L)
TIR 1	Magnesium	282	162
	Calcium	618	11
TIR 2	Magnesium	257	10.9
	Calcium	584	18
TIR 3	Magnesium	49.9	2
	Calcium	573	11

It is immediately evident that test TIR 1 did not achieve the magnesium impurity removal performance of tests TIR 2 and 3 due to faulty pH measurement during the test. As a result, TIR 1 results were excluded from consideration.

The test results demonstrated that the TIR process is capable of eliminating the magnesium and calcium impurities to below their respective targets of ten (10) mg/L and 30 mg/L for feed to ion exchange, which is tasked with polishing the pregnant leach solution of the minor remaining quantities of magnesium and calcium prior to electrolysis.

#### 13.2.9.6 Solid-Liquid Separation Test Work

One of the key objectives of the piloting activity was to generate material representative of the future commercial plant operation for solid-liquid separation testing. This activity was undertaken by Pocock Industrial Inc. at the COREM facility. Solid-liquid separation testing includes evaluating settling, rheology, and filtration characteristics. A total of 13 samples were tested representing concentrate leach, PIR, SIR, and TIR. Complete test data, figures and correlation for solid liquid separation



equipment selection and sizing were generated by Pocock Industrial. The solid-liquid separation design criteria generated was used as the basis for equipment sizing in the leach and purification circuits.

#### 13.2.10 PIR THICKENER OPTIMISATION TEST WORK – AUTUMN 2018

The PIR thickener is sized based on design criteria generated from dynamic thickening tests undertaken by Pocock Industrial using a continuous bench scale unit equipped with a motorized rake. A pump continuously provides representative feed slurry to the test thickener while an underflow pump withdraws underflow solids to maintain a constant pulp level during testing. Flows are varied to test the hydraulic limits of the material. The resulting criteria is used to determine the thickener diameter.

When the solid/liquid separation test work was conducted by Pocock at the COREM site in July 2017, the basis for the PIR thickener was that it would not make use of flocculant. In an effort to reduce the diameter of the thickener, it was later decided that flocculant would be used. Hence, in September of 2018, COREM undertook another campaign to generate material representative of primary impurity removal precipitate for further solid/liquid separation test work by Pocock. The continuously operated pilot scale primary impurity removal circuit operated by COREM was the same as the one used in 2017.

A full day was required to reach steady state operation for each test condition and then a sample for solid/liquid separation test work was harvested. The optimum conditions were found to be a slurry generated whilst operating with a 300% seed recycle that is flocculated upstream of the thickener. As a result of this test work, the thickener diameter was significantly reduced.

#### 13.2.11 ION EXCHANGE TEST WORK – 2014 AND 2016

During 2014 and 2016, test work was performed by Electrosynthesis Company that defined the removal of divalent impurities (calcium and magnesium) remaining in the lithium sulphate solution already purified by PIR, SIR, and TIR. The goal was to ensure robust operation and optimal long-term performance of the electromembrane process which is sensitive to impurity levels. The optimal ion exchange resin was identified along with key variables such as loading rate, elution rate, and eluent concentration. It was demonstrated that ion exchange is an effective means by which to reduce both the calcium and magnesium concentrations below the target of one (1) mg/L in advance of electrolysis. This test work formed the basis of design for the commercial ion exchange system.

#### 13.2.12 ION EXCHANGE TEST WORK – 2019

Ion exchange column test work was conducted at SGS in Lakefield, Ontario during the months of January and February of 2019. The test work program confirmed the selected resin's effectiveness in removing calcium and magnesium, the superficial velocity to be used in the design, and the loading capacity of the resin. The height of resin used was the same height as will be used in the commercial plant, thereby providing the same number of theoretical stages.



Tests were performed using a single column of commercial height and in lead-lag operation using two columns of commercial height. Representative brine was obtained from the Phase 1 Plant (P1P) for the tests; 200 bed volumes were processed in each of three tests using single columns and 360 bed volumes were processed in the lead-lag test. Calcium was successfully removed to below a detection limit of 0.06 mg/L. Magnesium was successfully removed to below a detection limit of 0.008 mg/L.

Test work is ongoing at SGS to further optimize the water balance around ion exchange as well as the life of the resin.

### 13.2.13 MEMBRANE ELECTROLYSIS TEST WORK

Various phases of membrane electrolysis test work on different configurations were performed by the Electrosynthesis Company to improve upon the results obtained during original SGS test work.

The objectives were to determine optimal flow sheet and operating parameters (concentration, current efficiency, current density, configuration etc.) and to estimate membrane life cycle.

#### 13.2.13.1 Membrane Electrolysis Test Work – Autumn 2012

An initial series of test work was performed in the autumn of 2012. The objectives of the tests were to:

- Increase the concentration of the lithium hydroxide and sulfuric acid streams produced;
- Improve current efficiency;
- Test different cationic and anionic membranes to increase operating temperature, reducing cooling water requirements.

The experiments were performed in an Electrocell MP (100 cm<sup>2</sup>) using three (3) distinct compartments: one compartment for the salt stream (Li<sub>2</sub>SO<sub>4</sub>), one for the base recovery (LiOH) and one for the acid recovery (H<sub>2</sub>SO<sub>4</sub>). When an electric field is applied, the cations migrate from the salt, through the cationic membrane and into the base loop. Anions migrate through the anionic membrane and into the acid loop. Water molecules are split at the electrodes located in the base and acid compartments, allowing the formation of the acidic and basic solutions.

A single cationic membrane and two (2) anionic membranes were tested during a total of eight trials.

Based on the results, it was concluded that the 3-compartment membrane electrolysis successfully produced lithium hydroxide at high temperature (60°C). The tests determined optimal base and acid concentrations, current density, current efficiency, cell voltage, water transport and feed operating pH.

#### 13.2.13.2 *Membrane Electrolysis Test Work – Summer 2013*

A subsequent series of test work was performed in the summer of 2013. The objectives of the tests were to determine if a 2-compartment cell could be used to generate lithium hydroxide and if so, determine operating parameters and subsequent impact on 3-compartment cell operation.

The experiments on the 2-compartment cells were performed in an ICI FM-01 electrolysis cell (64 cm<sup>2</sup>) using two (2) distinct compartments: 1-compartment for the salt stream (Li<sub>2</sub>SO<sub>4</sub>) and one for the base recovery (LiOH). When an electric field is applied, the cations migrate from the salt, through the cationic membrane and into the base loop. Anions remain in the salt compartment, being acidified by protons being generated at the anode. Water molecules are split at the electrodes located in the base and salt compartments.

A single cationic membrane was tested during multiple trials.

Based on the results, it was concluded that 2-compartment membrane electrolysis successfully converted a significant portion of the lithium in the feed stream with a high current efficiency. The tests determined optimal base concentration, current density, current efficiency, cell voltage, water transport and feed operating pH and extend of conversion.

Additional test work was performed on the salt recovered from the 2-compartment test work to determine if further lithium hydroxide production could be achieved by processing the waste stream in a 3-compartment cell. The experiments were performed in the same Electrocell MP (100 cm<sup>2</sup>) used for the initial trials (Autumn 2012) and successfully demonstrated that complete conversion could be achieved.

#### 13.2.13.3 *Membrane Electrolysis Test Work – Winter 2014*

In the winter of 2014, long term stability testing on the 2-compartment cells and 3-compartment cells were undertaken at the Electrosynthesis laboratory to determine membrane and electrode lifespan. Test work was conducted over a period of 1,000 hours and results were used to determine expected replacement frequency for the membranes and electrodes allowing for calculation of the operating costs.

#### 13.2.13.4 *Phase 1 Plant Electrolysis Operation through June 2019*

The Phase 1 Plant demonstration scale electrolyzer was successfully commissioned in February 2017 with 2 cells. Based on smooth operation, the cell pack was expanded to a nominal capacity of 250 TPY LiOH.H<sub>2</sub>O equivalent in April 2017. The system ran smoothly, in combination with the LiOH evaporator/crystallizer. It produced high-quality LiOH product from recycled lithium sulfate provided by a client. The operation of the electrolyzer suggested possibilities for optimization of the circuit.

#### 13.2.14 *LiOH.H<sub>2</sub>O CRYSTALLIZATION TEST WORK – 2014 AND 2017*

During summer 2014, Lithium Hydroxide Monohydrate (LHM) crystallization test work was performed by the GEA Group in Duisburg Germany to produce about 2 kg of battery grade LHM representative

samples from lithium hydroxide solution generated through electromembrane process at Electrosynthesis Company and generate basic data for engineering of crystallization unit operations. 63 kg of solution was sent to GEA, from which 2 kg of LHM was produced. Final product quality respected the more stringent cathode materials manufacturer's requirements, with for Na tenor <20 ppm and a total of chromium, zinc and iron content of less than 150 ppb. The test work done at GEA confirmed the proposed crystallization process flow sheet and equipment selection for this feasibility study.

Additional test work was performed with GEA in 2017 to determine the impact of certain impurities should they be present. This test work resulted in an adjustment in the purge requirements from the LHM crystallizer.

### 13.2.15 LHM DRYING TEST WORK – FEBRUARY & APRIL 2018, AND ONGOING AT P1P

#### 13.2.15.1 *Piloting*

Test work was performed at Andritz' facilities in Germany. A first set of tests were performed in February 2018, with the aim of validating operating parameters.

LHM slurry feed material was sourced from Nemaska's Phase 1 Plant (P1P) facility and shipped in 200 L barrels.

A small type HZ 25/0.1 peeler centrifuge was used for dewatering (2.5 L basket volume), inerted with Nitrogen. Resulting free moisture was below 5%, for g-forces ranging from 150 to 700. Purity requirements were met at all wash ratios (incl. none), but a ratio greater than 0.5 kg/kg started affecting average particle size. The primary aim of dewatering was not for centrifuge sizing, but for fluid bed dryer feed production.

The drying tests were performed in a pilot-plant sized fluid bed reactor (185 mm ID), aimed at validating a Mollier-type diagram (dry LHM stability vs. temperature and ambient moisture levels). The dryer is fluidized using Nitrogen wetted with steam (controlled addition, measured on-line), at a controlled incoming temperature.

The off-gas is monitored for humidity and dedusted in a baghouse (dust is contaminated and not collected). Material is added manually to the reactor on a semi-batch basis and left inside the reactor for the duration of a run, with samples extracted at set time intervals. The addition rate sets the bed temperature. Analysis is based on loss-of-weight in an oven, i.e. relies on the (reasonable) assumption that drying precedes dehydration. PSD is quantified using laser diffraction, and qualitatively assessed by micrographs.

A set of five (5) conditions was trialed, validating operating conditions as well as transition stages (start-up/shut-down). The material proved more resilient than initially feared, with only extreme dry conditions (very low gas dew points) leading to dehydration. Under expected operating conditions, the product was fully dried, while retaining its hydrate to within specifications (57.5% typical equivalent LiOH).

The drier could be started up from empty, had a very good fluidization behavior, and the product qualitatively had good flowability. Some degree of caking was observable after >1 week in storage.

#### 13.2.15.2 *Marketing Sample Production*

A mandate for marketing sample production provided further opportunity for testing operating variables. This took place in April 2018, processing the balance of the LHM slurry material available at Andritz' test facility. In particular, considering evaluation of the earlier tests showed some flexibility, this allowed for testing of more aggressive process conditions.

Due to the larger volumes involved, Andritz's larger (commercial-sized) pusher centrifuge SZ400/2-h could be used (a pusher is used in the commercial plant), running at 580 kg/h. This resulted in a very low residual free moisture of less than 2.0% by weight. A total of 126 kg (wet) material were produced and forwarded on to the drying test center.

Fluid bed drying took place in the same base unit as tested previously, modified to allow for continuous feed (screw feeder) and continuous discharge (bed overflow into a sealed/inerted bottle).

About 87 kg of usable product were generated, of consistent and good quality. Losses to the off-gas, at around 20% of the feed, were significant, but expected in such a small unit. Design flexibility on the freeboard of the commercial unit will allow for much less elutriation.

The bulk of the production was done under the operating conditions previously validated, at a rate of about 2.8 kg/h discharge. Challenging material handling of the dewatered feed material were confirmed, with the screw feeder hopper plugging, leading to the production reverting back to a manual feed introduction.

Further tests showed that idling was possible without quality degradation at temperatures up to approx. 70°C as long as the dew point of the gas was carefully controlled, while any temperatures in excess of that led to product quality loss from dehydration. Conversely, even small amounts of moisture (e.g. from feed material) at low temperatures lead to lumping.

#### 13.2.15.3 *LHM Dryer at P1P (on-going)*

In January 2019, Nemaska installed a LHM dryer in the P1P demonstration plant. This unit was sourced from the same Supplier as the commercial unit (GEA) and has the same mechanical design. The process conditions are drawn from GEA's past experience in the field. Though it operates under slightly different conditions than proposed in the Andritz test work (colder and dryer), they are still within the stability envelop validated earlier.

The P1P dryer is being used to gain practical experience related to the dryer operation.

### 13.2.16 ACID RECYCLE SOLUBILITY TEST WORK – 2016 AND 2017

Nemaska intends to recycle the sulfuric acid produced in the electrochemical process. This requires an evaporative crystallizer to concentrate the sulfuric acid, followed by a Spent Acid Concentrator (“SAC”) process to remove water from sulfuric acid before it is recycled.

From June 2016 to October 2017, NORAM organized a series of tests at BC Research (“BCRI”) to identify optimum process conditions for the concentration of the sulfuric acid solution. The tests were also aiming at identifying conditions for the final evaporation stage required to regenerate acid (Figure 13.17).

**Figure 13.17 – Material Testing Rig for Solubility Tests at BCRI**



This test work provided valuable information on the behaviour of lithium sulphate / sulfuric acid / water ternary systems under various temperatures and pressure conditions. Based on the experimental testing performed during that test, a conceptual flow diagram was created for the acid regeneration process.

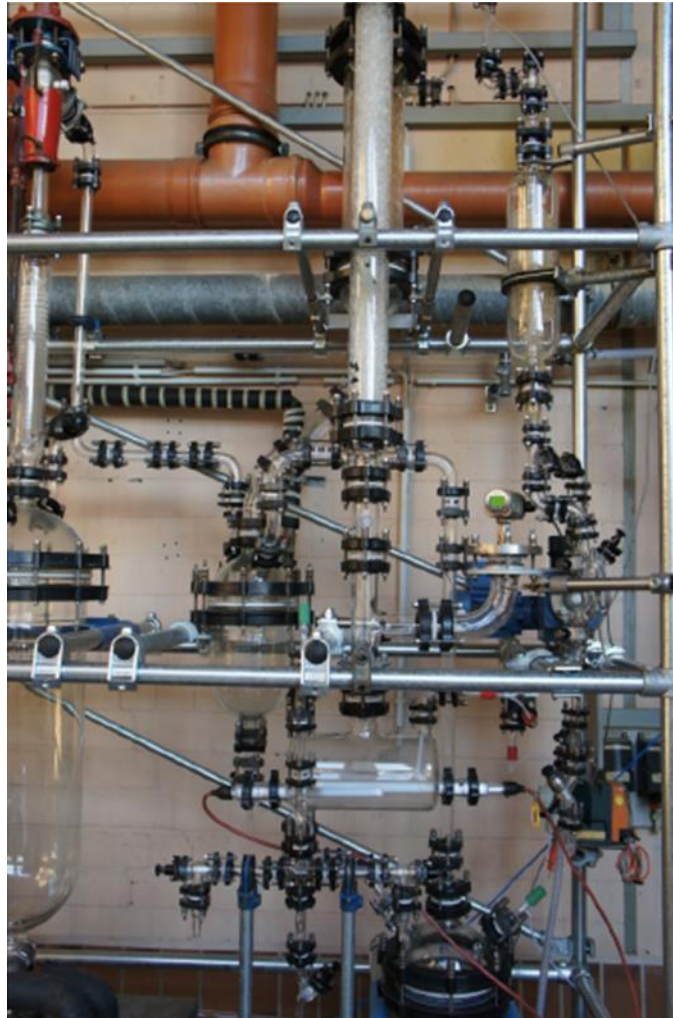
Initial work in 2016 was followed by work in 2017. This provided more detailed solubility data on the ternary system at elevated temperatures (between 35 and 160°C). This was required to confirm the conceptual design of the regeneration process. Ternary phase solubility diagrams for lithium sulphate, sulfuric acid and water system were produced at various temperatures, allowing the system to be designed for the whole range of concentrations, from the diluted acid feed with dissolved sulphate salts to the final acid concentration at less than 10% H<sub>2</sub>O.

### 13.2.17 ACID RECYCLE TEST WORK – 2017

During the period between May and September 2017, laboratory and pilot scale test work was performed with multiple reputable technology suppliers to validate both acid concentration stages. These tests simulated the range of conditions (nominal and upset) envisioned for the commercial acid recycle circuit. The objective was to confirm the equipment configuration, allow design robustness and allow the suppliers to accurately quote the equipment (Figure 13.18).



**Figure 13.18 – Pilot SAC Unit**



(Courtesy of De Dietrich)

#### 13.2.18 OTHER TEST WORK – 2017-2019

Multiple other tests were performed in order to gather data for proper engineering of the facility. This included:

- Material handling properties testing for proper sizing of silos, piles, chutes and conveyors.
- River water quality testing for sizing of water treatment systems.
- Materials of construction test work for selection of appropriate materials of construction within the highly abrasive and corrosive sulphation area (pug mixer, acid bake kiln, etc.).

#### 13.2.19 ELECTROCHEMICAL DEMONSTRATION PLANT – PHASE 1 PLANT –2017-2019

Phase 1 Plant is a ~1/65 scale demonstration plant with full scale electrolysis cells installed by Nemaska representing an investment of approximately \$42M. It is designed for continuous operation, with complete instrumentation and DCS, allowing automated and safe operation. It can produce high



quality lithium hydroxide monohydrate (LHM) from spodumene and recycled lithium sulfate salts. It has a nameplate capacity of 500 t/y of LHM crystal production from recycled lithium sulfate salts and 100 t/y of LHM from spodumene concentrate. The Phase 1 Plant design is based on comparable industries (namely chlor-alkali), the traditional spodumene processing flow sheet, internally developed processes, and know-how from reputable technology suppliers. Its design basis and technologies were established through extensive laboratory and pilot scale testing described above and realized under the supervision of Nemaska technical team and/or designated engineering firms at independent testing and suppliers' facilities since 2011. Figure 13.19 below shows part of the Phase 1 Plant.

**Figure 13.19 – P1P Overview Picture - Purification and Crystallization Unit Operation**



The objectives of Nemaska in building and operating the Phase 1 demonstration plant in advance of starting commercial scale operation were multiple:

- To demonstrate its ability to repeatedly produce lithium hydroxide according to quality specifications as defined by customers including battery customers;
- To qualify its products with customers and sign off-take agreements before starting operation of the commercial plant;
- For the development of staff skills and internal processes and to provide strong foundations for the integration of new staff in the commercial plant;

- Process improvements made during the life of the demonstration plant and operational lessons learned can be integrated in the engineering of the commercial plant;
- To demonstrate the versatility of the process by also converting lithium sulfate salts (that are produced by some customers in their industrial processes) into lithium hydroxide.

The timeline for the Phase 1 Plant is as follows:

- May 2016 – P1P financing completed. The total budget to build and operate the Phase 1 Plant for two years is \$38 M;
- June 2016 – Beginning of construction at Shawinigan site;
- December 2016 – Phase 1 Plant operation team training;
- February 2017 – Start Electrolysis continuous operation on synthetic lithium sulfate solution from LiOH and H<sub>2</sub>SO<sub>4</sub>;
- March 2017 – First tonne equivalent of LiOH-H<sub>2</sub>O solution produced from synthetic lithium sulfate solution;
- April 2017 – Start Purification and Electrolysis on recycled lithium sulfate salts from a client;
- June 2017 – First tonnes equivalent of LiOH-H<sub>2</sub>O solution produced from recycled lithium sulfate salts meeting Johnson Matthey Battery Materials battery grade specification;
- October 2017 – Start processing spodumene concentrate feed while over 20 tonnes of LHM meeting our client specification were produced from lithium sulphate salts;
- December 2017 – First tonnes equivalent of LiOH-H<sub>2</sub>O solution produced from spodumene concentrate meeting battery grade specifications;
- February 2019 – First tonnes of LiOH-H<sub>2</sub>O crystals and samples to potential clients within 60 days of installing a fluid bed dryer and packaging equipment;
- May 2019 – Over 240 tonnes of Whabouchi spodumene concentrate processed and over 100 tonnes equivalent of LiOH-H<sub>2</sub>O produced from spodumene concentrate and/or recycled lithium sulfate salts. Phase 1 Plant continues to deliver High purity lithium hydroxide monohydrate commercial samples to potential clients internationally.

The Phase 1 Plant includes the following key unit operations:

- Acid bake pug mixer, kiln, and cooler;
- Leaching reactor and filter;
- PIR reactors and filter;
- SIR reactors and filter;
- TIR reactors and filter;
- IX columns;
- Electromembrane cells within electrolyzer;

- Crude and pure LHM crystallizer;
- LHM dryer;
- Services.

When running on recycled lithium sulfate salts, the acid bake and leaching steps aren't used, and impurity removal is adapted for the specific feedstock.

Since the acid regeneration circuit is not present, the spent anolyte from electrolysis is recycled to PIR where it is neutralized.

The spodumene concentrate was sourced from the Whabouchi mine. Spodumene calcination was performed offsite by third-party suppliers.

Key operational learnings by process sectors:

a. Lithium extraction circuit

Between Q4-2017 and Q1-2019, approximately 240 tonnes of Whabouchi spodumene concentrate were processed. Operational learnings influenced commercial plant materials selection to prevent premature corrosion and erosion of equipment.

b. Purification circuit

Conditions to produce gypsum with low lithium losses and removal of almost all metallic impurities.

Conditions to produce high purity feed to electrolysis.

c. Electrolysis circuit

Operation of commercial scale electrolysis cell at various current densities. Confirmation of key design parameters.

Conditions that affect membrane and anode life, and current efficiency. More than 5,000 hours of continuous operation to understand cell performance over time.

d. Lithium Hydroxide Monohydrate circuit

Confirmation of two step crystallization process configuration to obtain product quality. In Q1 2019 quality battery grade was confirmed for at least two potential clients

Since the beginning of its operation in Q1 2017 to Q1 2019, many of those objectives and milestones were achieved:

- Phase 1 Plant was operated in several campaigns and produced over 100 tonnes equivalent of LiOH-H<sub>2</sub>O produced from spodumene concentrate and/or recycled lithium sulfate salts. The plant was deliberately run at lower than nameplate capacity to ramp up and stabilize operation and adapt operation to match the availability of feedstock. This material qualified as battery grade as per typical market specifications.

**Table 13.30 – Nemaska Lithium LiOH-H<sub>2</sub>O Produced at P1P from Recycled Lithium Sulfate Solution**

Element	Unit	Market LiOH-H <sub>2</sub> O Specs* Span of Max Values	Nemaska LiOH-H <sub>2</sub> O Product measures
LiOH	% w/w	54.8 - 56.5	Min 56.5
Ca	mg/kg	10 - 100	< 4
Na	mg/kg	20 - 500	< 4
K	mg/kg	10 - 250	< 4
Mg	mg/kg	10	< 4
Fe	mg/kg	5 - 21	< 4
Al	mg/kg	10	< 4
CO <sub>2</sub>	% w/w	0.035 - 0.35	< 0.1
Cl	mg/kg	15 - 100	< 10
SO <sub>4</sub>	mg/kg	50 - 300	< 120
Cr	mg/kg	5 - 100	< 4
Cu	mg/kg	1 - 5	< 4
Ni	mg/kg	1 - 10	< 4
Si	mg/kg	20 - 30	< 4
Zn	mg/kg	10	< 4
Sol. Acid	mg/kg	40 - 1,000	< 50

\* Data from publicly available company product list

- Since the end of 2016, engineers, process specialists, support teams, key management staff, and 20 technical operators have been hired and trained to operate Phase 1 Plant. These highly skilled technicians have educational backgrounds in mechanical, chemical, and electrical disciplines as well as a range of technical work experience including chemical plant start-up. Both process safety reviews during engineering and skilled personnel proved to be efficient at preventing accidents during commissioning, start-up, and operation of the plant. This phase allowed the development of important internal processes and know-how required for the commercial phase.
- Learnings from Phase 1 Plant operation were transferred and integrated to the process and engineering design of the commercial plant. This mitigates many of the technical risks associated with new process development.

In 2019 the Phase 1 Plant will continue to produce LHM crystal from recycled lithium sulfate salts and/or spodumene concentrate from the Whabouchi mine, to further demonstrate and optimize the process, qualify product with clients, and to develop the know-how of the workers in advance of the start-up of the full-scale commercial process. In addition, optimisation tests will be done to increase current efficiency, increase lithium recovery in acid bake and leaching, reduce impurities

concentration in electrolysis feed, reduce purge from the crude LHM crystalliser, and to extend life of resins of IX columns before regeneration, amongst others.

The Phase 1 Plant has significantly contributed to de-risking the project. Nevertheless, it is important to understand the limits of what could be tested and learnt. The following points should be noted:

- The Phase 1 Plant does not have calcination, acid regeneration and purge circuits, therefore these systems have not been tested except offsite or at supplier facilities;
- The Phase 1 Plant does not have either of the two-stage acid recirculation loop. As a result, neither stage has been tested in P1P, and some operating conditions are somewhat different (for example the pug mill uses fresh acid instead of recycled acid, which does not have the same composition). In addition, the buildup of minor impurities through the acid recycle loop cannot be observed;
- Due to design constraints, the purification circuit is not designed or operated exactly like the commercial facility is expected to operate. The purification circuit is therefore able to test the chemistry and certain aspects of the design but can only contribute qualitatively to other aspects of the design (e.g. filter sizing);
- Due to design constraints, certain flows in P1P are of a different concentration, or of a different composition, than what is planned for the commercial facility. This affects densities, viscosities and some efficiencies. This means that direct comparison of the behavior within equipment cannot always be made, although qualitative comparison can be made;
- Due to limited sulphation capacity, P1P generally operates on a blend of recycled lithium sulfate salts and spodumene concentrate. The lithium sulfate salts are generally significantly purer than the concentrate which aids the operation of the purification circuit. Long campaigns with only spodumene concentrate as feed have not been performed, and therefore should any impurities or problems accumulate over time, these will not have been observed.



## 14 MINERAL RESOURCE ESTIMATES

This Section reports the results of the 2018 Fall and January 2019 update of the geological model as well as the update of the mineral resource estimates for the Whabouchi Project. SGS completed the update using the digital database supplied by Nemaska (as of January 25, 2019) which includes channel data from trenches and drill hole data completed by Nemaska since 2009 and up to the end of 2018.

The aim of the updated mineral resource estimation was to better define the geological units present in the model and highlighting the presence of distinct mineralised and barren pegmatites in the geological model. The 2018-2019 geological interpretation also highlighted the presence of smaller parallel dykes and dykelets (1-3 m wide) close to the Main deposit, within the designated mining area outlined by previous open pit scenarios.

The database used to produce the mineral resource estimate is derived from a total of 617 channels and diamond drill holes and contains the collar, survey, lithology, and analytical results information. A significant number of channels do not have analytical data but include lithological information which was considered during the modeling of the mineralized envelopes.

The mineral resource estimate is derived from a computerized resource block model. The construction of the block model starts with the modeling of 3D wireframe solids of the geology and mineralization using channel and drill hole  $\text{Li}_2\text{O}\%$  analytical results and lithological data.

The solids from the past mineral resources estimation were updated to fit the new data and the new geological interpretation were changed in certain sections of the deposit given the new data from the 2018 infill drilling and the added geological information on the project according to precisions on the type of mineralisation present and its affect on the recovery of minable Ore.

The analytical data contained within the wireframe solids was normalized to generate fixed length analytical composites. The composite data was used to interpolate the grade of blocks regularly spaced on a defined grid that fills the 3D wireframe solids.

The blocks are then classified based on confidence level using proximity to composites, composite grade variance and mineralized solids geometry. The 3D wireframe modeling, block model, and mineral resource estimate were completed by SGS based on information provided by Nemaska.

### 14.1 Exploratory Data Analysis

Exploratory data analysis for lithium ( $\%\text{Li}_2\text{O}$ ) was completed on both original analytical data and composite data contained within the modeled mineralized solids. The coordinates of the drill holes were measured in the field in UTM coordinates.

#### 14.1.1 ANALYTICAL DATA

There is a total of 15,590 assay intervals in the database used for the current mineral resource estimate and 9,681 of them are contained inside the mineralized solids. Most of the drill hole intervals



defining the mineralized solids have been sampled continuously. Table 14.1 shows the range of Li<sub>2</sub>O values from the analytical data.

**Table 14.1 – Range of Analytical Data Inside Mineralized Solids**

	Li <sub>2</sub> O (%)
Count	9,681
Mean	1.49
Std. Dev.	0.78
Min	0.00
Median	1.51
Max	5.19

Assays received in Li values were transformed into Li<sub>2</sub>O values using the conversion factor of 2.153. This conversion factor was used upon conversations with SGS pears and according to sources such as the ministry of petroleum and mines of British Columbia:

<http://www.empr.gov.bc.ca/Mining/Geoscience/MINFILE/ProductsDownloads/MINFILEDocumentation/CodingManual/Appendices/Pages/VII.aspx>.

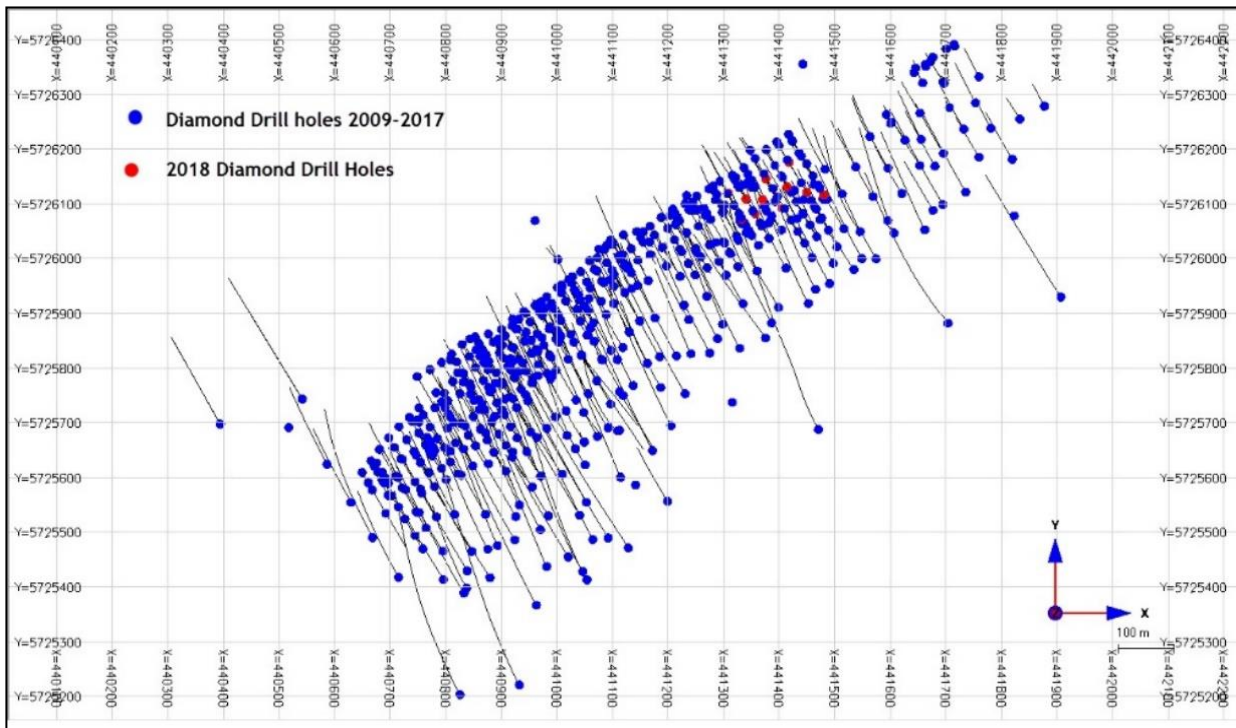
The channel samples collected at Whabouchi are mostly located at the highest topographic area of the Property where the outcrop exposure is best. The channel's azimuth ranges from N060° to N210° with an average of N149° which is generally perpendicular to the orientation of the pegmatite intrusions. The channels average 19.78 m in length and the sampling interval is typically one (1) metre.

The core holes drilled on the Project are generally oriented N330°, perpendicular to the general orientation of the pegmatite intrusions, and have a weak to moderate deviation toward the east (Figure 14.1). Their spacing is typically 25 m with larger spacing of 50 m spacing between sections 00+50 mE and 14+50 mE. The drill holes dips range from 43° to 75° with an average of 50° and the drill hole intercepts range from approximately 70% of true width to near true width of the mineralization.

#### 14.1.2 MINERALISED INTERVALS DATA

Mineralised intervals were selected for the modeling of the 3D wireframe. A minimum weighted average grade of 0.4% Li<sub>2</sub>O over a minimum drill hole interval length of 2 m was generally used as guideline for the definition of the mineralised solid to define the width of mineralized interpretations on sections. Only Pegmatite intervals were kept even if there were good results either on the footwall or hanging wall of the pegmatite. These were later used to create mineralised interpretations on sections. Mineral intervals that were not retained during the creation of the interpretations on sections were discarded (See Section 14.2).

**Figure 14.1 – Plan View of the Drill Holes and Trenches**



### 14.1.3 COMPOSITE DATA

Block model grade interpolation is conducted on composited analytical data. A 2-m composite calculated length has been selected based on the N-S thickness of the 5 m by 3 m by 6 m block size defined for the resource block model.

Compositing is conducted within the drill hole mineralised intervals that were also used for 3D solid creation. A minimum of 2 m and a minimum of 1 m was applied to composite creation settings. No capping was applied on the analytical composite data.

Table 14.2 shows the statistics of the analytical composites used for the interpolation of the I1G\_SO domains of the resource block model and Figures 14.2 and 14.3 show the related histogram for  $\text{Li}_2\text{O}$ .

Figures 14.4 and 14.5 display the spatial distribution of the composites in plan and longitudinal view respectively (hole collars are shown as blue circles and sample composites are shown as black diamonds).

**Table 14.2 – Statistics for the 2-m Composites for Li<sub>2</sub>O**

	Li <sub>2</sub> O (%)
Count	5,614
Min	0.00
Median	1.48
Max	4.13
Mean	1.42
Std. Dev.	0.71

**Figure 14.2 – Histograms of the Composites**

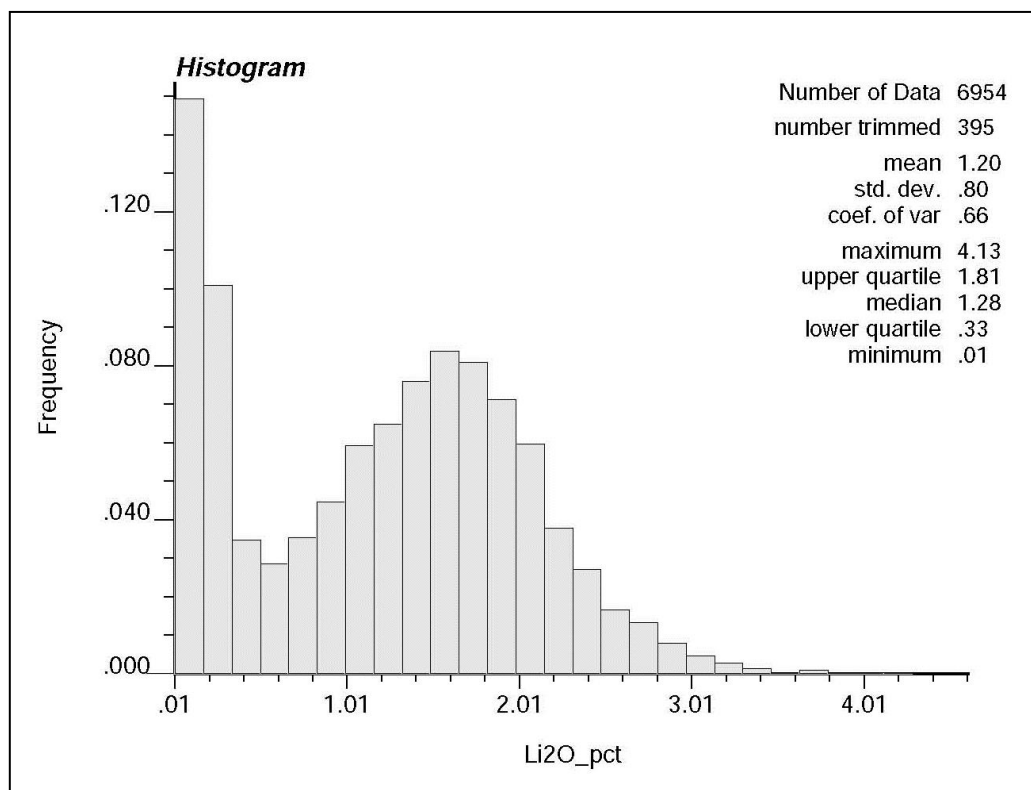


Figure 14.3 – Histograms of the Original Samples Compared to the Composites

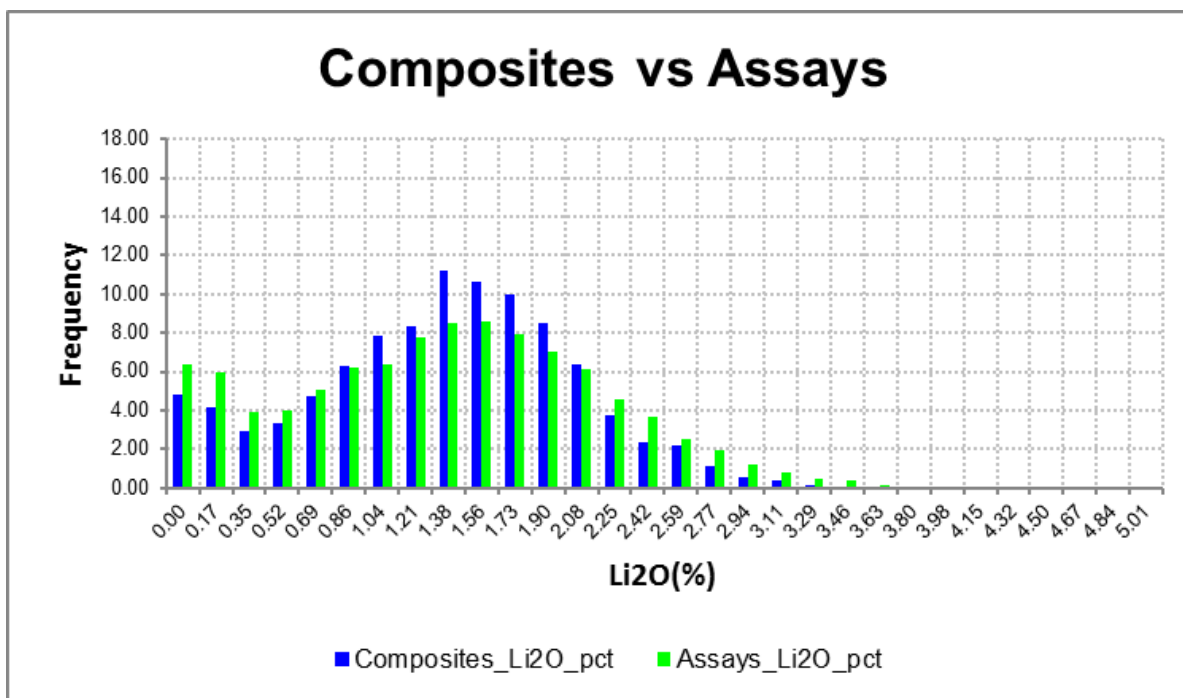
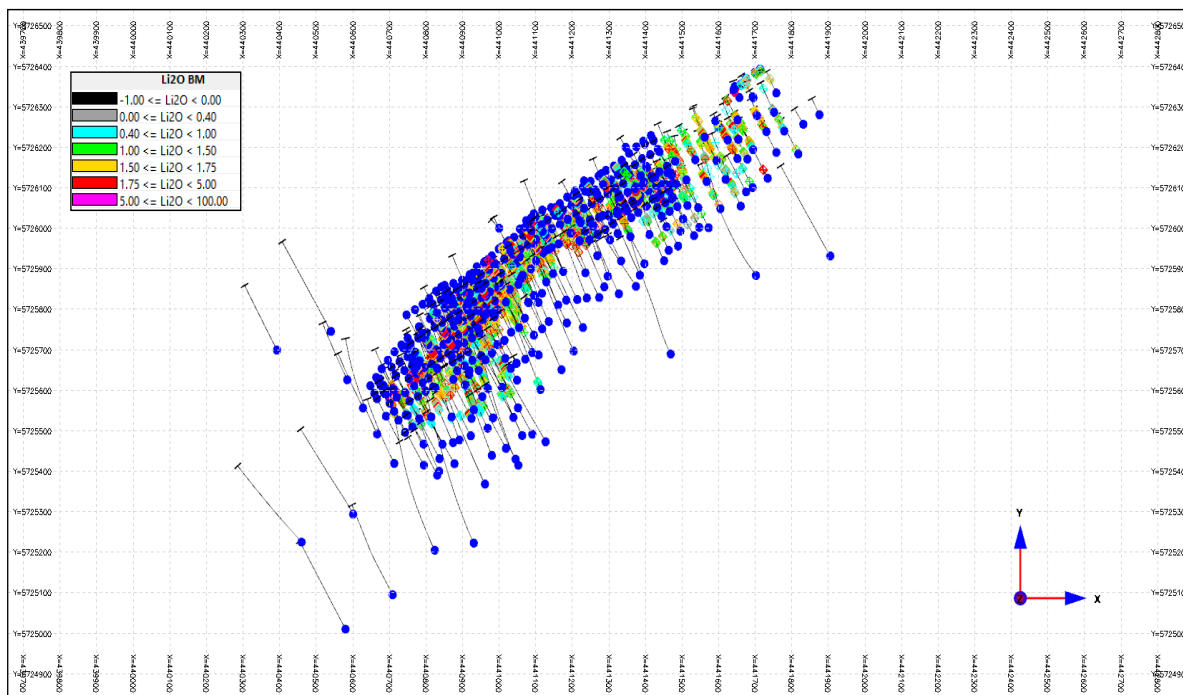
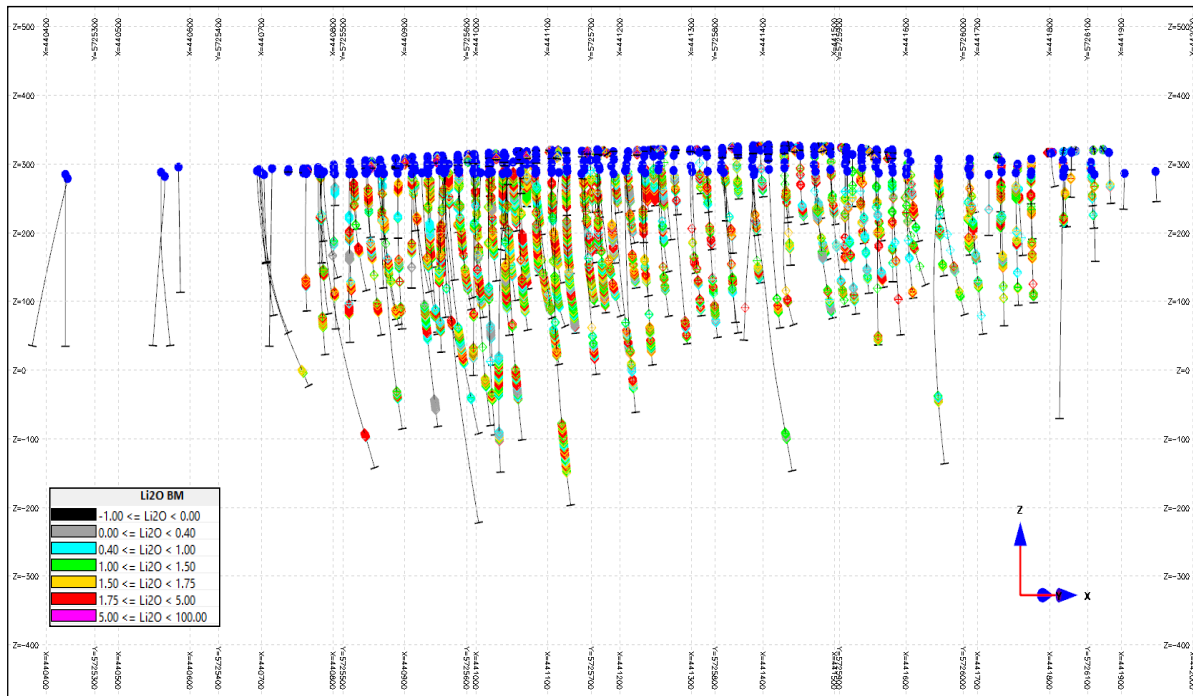


Figure 14.4 – Plan View Showing the Spatial Distribution of the Composites



**Figure 14.5 – Longitudinal View Showing the Distribution of the Composites (Looking North)**



#### 14.1.4 SPECIFIC GRAVITY

Section 11.4 summarizes the SG determination in detail. The results of the SG measurements conducted by SGS and Nemaska in 2010 and 2011 on selected mineralized core samples returned an average SG value of 2.71/m<sup>3</sup> for the mineralized pegmatite. This value was used for the calculation of the tonnages from the volumetric estimates of the resource block model.

## 14.2 Geological Interpretation

In late 2018, early 2019, SGS and Nemaska geologists jointly conducted the interpretation and update of the prior (2017, SGS Canada Inc.). The interpretations were done using the 2018 reviewed drillhole database especially for the lithological interpretations; updated in 2018 by Nemaska's Geologist. The aim was to better understand any difference in barren and spodumene bearing pegmatite within the core descriptions.

Nemaska and SGS focused on the outlining of mineralised and barren pegmatites within the Whabouchi mineralised deposit. SGS and Nemaska outlined several distinct geological units mainly composed of:

- mineralised pegmatites (\_I1G\_SO);
- barren pegmatites (\*\_I1G);
- Non-pegmatitic internal waste.

The internal waste is consisting of enclaved and/or isolated shreds of barren host rock i.e. mainly pyroxenite and volcanites, other than pegmatitic material.

For the purpose of modeling, section (looking northeast) where generated every 25 m, with intermediate section where necessary to tie in the solids. The modeling was first completed on sections to define mineralized prisms using the lithologies and analytical data for lithium. A minimum grade of 0.4%  $\text{Li}_2\text{O}$  over a minimum drill hole interval length of 2 m was generally used as guideline to define the width of mineralized prisms (Figure 14.6).

However, the aim of the 2018 updated geological interpretation was to better define the geological units present in the model and highlighting the presence of distinct mineralised and barren pegmatites in the geological model. The 2018-2019 geological interpretation also highlighted the presence of smaller parallel dykes and dykelets (1-3 m wide) close to the Main deposit, within the designated mining area outlined by previous open pit scenarios.

The revised 2018 interpretation continues to show a series of dykes parallel to the Main zone, with an orientation of  $\text{N}060^\circ$  and a dip averaging  $-80^\circ$  toward  $\text{N}150^\circ$  (Figure 14.6). The second set of dykes is connected at depth to the Main zone forming a “Y” shape. This orientation is characteristic of the Doris dyke, oriented  $\text{N}070^\circ$  with an average dip of  $70^\circ$  towards  $\text{N}340^\circ$  (Figure 14.6). The final 3D wireframe model was constructed by meshing the defined mineralized prisms based on the geological interpretation.

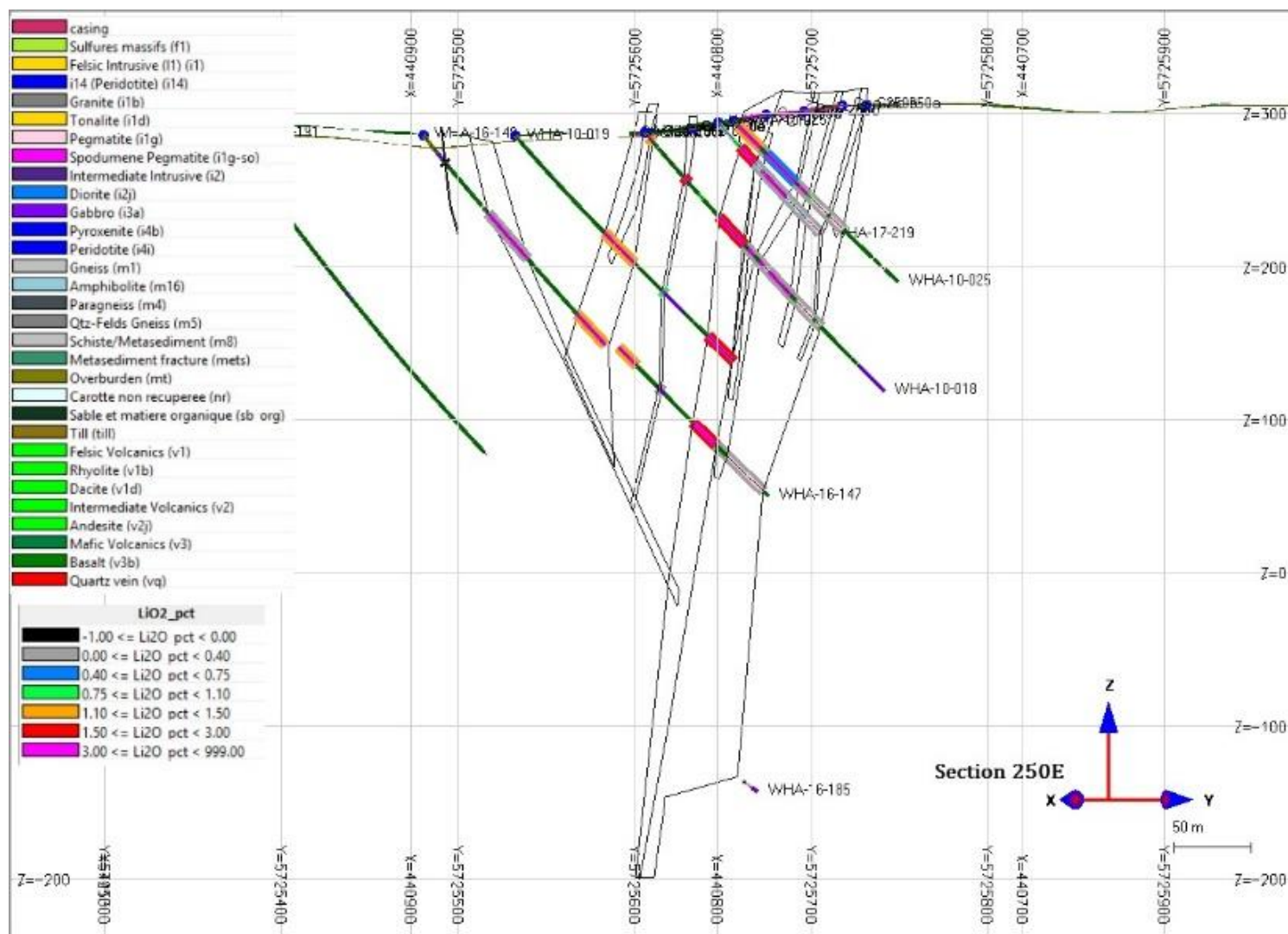
Local smaller 3D wireframe solids of internal waste (host rock material located inside the large envelopes) of significant size were also modeled separately. The total volume of the 19 individual mineralized solids is  $22,037,100 \text{ m}^3$  (including waste).

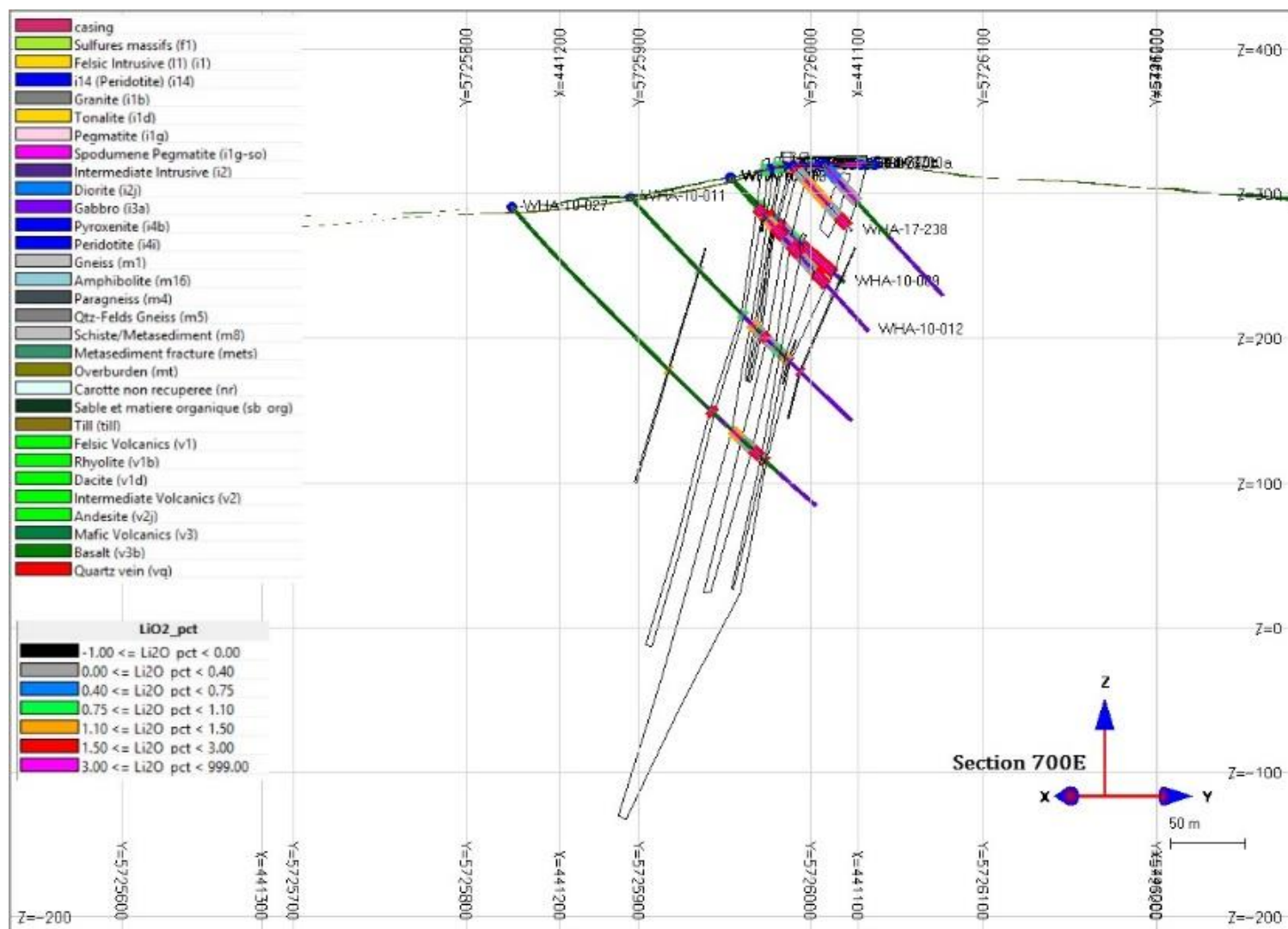
The geological solids were not cut by the overburden contact. However, the bedrock-overburden interface 3D surface has been updated by Nemaska in 2019 taking into account the 2016 bulk sampling area and only block centers below the overburden contact were taken into account for the mineral resources statement.

Figure 14.7 shows the final 3D wireframe solids in isometric view. The different colors of the envelopes do not represent any specific parameters and are used to help the visual interpretation.



Figure 14.6 – Typical Section (looking West) Interpretation of the Mineralized Solids





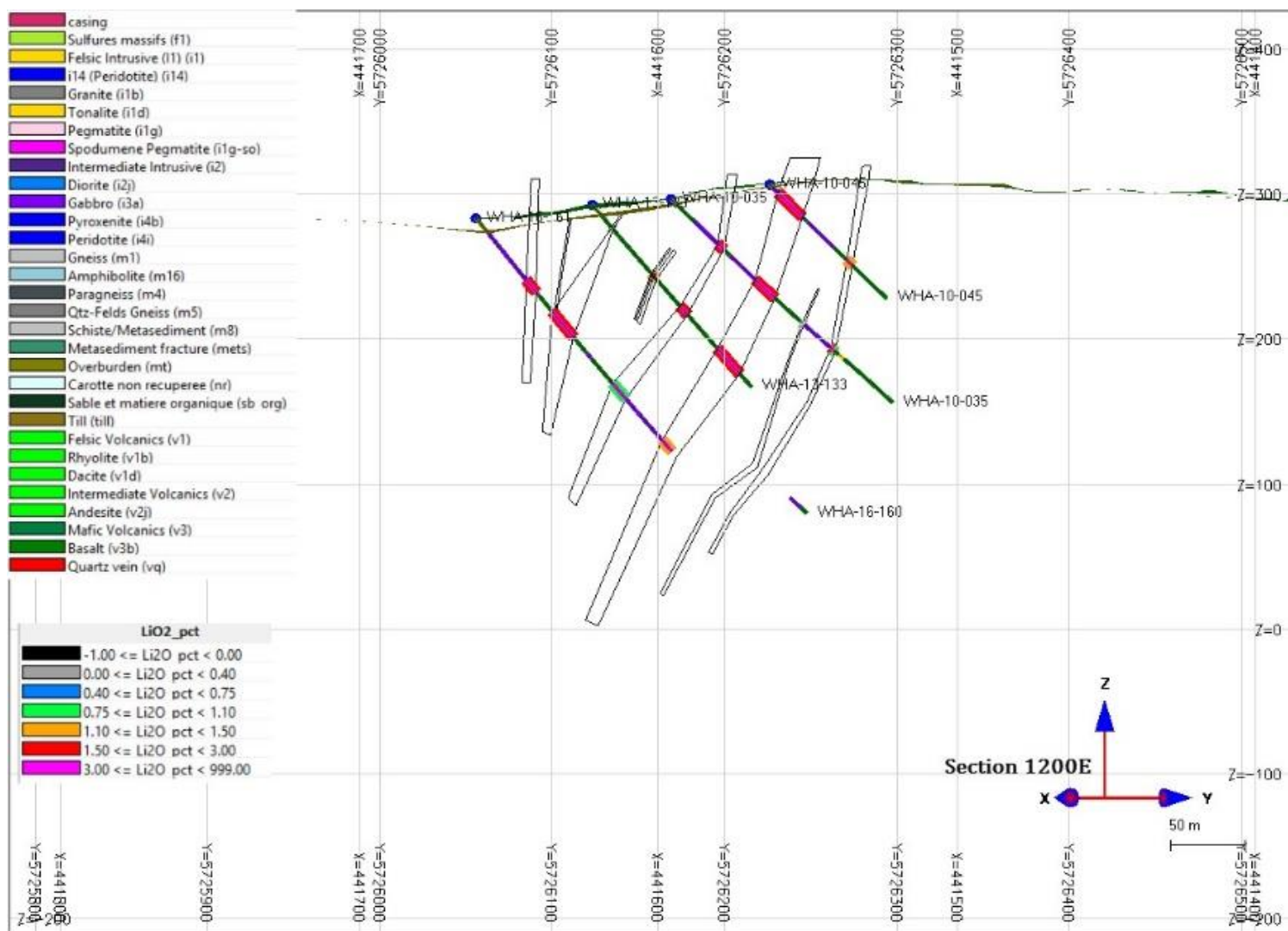
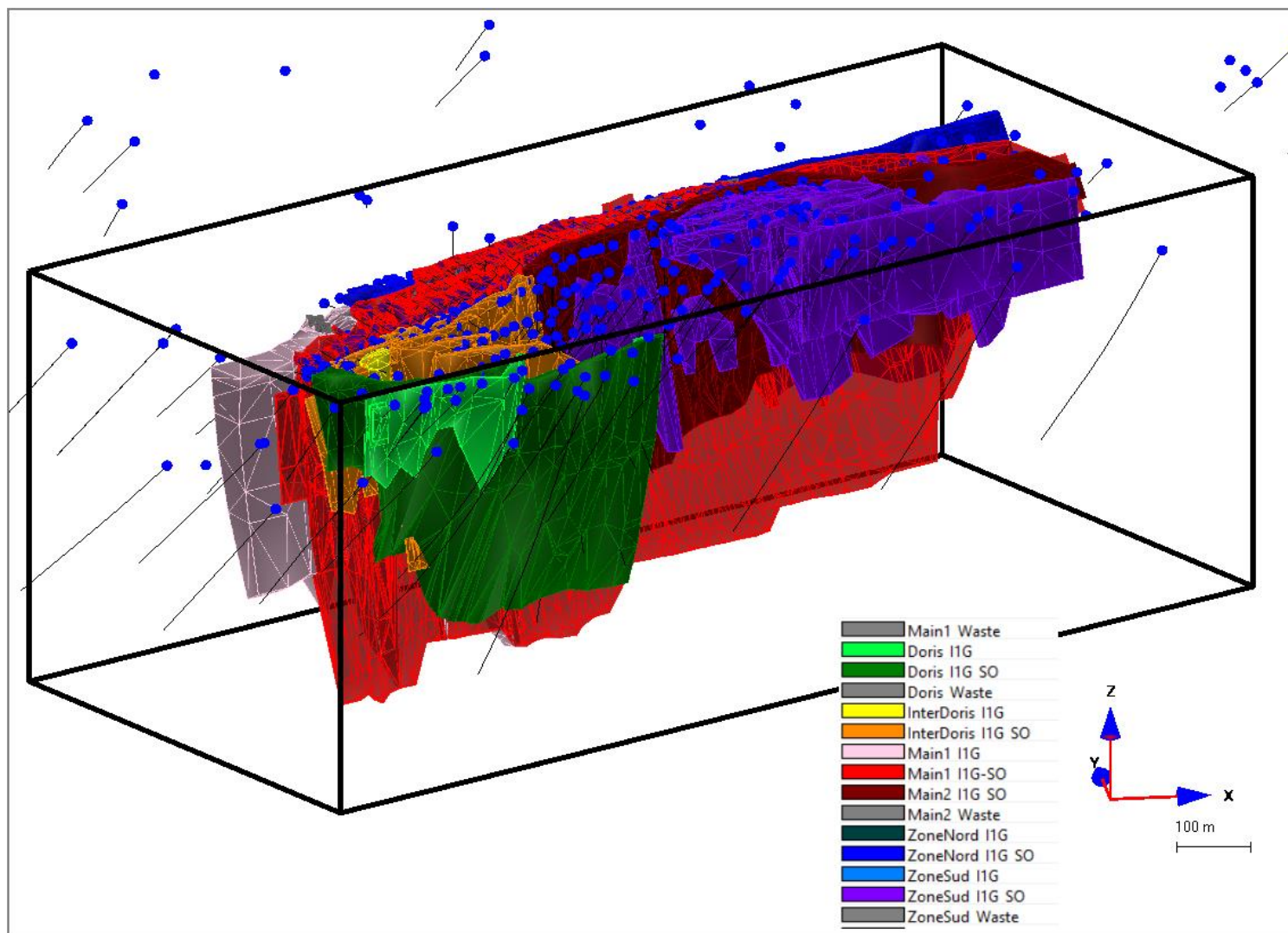


Figure 14.7 – Isometric View of the Final Mineralized Solids





### 14.3 Resource Block Modeling

A block size of five (5) m (NE-SW) by three (3) m (NW-SE) by six (6) m (vertical) was selected for the resource block model of the Project based on drill hole spacing, width and general geometry of mineralization. The 6 m vertical dimension corresponds to half the bench height and the height of 6 m high mining flitches for open pit mining operations as per evaluations on of the equipment fleet proposed for the Whabouchi Project (see Section 16).

The 5 m NE-SW dimension corresponds to about a quarter to a fifth of the minimum spacing between the drill holes and accounts for the variable geometry of the mineralization in that direction. The 3 m NW-SE block dimension accounts for the average minimum width of the mineralization modeled at Whabouchi.

The resource block model contains a total 425,958 blocks located inside the mineralized solids (\*\_I1G\_SO) and under the overburden contact for a total of volume of 27,646,900 m<sup>3</sup> Blocks having its center block located above the overburden surface have been removed from the block model. Table 14.3 summarizes the parameters of the block model limits.

**Table 14.3 – Resource Block Model Parameters**

Direction	Block Size (m)	Number of Blocks	Coordinates (Local Grid)	
			Min (m)	Max (m)
East-West (x)	5	310	440,700	442,245
North-South (y)	3	230	5,725,250	5,725,937
Elevation (z)	6	101	-250	350

### 14.4 Grade Interpolation Methodology

The geostatistical study was revised in 2018 and the resulting variogram model has changed since last resource estimate (2017).

In order to determine the continuity and distribution of the Li<sub>2</sub>O grades from the updated geological model, the 2-m composites were submitted to a variographic study within the mineralised zones. The variographic study helped determine the search ellipses criteria's and define the kriging parameters for the block interpolation process within the mineralised pegmatites.

The composites show a normal distribution (Figure 14.2) with a relatively low variation percentage of 66%. Variograms; more precisely Correlograms were generated for the mineralised Main zone orientation and the conjugated dykes that dip 180° from the main direction (Doris orientation). The correlograms have a sill at 1.

Only the mineralised pegmatite of the Main zone (Main1\_I1G\_SO, Main2\_I1G\_SO, ZoneNord\_I1G\_SO, ZoneSud\_I1G\_SO, InterDoris\_I1G\_SO) and mineralised pegmatite of the Doris zone (conjugated dykes; Doris\_I1G\_SO) were taken into account for the geostatistical study.

The external waste; internal waste, and barren pegmatite solids were not taken into account for this study and were the subject of a limited variography study showing barren material to low-grade, well below 0.30% COG. These solids were modeled for a better understanding of the external and internal waste other than pegmatites and for barren pegmatites within the Whabouchi mineralised body.

The resulting model correlogram for the Main l1G\_SO zone can be modelled with the following function. This corresponds to a correlogram, with an isotropic function (Figure 14.18):

$$\text{Gamma} = N(0.15) + S(0.37, 5/5/5, 0/0/0) + S(0.48, 45/45/45, 0/0/0)$$

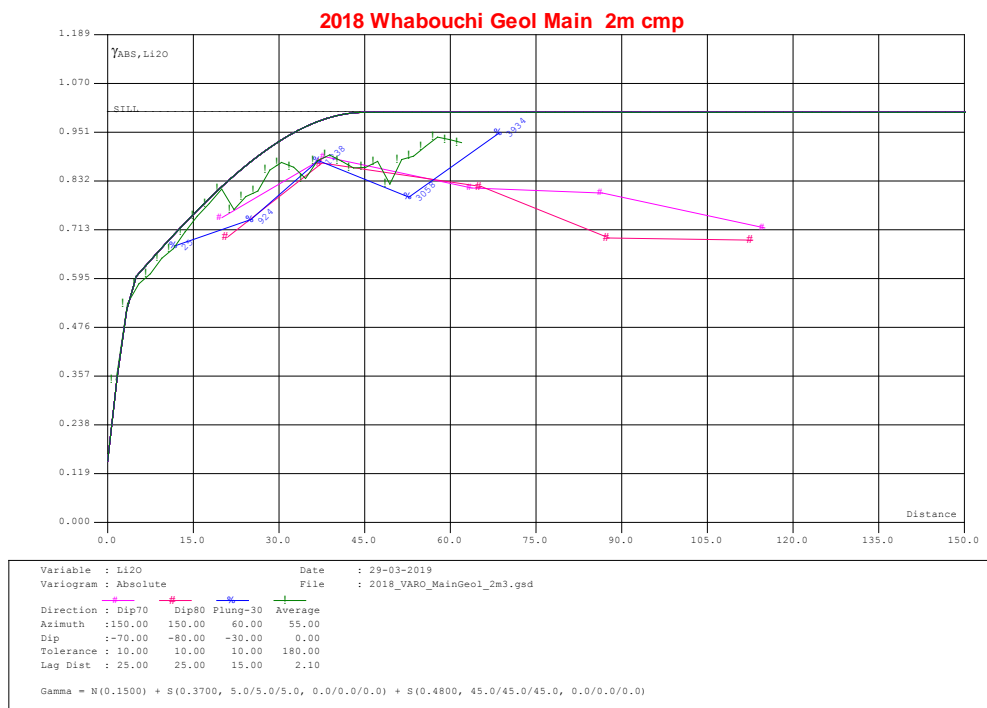
Where N represents a nugget effect of 15% and maximum continuity of 45 m is found along both the average direction. (Figure 14.18).

The resulting model correlogram for the Doris l1G\_SO zone can be modelled with the following function. This corresponds to a correlogram, with an isotropic function (Figure 14.18):

$$\text{Gamma} = N(0.05) + S(0.30, 5/5/5, 0/0/0) + S(0.65, 40/40/40, 0/0/0)$$

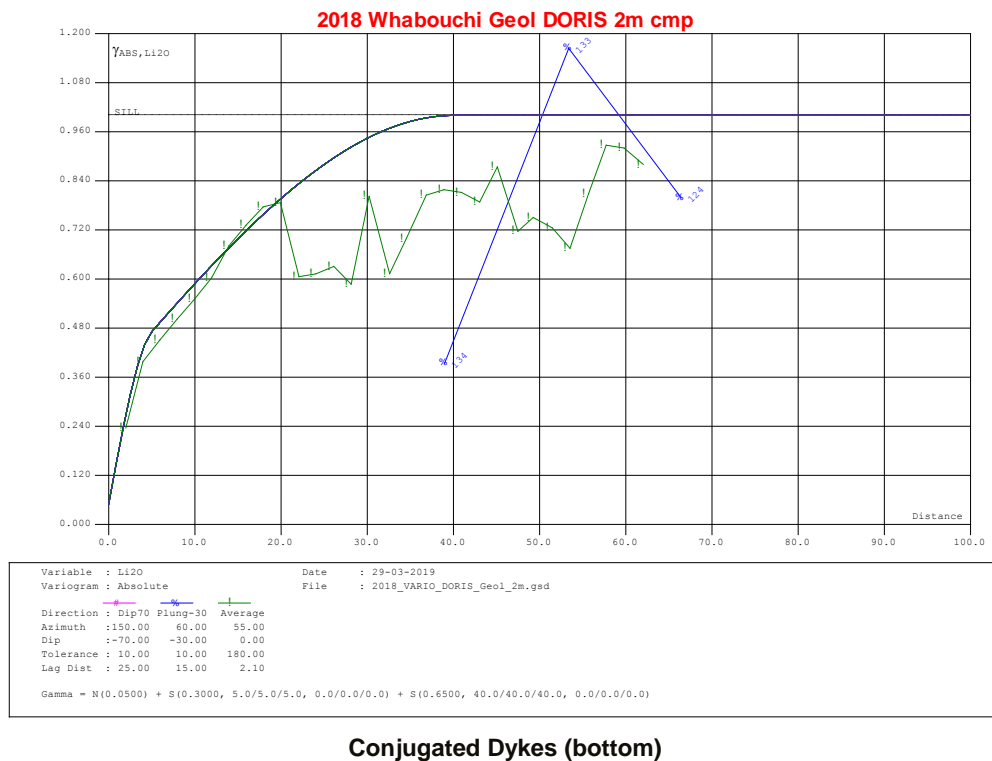
Where N represents a nugget effect of 5%. No preferential orientations are found at the moment in the data. This can be attributed to the limited number of pairs found in the different search direction. The Doris type dykes have limited drilling data defining them (Figure 14.18).

**Figure 14.8– Variogram of the two (2) m Composites for Li<sub>2</sub>O% Grades**



**Main Zone (top)**





## 14.5 Block Model Interpolation

### 14.5.1 MINERALIZED PEGMATITE SOLIDS GRADE INTERPOLATION

The grade interpolation for the Whabouchi mineralised pegmatite solids resource block model was completed using the Ordinary Kriging (“OK”) methodology. The interpolation process was conducted using three (3) successive passes with more inclusive search conditions from one (1) pass to the next until most blocks were interpolated.

Variable search ellipse orientations were used to interpolate the blocks. The general dip of the mineralized pegmatite was modeled on each section and then interpolated in each block (Figure 14.9). During the interpolation process, the search ellipse was orientated following the interpolation direction of each block, hence better representing the dip and orientation of the mineralization.

The first pass was interpolated using a search ellipsoid distance of 75 m (long axis) by 75 m (intermediate axis) and 25 m (short axis) with an orientation of 330° azimuth (local grid), -90° dip and 0° spin which represents the general geometry of the pegmatites in the deposit. Using search conditions defined by a minimum of seven (7) composites, a maximum of 24 composites and a minimum of three (3) holes, 85% of the blocks were estimated.

For the second pass, the search distance was twice the search distance of the first pass and composites selection criteria were kept the same as for the first pass. A total of 98% of the blocks were interpolated following the second pass.

Finally, the search distance of the third pass was increased to 200 m (long axis) by 200 m (intermediate axis) by 50 m (short axis) and again the same composites selection criteria were applied. The purpose of the last interpolation pass was to interpolate the remaining un-estimated blocks mostly located at the edges of the block model, representing 2% of the blocks. Only 0.2% (327 blocks) remain un-estimated and are at the edges of the Main1 South Zone (4) area.

Figures 14.9 and 14.10 illustrate the three (3) search ellipsoids used for the different interpolation passes. Figure 14.11 show the results of the block model interpolation in longitudinal view respectively.

#### 14.5.2 BARREN PEGMATITE AND INTERNAL WASTE SOLIDS GRADE INTERPOLATION

The grade interpolation for the Whabouchi barren pegmatite and internal waste solids resource block model was completed using the Inverse Distance Squared (“ID2”) methodology. The interpolation process was conducted using three (3) successive passes with more inclusive search conditions from one (1) pass to the next until most blocks were interpolated.

These interpolated blocks remain present in the Whabouchi Block model for added information of the barren pegmatites which can be hard to distinguish during selective mining per bench according to Nemaska geological team.

#### 14.5.3 STATISTICAL VALIDATION OF THE INTERPOLATION PROCESS

In order to validate the interpolation process, the block model was compared statistically, to the assays and composites. The distribution of the assays, composites and blocks are normal and show a similar average value with decreasing levels of variance (Figures 14.12 to 14.16). The assays and composites have respective averages of 1.43% Li<sub>2</sub>O and 1.42% Li<sub>2</sub>O with variances of 0.67 and 0.50. The resulting interpolated blocks have an average value of 1.29% Li<sub>2</sub>O with a variance of 0.19%.

Furthermore, the block values were compared to the composites values located inside the interpolated blocks (Figure 14.17). This enables to test for possible over or under evaluation of the grade by the search parameters by testing the local correlation. A correlation ratio of 0.65 (R<sup>2</sup>) was established between the blocks and the composites (which is typical and considered acceptable). Note that data formatting was involved.

The presence of low grade values in the assays, composites and blocks are mainly due to the mislabelling of some areas within the mineralised solids as I1G\_SO instead of I1G (Figure 14.17 and Figure 14.12 to Figure 14.13).

**Figure 14.9 – General View of the 3 Different Search Ellipsoids used in the Interpolation Process of Main1 I1G\_SO**

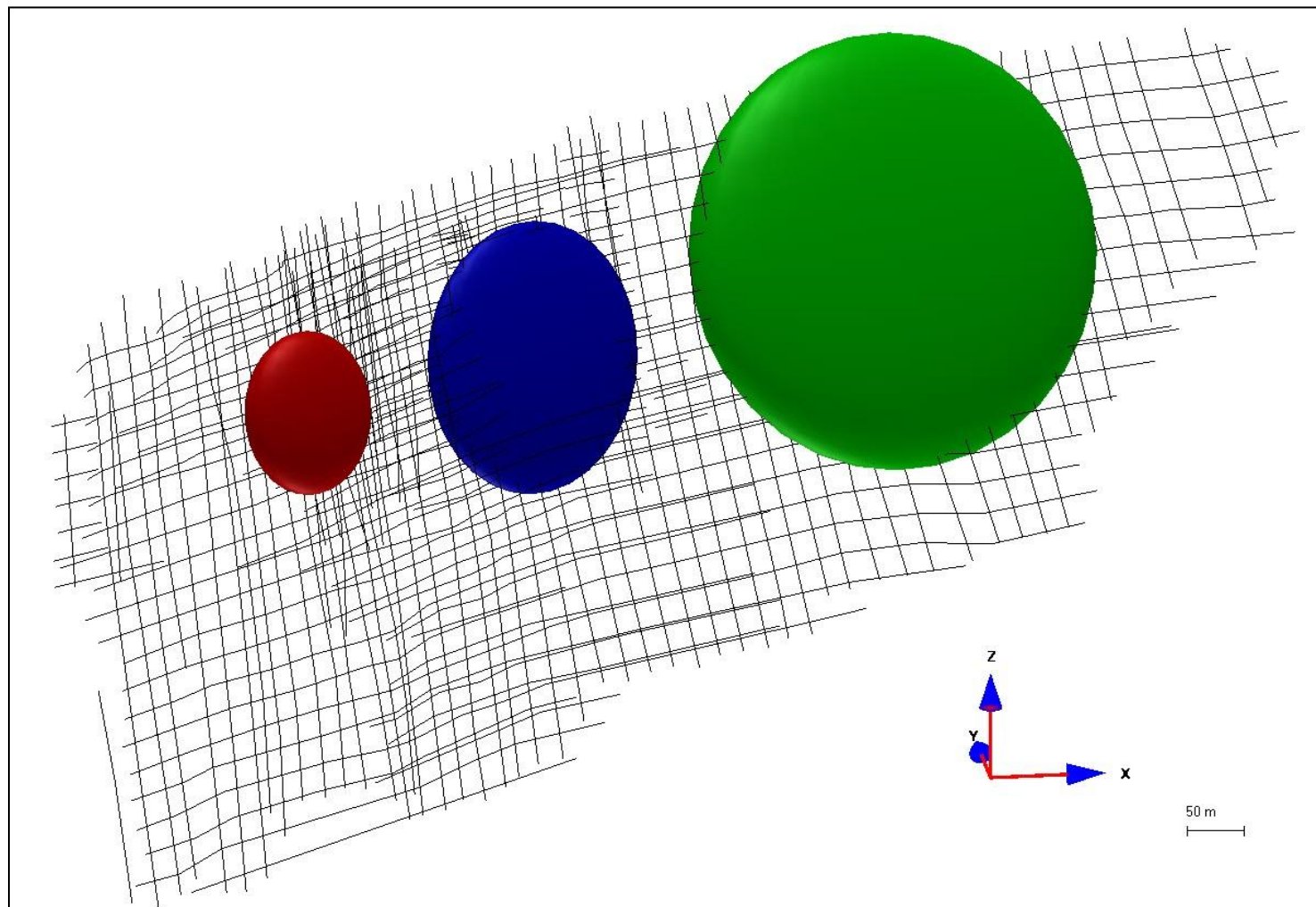


Figure 14.10 – Isometric View of the Modeled Orientation of the Ellipse

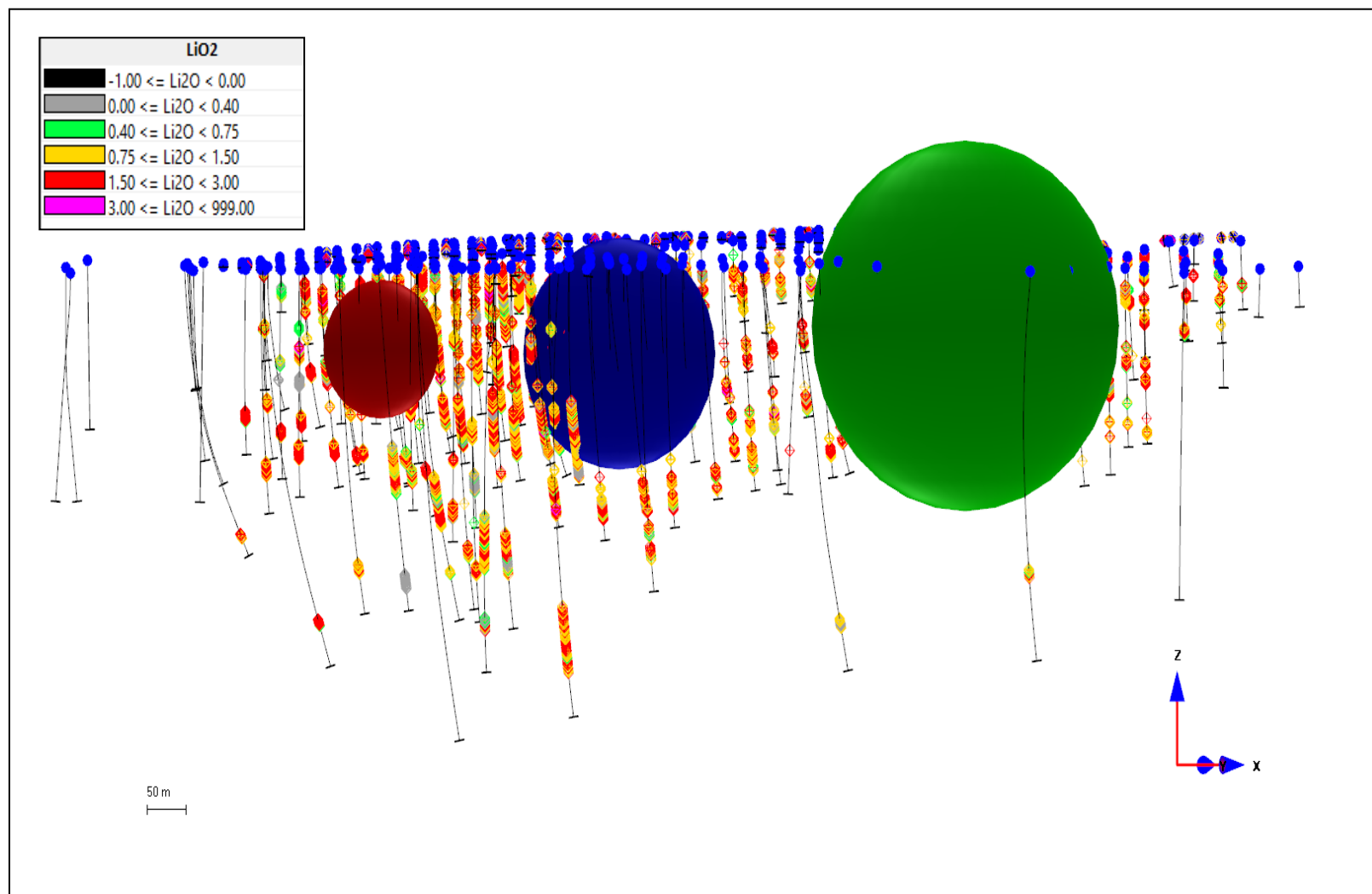


Figure 14.11 – Isometric View of the Interpolated Block Model

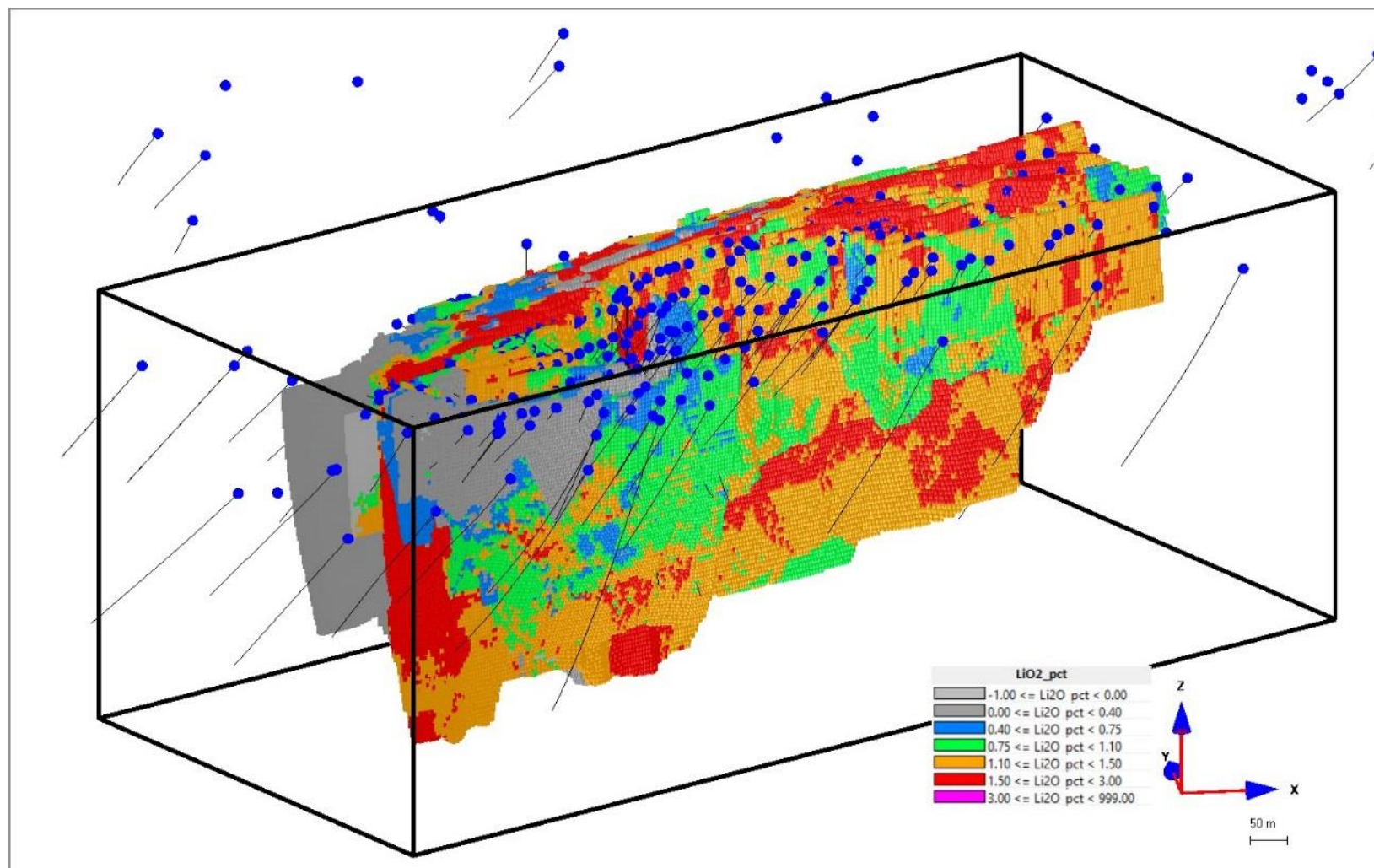


Figure 14.12 – Histogram of Blocks vs Composites vs Assays

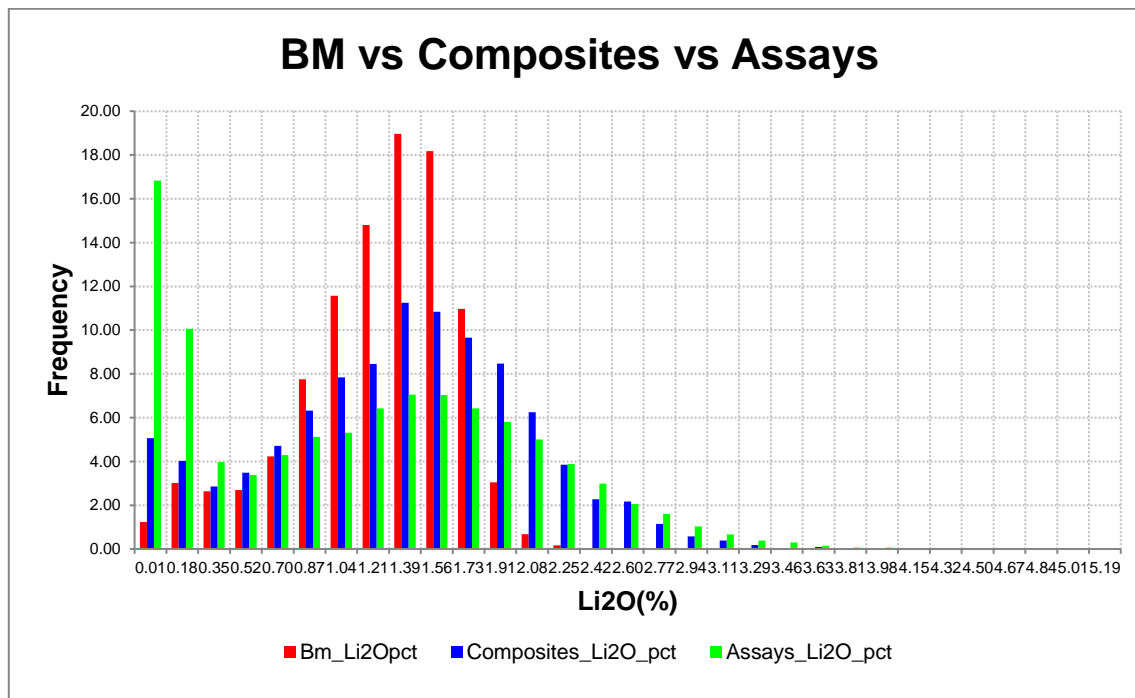
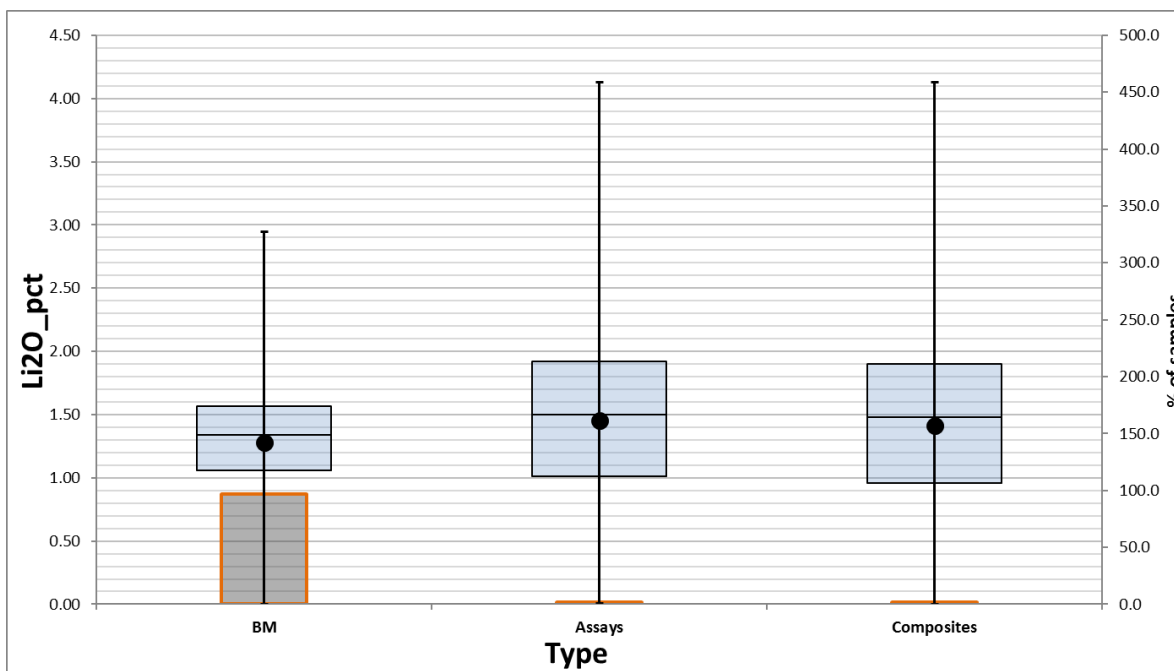
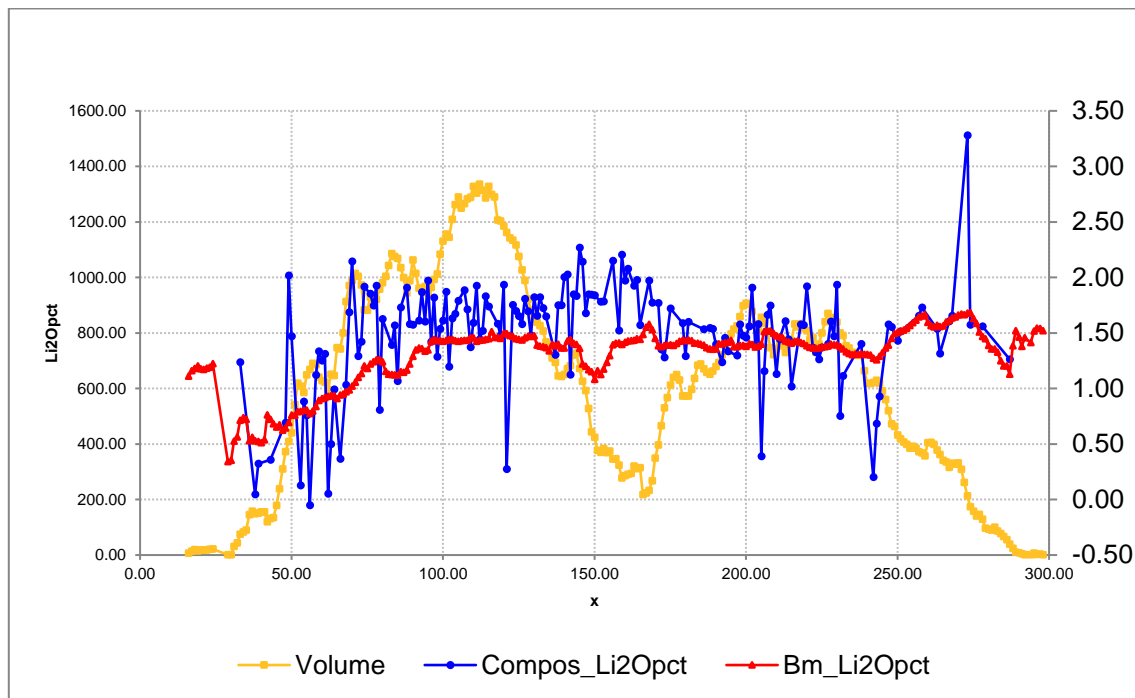


Figure 14.13 – BoxPlot of Blocks vs Composites vs Assays

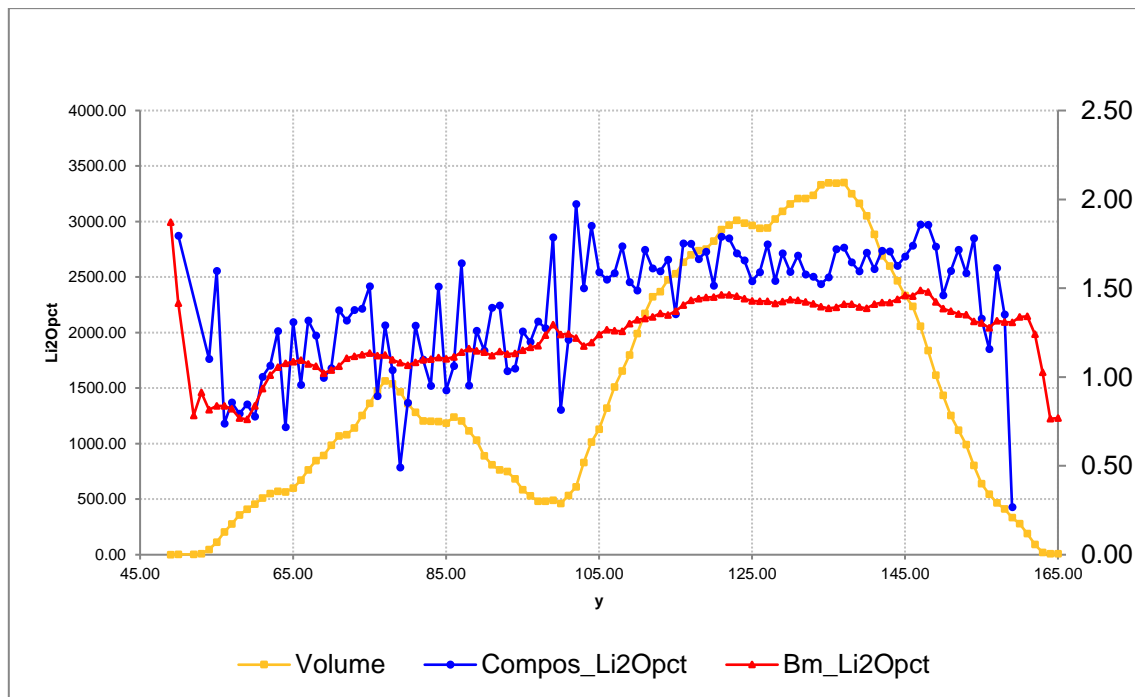




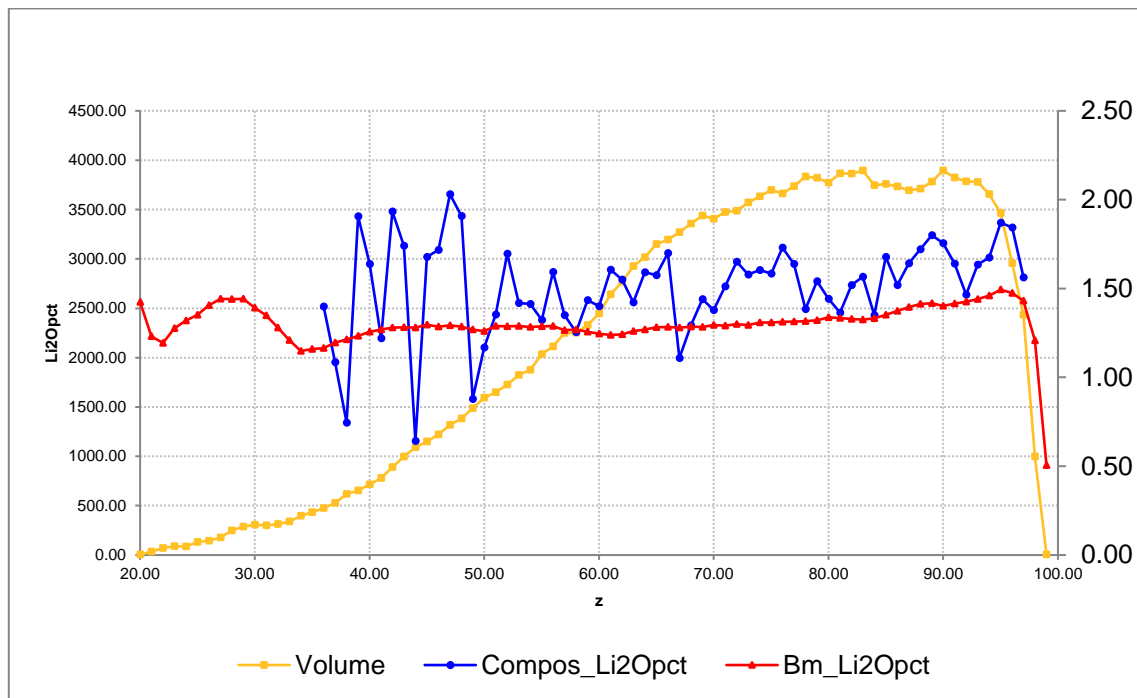
**Figure 14.14 – Swathplot (X) of Blocks vs Composites vs Volume**



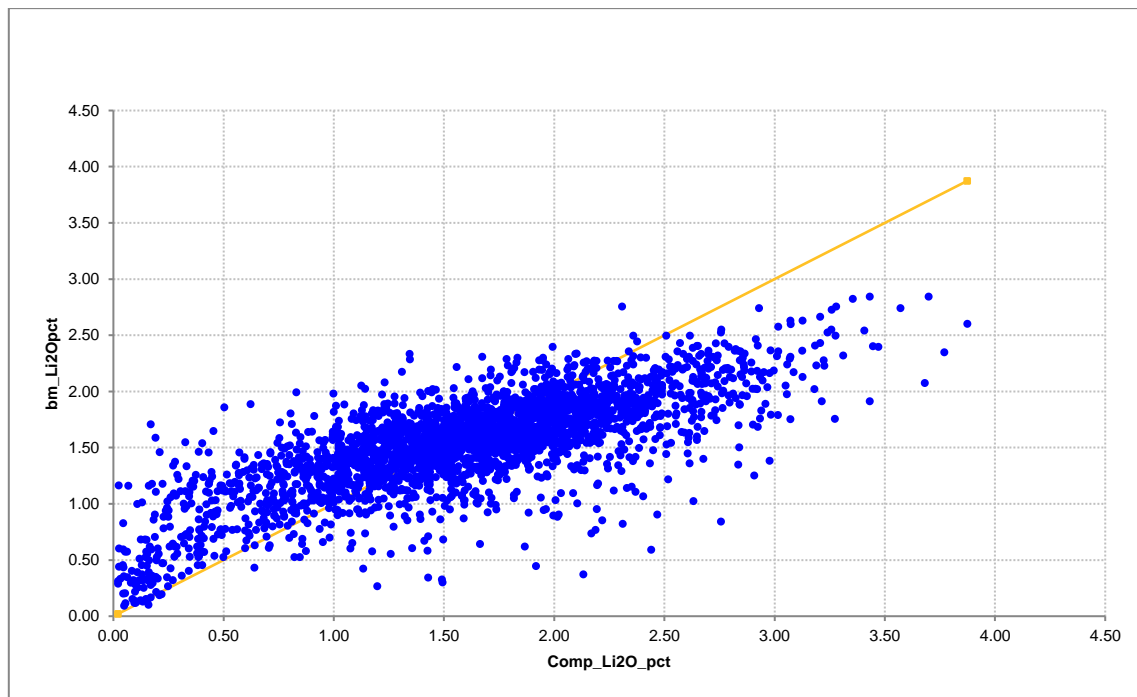
**Figure 14.15 – Swathplot (y) of Blocks vs Composites vs Volume**



**Figure 14.16 – Swathplot (z) of Blocks vs Composites vs Volume**



**Figure 14.17 – Block Values Versus Composites Inside those Blocks Comparison**



**Table 14.4 – Statistical Comparison of Assay, Composite and Block Data Statistics Report on the mineralised pegmatite (I1G\_SO)**

	Orig. Assays	Composites	Blocks
Min Value	-	-	-
Max Value	5.19	4.13	2.95
Average	1.43	1.42	1.28
Variance	0.67	0.50	0.18
Standard Deviation	0.82	0.71	0.42
% Variation	57.4%	50.2%	33.3%
Median	1.46	1.48	1.34
Count	10,857	5,614	349,553

## 14.6 Mineral Resource Classification

The mineral resources at Whabouchi are classified into Measured, Indicated and Inferred categories. The mineral resource classification follows the CIM requirements and guidelines and is based on the density of analytical information, the grade variability and spatial continuity of mineralization. The mineral resources were classified in two (2) successive stages: automated classification followed by manual editing of final classification results.

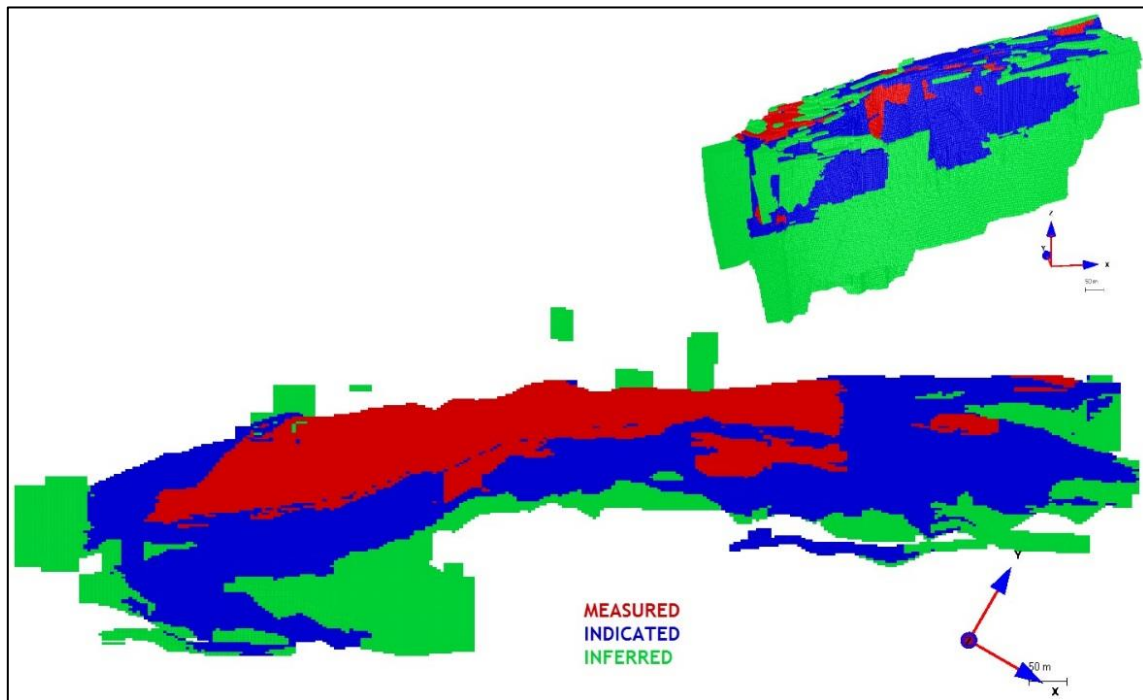
The first classification stage is conducted by applying an automated classification process which selects around each block a minimum number of composites from a minimum number of holes located within a search ellipsoid of a given size and orientation. For the Measured resource category, the search ellipsoid was 55 m (strike) by 55 m (dip) by 10 m with a minimum of seven (7) composites in at least three (3) different drill holes. For the Indicated category, the search ellipsoid was twice the size of the Measured category ellipsoid using the same composites selection criteria. All remaining blocks were considered to be in the inferred category.

The second classification stage involves the delineation of coherent zones for the Measured and Indicated categories based on the results of the automated classification. The objective is to homogenize or “smooth” the results of the automated process by removing the “Swiss cheese” or “spotted dog” patterns typical of the automated process results. The second stage is conducted by defining 3D solids on a bench by bench basis for the Measured and Indicated categories.

Figure 14.18 shows the block model classification process in plan and isometric views with respective categories (categories: Measured – red, Indicated – blue, and Inferred – green).

Changes in the classification manual delineation of coherent zones have been updated since last 2017 resource update. The 2018 infill drilling has been done on the shallow eastern part of the deposit affecting mostly the Main1\_I1G\_SO and Main2\_I1G\_SO mineralised domains in the measured category.

**Figure 14.18 – Block Model Final Classification in Plan and Isometric Views**



## 14.7 Mineral Resource Estimate

The general requirement that all mineral resources have “reasonable prospects for economic extraction” implies that the quantity and grade estimates meet certain economic thresholds and that the mineral resources are reported at an appropriate cut-off grade taking into account extraction scenarios and processing recoveries. In order to meet this requirement, The Authors consider that the Whabouchi deposit mineralization is amenable for open pit extraction.

In order to determine the quantities of material offering “reasonable prospects for eventual economic extraction” by an open pit, Whittle™ pit optimization software and reasonable mining assumptions and metal recovery assumptions are used to evaluate the proportions of the block model that could be “reasonably expected” to be mined from an open pit were used. The pit optimization was completed by SGS.

The pit optimization parameters used are summarized in Table 14.5. Based on available economic parameters provided by Nemaska and SGS’s experience with open pit exploration projects and mining operations, the Authors consider the assumptions listed in Table 14.5 to be appropriate reporting assumptions for the purposes of the current report.

A Whittle pit shell at a revenue factor of 1.0 was selected as the ultimate pit shell for the purposes of the current Mineral Resource Estimate (Figures 14.19 and 14.20). The corresponding stripping ratio is 5.27:1.

The reader is cautioned that the results from the pit optimization are used solely for the purpose of testing the “reasonable prospects for economic extraction” by an open pit and do not represent an attempt to estimate mineral reserves. Mineral reserves are listed in Section 15. The results are used as a guide to assist in the preparation of a mineral resource statement and to select an appropriate resource reporting cut-off grade.

The interpolated blocks located below the bedrock/overburden interface, within the optimized pit shell and above a determined cut-off grade comprise the mineral resources.

The 2019 Mineral Resource Estimate for the Whabouchi deposit is presented in Tables 14.7 and 14.8. Highlights of the Whabouchi deposit Mineral Resource Estimate are as follows:

- The final mineral resource estimates within the open pit are reported at a cut-off of 0.30% Li<sub>2</sub>O and totals 17.734 Mt, with an average grade of 1.60% Li<sub>2</sub>O in the Measured category, 20.549 Mt, with an average grade of 1.34% Li<sub>2</sub>O in the Indicated category, with an additional 11.745 Mt, with an average grade of 1.27% Li<sub>2</sub>O in the Inferred category (See Table 14.7).
- The mineral resource estimates below the optimized pit are reported at a cut-off of 0.60% Li<sub>2</sub>O and totals 296,000 t of indicated resources with an average grade of 1.11% Li<sub>2</sub>O and 5.423 Mt of inferred resources with an average grade of 1.33% Li<sub>2</sub>O (See Table 14.8).

Figure 14.19 is a section showing the optimized pit outline with the final in-pit resource block model.

The cut-off grade of 0.30% Li<sub>2</sub>O was established by DRA/Met-Chem and verified and validated by SGS according to the parameters presented in Table 14.5.

The cut-off grade of 0.60% Li<sub>2</sub>O was established by DRA/Met-Chem and verified and validated by SGS according to the parameters presented in Table 14.6.

**Table 14.5 – Parameters Used by SGS for the Whittle Pit Optimization**

Parameters	Value	Unit	References
Sales Revenues			
Concentrate Price	\$800	C\$ / tonne	Nemaska
(6.25% Li <sub>2</sub> O: 2.90% Li)			
Based on Concentrate at 100% Li <sub>2</sub> O	\$12,800	C\$ / tonne	
Operating Costs			
Mineralized Material	4.76	C\$ / tonne	Nemaska
Waste Rock	3.39		
Overburden	1.92		
Process	16.31		
Other Costs			
Fixed Operating Costs	10.02	C\$ / t. milled	Nemaska
General and Administration	11.48	C\$ / t. milled	
Freight Mine to Refinery	8.00		
Sustaining Capex	12.80		
Royalties	1.10		
Metallurgy			
Concentration Recovery	85.2	%	NI 43-101 Technical Report February 21, 2018
Concentrate Grade	6.25	%Li <sub>2</sub> O	
Cut-off Grade	0.30	%Li <sub>2</sub> O	Nemaska / BBA
Geotechnical Parameters			
North Wall	56	Degrees	Nemaska
South Wall	59		
Material Densities			
Mineralized Material	2.71	t / m <sup>3</sup>	NI 43-101 Technical Report February 21, 2018 (SGS and DRA/Met-Chem)
Waste Rock	3.06		
Overburden	2.10		



**Table 14.6 – Parameters Used by SGS for the Underground Cut-Off Estimation**

Parameters	Value	Unit	References
<b>Sales Revenues</b>			
Concentrate Price (6.25% Li <sub>2</sub> O)	\$800	C\$/tonne	Nemaska
Based on Concentrate at 100% Li <sub>2</sub> O	\$12,800	C\$ / tonne	
<b>Operating Costs</b>			
Mining Mineralized Material	29.52	C\$/t mined	DRA/Met-Chem
Process, General & Administration	27.87	C\$/t milled	DRA/Met-Chem
Freight Mine to Refinery	50	C\$/Conc.	Nemaska
<b>Metallurgy and Royalties</b>			
Concentration Recovery	85.2	%	SGS Canada Inc.
NSR Royalties	1.665	\$/t	Nemaska
Cut-Off Grade	0.6	% Li <sub>2</sub> O	DRA/Met-Chem

**Table 14.7 – Whabouchi Deposit In-Pit Mineral Resource Estimate**

Cut-Off Grade (Li <sub>2</sub> O%)	Category	Tonnage* (t)	Average Grade (% Li <sub>2</sub> O)
0.30	Measured	17,734,000	1.60
0.30	Indicated	20,532,000	1.33
<b>0.30</b>	<b>Measured + Indicated</b>	<b>38,266,000</b>	<b>1.45</b>
0.30	Inferred	11,745,000	1.27

Note: The Mineral Resource estimate has been estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definitions Standards for Mineral Resource and Mineral Reserve in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects. Mineral resources which are not Mineral Reserve do not have demonstrated economic viability.  
 Inferred Mineral Resource are exclusive of the Measured and Indicated Resources.  
 Bulk density of 2.71 t/m<sup>3</sup> is used.  
 Effective date is June 26, 2019  
 Blocks centers were used as extraction factor for the overburden and pit surfaces  
 \* Rounded to the nearest thousand.  
 Blocks from Bulk sample area were taken out from Block Model.  
 Mineral resources on the Pad of 19,200t at 1.56% Li<sub>2</sub>O are included in the Measured category

**Table 14.8 – Whabouchi Deposit Below Pit Mineral Resource Estimate**

Cut-Off Grade (Li <sub>2</sub> O%)	Category	Tonnage* (t)	Average Grade (% Li <sub>2</sub> O)
0.60	Measured	--	--
0.60	Indicated	274,000	1.13
<b>0.60</b>	<b>Measured + Indicated</b>	<b>274,000</b>	<b>1.13</b>
0.60	Inferred	5,413,000	1.32

Note: The Mineral Resource estimate has been estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Definitions Standards for Mineral Resource and Mineral Reserve in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects. Mineral resources which are not Mineral Reserve do not have demonstrated economic viability.  
 Inferred Mineral Resource are exclusive of the Measured and Indicated Resources.  
 Bulk density of 2.71 t/m<sup>3</sup> is used.  
 is June 26, 2019  
 Blocks centers were used as extraction factor for the overburden and pit surfaces  
 \* Rounded to the nearest thousand.

#### 14.7.1 CAUTIONARY STATEMENT

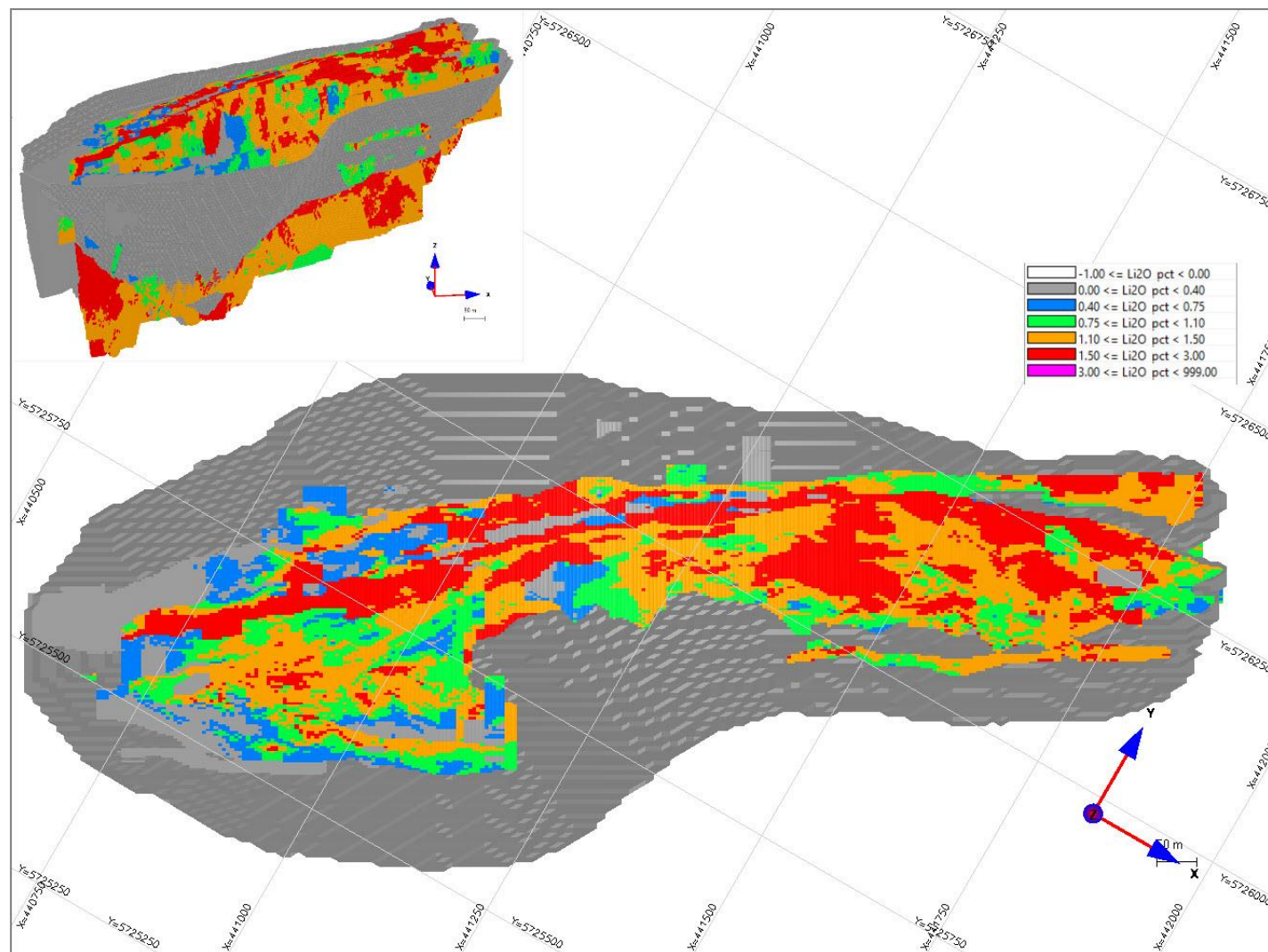
The measured resources contain 19,200 t at 1.56% Li<sub>2</sub>O from bulk sampling material available on the Mini-DMS Pad. The bulk sampling program from December 2016 is the result of a pilot test up to 60,000 tonnes of mineralized material extracted. The topography and overburden surfaces were updated with the location of the bulk sample area.

### 14.8 Variables in the Block Model

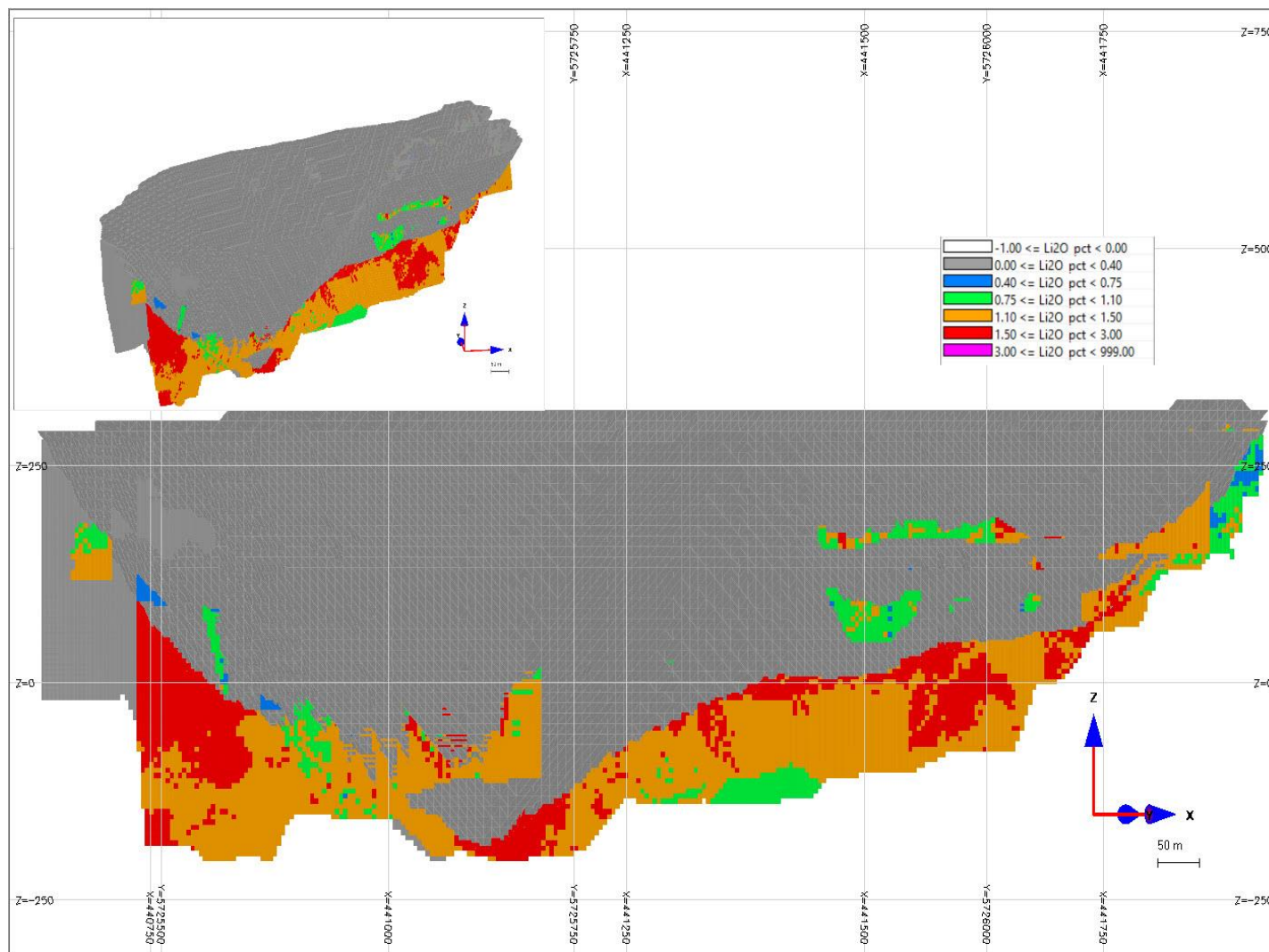
The final block model contains the estimated values of Li<sub>2</sub>O (%) for each separate domain solids used. The final block model also contains the calculated block fraction of each separate domain solids used. Each variable was estimated separately for each solid.

The Block Model also contains the final weighed average Li<sub>2</sub>O (%) in respect to each relevant solid estimated Li<sub>2</sub>O (%) and their corresponding calculated block fraction. SGS calls this block model a MULTIFOLDER Type Block Model.

**Figure 14.19 – Plan View Showing Optimized Pit Outline and Final In-Pit Resource Block Model (Looking N-E UTM Grid)**



**Figure 14.20 – Longitudinal View Showing Mineral Resources Below the Pit  
 (Looking N-E Grid)**



## 15 MINERAL RESERVE ESTIMATES

The Whabouchi deposit will be mined using conventional open pit mining for the first 26 years of operation, followed by seven (7) years of underground mining. The Project life of mine (LOM) plan and subsequent Mineral Reserves are based on a lithium Spodumene selling price of \$800/t CAD. The effective date of the Mineral Reserve estimate is July 5, 2019.

Development of the LOM plan included pit optimization, pit design, mine scheduling and the application of modifying factors to the Measured and Indicated Mineral Resources. The reference point for the Mineral Reserves is the feed to the primary crusher. The tonnages and grades reported are inclusive of mining dilution, geological losses and operational mining losses.

The Mineral Reserves for the open pit component of the Whabouchi Mine were prepared by Jeffrey Cassoff, P. Eng., Senior Mining Engineer with BBA Inc.; a Qualified Person as defined under National Instrument 43-101.

The Mineral Reserves for the underground component of the Whabouchi Mine were prepared by Andre-Francois Gravel, P. Eng., Senior Mining Engineer with DRA/Met-Chem; a Qualified Person as defined under National Instrument 43-101.

Both the Open Pit and Underground Mineral Reserves have been developed using best practices in accordance with CIM guidelines and National Instrument 43-101 reporting.

The QPs are of the opinion that no other known risks including legal, political or environmental, would materially affect potential development of the Mineral Reserves, except for those risks already discussed in this Report.

Table 15.1 presents the Mineral Reserves that have been estimated for the open pit component of the Whabouchi deposit which include 18.3 Mt of Proven Mineral Reserves at an average grade of 1.41% Li<sub>2</sub>O and 9.6 Mt of Probable Mineral Reserves at an average grade of 1.18% Li<sub>2</sub>O for a total of 27.9 Mt of Proven and Probable Mineral Reserves at an average grade of 1.33% Li<sub>2</sub>O. In order to access these Mineral Reserves, 1.3 Mt of overburden and 75.2 Mt of waste rock must be mined, resulting in a strip ratio of 2.7:1.

In 2017, Nemaska mined a portion of the deposit for a bulk sample used to feed a demonstration plant in Shawinigan. Approximately 19,000 tonnes of ore at an average grade of 1.79% Li<sub>2</sub>O are currently stockpiled about 600 m from the primary crusher, and are included in the Mineral Reserves.

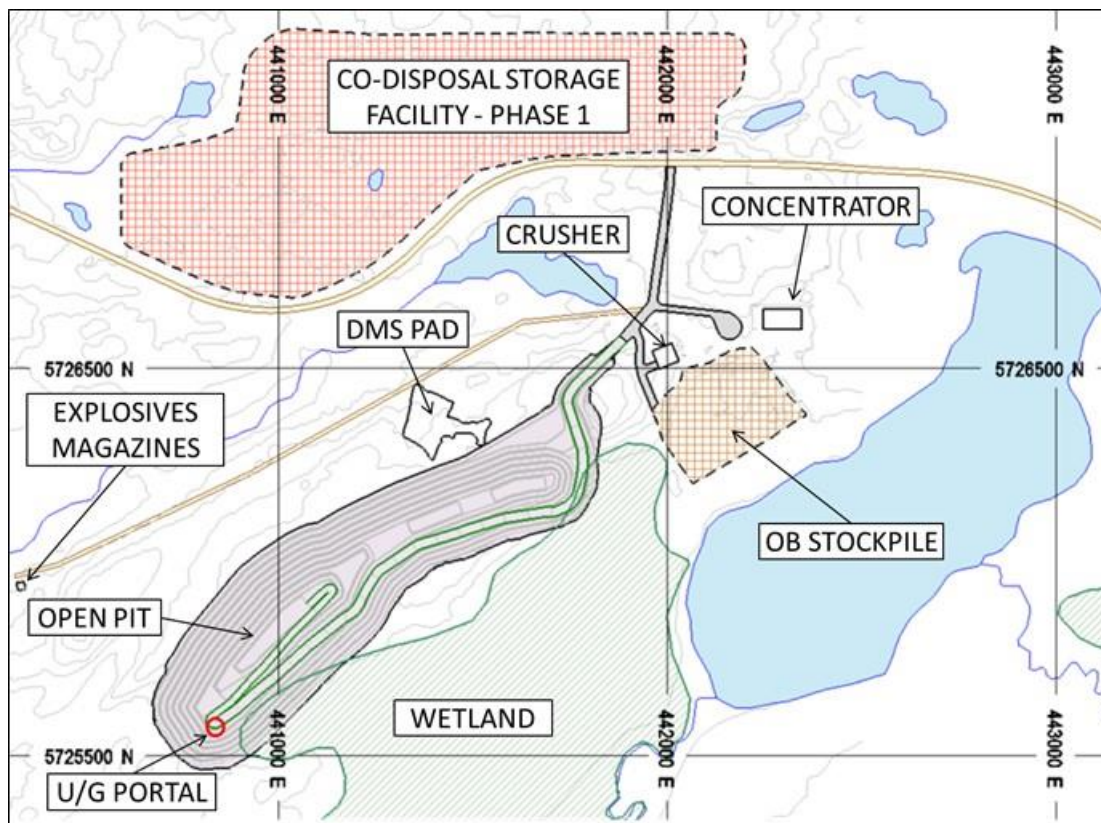
Table 15.2 presents the Mineral Reserves that have been estimated for the underground component of the Whabouchi deposit.

Table 15.3 presents the combined open pit and underground Mineral Reserves that have been estimated for the Whabouchi deposit.



Figure 15.1 presents a general layout of the mine site. Note that the layout only presents the location of the Phase 1 Co-Disposal Storage Facility. The Phase 2 Co-Disposal Storage Facility will be located to the North of Phase 1.

**Figure 15.1 - Mine General Layout**



**Table 15.1 - Whabouchi Open Pit Mineral Reserves**

Category	Tonnes (Mt)	Li <sub>2</sub> O Grade (%)
Proven	18.3	1.41
Probable	9.6	1.18
<b>Proven and Probable</b>	<b>27.9</b>	<b>1.33</b>

- The Mineral Reserves are above a cut-off grade of 0.4% Li<sub>2</sub>O.
- The Mineral Reserves are based on a Spodumene concentrate selling price of \$800/t CAD delivered to the hydrometallurgical plant in Shawinigan at an average concentrate grade of 6.20% Li<sub>2</sub>O.
- The Reference Point for the Mineral Reserves is the feed to the primary crusher.
- The effective date of the Mineral Reserves is July 5, 2019.



**Table 15.2 - Whabouchi Underground Mineral Reserves**

Category	Tonnes (Mt)	Li <sub>2</sub> O Grade (%)
Proven	0.7	1.42
Probable	8.0	1.20
<b>Proven and Probable</b>	<b>8.7</b>	<b>1.16</b>

**Table 15.3 - Whabouchi Combine Mineral Reserves**

	Category	Tonnage (Mt)	Li <sub>2</sub> O Grade (%)
<b>Open Pit (OP)</b>	Proven	18.3	1.41
	Probable	9.6	1.18
	<b>Proven and Probable</b>	<b>27.9</b>	<b>1.33</b>
<b>Underground (U/G)</b>	Proven	0.7	1.42
	Probable	8.0	1.20
	<b>Proven and Probable</b>	<b>8.7</b>	<b>1.21</b>
<b>Total OP &amp; U/G</b>	Proven	19.0	1.41
	Probable	17.6	1.19
	<b>Proven and Probable*</b>	<b>36.6</b>	<b>1.30</b>

\* due to rounding errors, totals may not add-up exactly.

## 15.1 General Parameters Common to the Open Pit and Underground Mineral Reserves

The following section discusses the geological information that was used for the open pit and underground mine plans and mineral reserve estimates. This information includes the topographic surface, the geological block model and the material properties for ore, waste and overburden.

The mine planning work carried out for the Feasibility Study Update was done using Hexagon's Mine Plan 3D Version 15.3 (formerly known as MineSight) and Deswik Version 2018-2.

### 15.1.1 TOPOGRAPHIC SURFACE

The mine design for the Report was carried out using a topographic surface based on 1 m contour intervals. The contours were supplied by Nemaska and derived from a LiDAR survey that took place in 2017.

## 15.1.2 MATERIAL PROPERTIES

The material properties for the different rock types are outlined below. These properties are important in estimating the mineral reserves, the equipment fleet requirements as well as the dump and stockpile design capacities.

### 15.1.2.1 *Density*

As discussed in Section 14.4, the in-situ dry density of the mineralized material was estimated to be 2.71 t/m<sup>3</sup>. A density of 3.06 t/m<sup>3</sup> has been used for the waste rock and a density of 2.1 t/m<sup>3</sup> for the overburden, both of which were the values used in the previous Feasibility Study with the effective date of November 7, 2017.

### 15.1.2.2 *Swell Factor*

The swell factor reflects the increase in volume of material from its in-situ state to after it is blasted and loaded into the haul trucks. A swell factor of 45% was used for the Report, which is a typical value used for open pit hard rock mines. Once the rock is placed in the waste dumps and stockpiles the swell factor is reduced to 30% due to compaction and settling.

### 15.1.2.3 *Moisture Content*

The moisture content reflects the amount of water that is present within the rock formation and due to exposure from precipitation. It affects the estimation of haul truck requirements and must be considered during the payload calculations. The moisture content is also an important factor for the calculation of the process water balance.

Since the mineral reserves are estimated using the dry density, they are not affected by the moisture content value. A moisture content of 2% was used for ore and waste rock and 10% for overburden.

### 15.1.2.4 *Resource Block Model*

The mine design for this Update is based on the 3-dimensional geological block model that was prepared by SGS and presented in Section 14.0. The model is a percentage model and each block in the model is 5 m wide, 3 m long and 6 m high. The model is rotated 330°.

In order to estimate the mining dilution and ore losses for the open pit, BBA Inc. converted the original percentage model into a sub-blocked model using the 3D wireframes for the mineralized pegmatite dykes, the non-mineralized pegmatite dykes, and the bedrock contact that were provided by SGS. The host waste rock around the pegmatite dykes was modelled as amphibolite.

The sub-blocking was done in the Deswik software which allows the sub-blocks to be variable in one of the three directions. In order to provide the most accurate fit to the mineralized wireframes BBA chose to use the “northing” as the variable sub block dimension. The sub block dimensions are presented in Table 15.4.

**Table 15.4 - Sub-Blocking Dimensions**

Model Direction	Parent Block Size	Minimum Sub-block Size	Sub-blocks by Parent Direction
	(m)	(m)	(#)
Easting (x)	5	1.0	5
Northing (y)	3	Variable	Variable
Elevation (z)	6	0.5	12

A comparison of the total resources contained within the percent model versus the sub blocked model is shown in Tables 15.5 and 15.6. The comparison is done at a cut-off grade of 0.40% Li<sub>2</sub>O. The difference between the tonnes and grades reported by the percent model and sub blocked model are considered within and acceptable range.

**Table 15.5 - Percent Model Versus Sub-Blocked Model – Tonnage Comparison**

Description	Parent Model (t)	Sub-block Model (t)	Delta (t)	Delta (%)
Measured	18,547,593	18,637,075	-89,483	-0.5%
Indicated	21,452,013	21,316,700	135,313	0.6%
<b>Measured &amp; Indicated</b>	<b>39,999,606</b>	<b>39,953,776</b>	<b>45,830</b>	<b>0.1%</b>

**Table 15.6 - Percent Model Versus Sub-Blocked Model – Lithium Oxide Units Comparison**

Description	Parent Model (t)	Sub-block Model (t)	Delta (t)	Delta (%)
Measured	295,615	297,129	-1,514	-0.5%
Indicated	287,955	286,431	1,524	0.5%
<b>Measured &amp; Indicated</b>	<b>583,570</b>	<b>583,560</b>	<b>10</b>	<b>0.0%</b>

## 15.2 Modifying Factors that Affect the Open Pit Mineral Reserves

The following section presents the modifying factors that were applied to convert the Mineral Resources in the Mineral Reserves for the open pit component of the Whabouchi deposit, as well as the pit optimization analysis and open pit design.

### 15.2.1 CUT-OFF GRADE

In order to determine if material within the open pit should be sent to the mill for processing or sent to the waste rock pile, the marginal cut-off grade is calculated. The marginal cut-off grade, which is referred to as the “Open Pit Discard Cut-off” in the CIM Estimation of Mineral Resource and Mineral

Reserves Best Practice Guidelines, differs from the breakeven cut-off-grade since mining costs are excluded from the calculation. The reason for excluding the mining costs is that material already defined to be within the limits of the open pit must be mined regardless if it is classified as ore or waste in order to access the bench below.

The only exception where a mining cost would be included in the marginal cut-off grade calculation is if there is an incremental cost for mining ore relative to mining waste. The following calculation was used to calculate the marginal open pit mining cut-off grade for Whabouchi deposit.

$$\text{Marginal COG} = \frac{(\text{Incremental Ore Mining Cost} + \text{Processing Cost}) \times \text{Concentrate Grade}}{(\text{Sales Price} - \text{Royalty} - \text{Transportation Cost} - \text{G\&A Cost}) \times \text{Mill Recovery}}$$

Using the economic parameters presented in

Table 15.9 which is provided in the Pit Optimization section of this report, the marginal open pit cut-off grade was calculated to be 0.25% Li<sub>2</sub>O. In order to ensure an average feed grade to the processing plant that can provide a high quality concentrate, the cut off grade for the open pit was artificially elevated to 0.40% Li<sub>2</sub>O.

Care must be taken when considering the cut-off grade for material being re-handled from stockpiles since the re-handling of the material results in an increased cost. Applying a re-handling cost of \$1.00/t, the open pit stockpile cut-off grade results in 0.26% Li<sub>2</sub>O, which is still below the elevated cut-off grade of 0.40%. Therefore, the low grade material that will be stockpiled, as discussed in Section 16, is still economic to process.

#### 15.2.2 MINING DILUTION AND ORE LOSS

In every mining operation, it is impossible to perfectly separate the ore and waste as a result of the large scale of the mining equipment and the use of drilling and blasting. In order to model the mining dilution and ore loss that can be expected for the open pit mining operation at Whabouchi, BBA used the mineable shape optimizer (MSO) tool in the Deswik software.

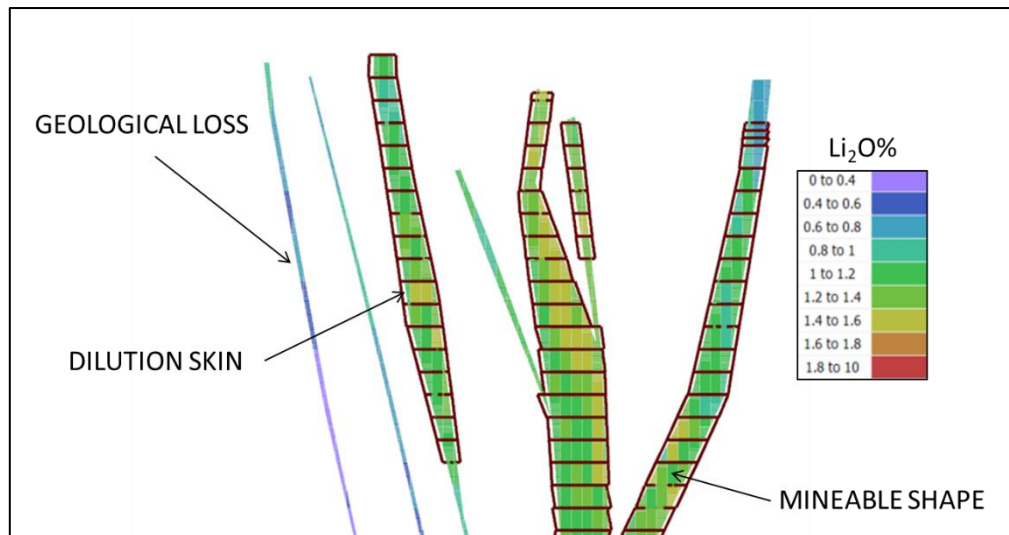
Table 15.7 presents the parameters that were used in the MSO tool. The parameters are based on mining using Komatsu PC1250 excavators equipped with 6.7 m<sup>3</sup> buckets which have a total width of 2.7 m. The MSO tool runs an algorithm on the sub-blocked model and provides “mineable shapes” (solids) that meet the minimum mining dimension criteria, include the dilution skin, and that would still provide a mill feed grade above the cut-off grade. Mineralization that does not fall within a mineable shape as a result of the diluted grade falling below the cut-off is considered as a geological loss.

Figure 15.2 presents a typical section through the deposit illustrating mineralization that did not pass as a mineable shape (geological loss), the dilution skin, and mineable shapes that pass the minimum cut-off grade.

**Table 15.7 - MSO Parameters**

Description	Units	Value
Minimum Mining Width	m	2.50
Shape Height	m	6.00
Shape Length	m	10.00
Footwall Dilution Thickness	m	0.75
Highwall Dilution Thickness	m	0.75
Minimum Waste Pillar	m	3.00
Cut-off Grade	%	0.40

**Figure 15.2 - Typical Section of MSO Shapes**



In addition to the mining dilution, BBA calculated the mining recovery that can be expected for the open pit mining operations. Similar to mining dilution, as a result of the large scale of the mining equipment and the use of drilling and blasting, it is not feasibly possible to recover 100% of the material that is identified as ore. For the mining recovery calculation, BBA considered that on average, a width of 0.25 m on each side (footwall and hanging) of the mineable shape would not be recoverable and would therefore be considered as an operational loss.

The following conventions have been used to calculate mining dilution, mining recovery, and ore loss.

- $$\text{Mining Dilution (\%)} = \frac{\text{Dilution Waste (t)}}{\text{Diluted Ore Tonnage (t)}}$$
- $$\text{Mining Recovery (\%)} = \frac{\text{Insitu Ore (t)} - \text{Operational Loss (t)}}{\text{Insitu Ore (t)}}$$
- $$\text{Ore Loss (\%)} = 100\% - \text{Mining Recovery (\%)}$$

Within the final open pit, the modelling work resulted in 0.6 Mt of Measured and Indicated Mineral Resources being considered as geological losses, as well as the addition of 14.1% mining dilution (composed of 0.3% non-mineralized pegmatite and 13.8% amphiboles). The average mining recovery (applied only within the “mineable shapes”) for the final open pit averages 96.7%.

Table 15.8 presents the effects of mining dilution and mining recovery on the Mineral Resources with the open pit and Figure 15.3 presents a waterfall chart showing the conversion of the Mineral Resources to Mineral Reserves within the open pit following the mining dilution and mining recovery modelling.

**Table 15.8 - Effect of Mining Dilution and Mining Recovery within the Open Pit**

Description	Tonnes	Li <sub>2</sub> O Grade (%)
Global Mineral Resources	25,471,633	1.54
Geological Losses	684,187	1.14
In-Situ Ore	24,787,447	1.55
Dilution Tonnes	3,943,265	0.00
Operational Loss	802,276	1.52
<b>Diluted Ore Tonnage</b>	<b>27,928,432</b>	<b>1.33</b>

It is important to note that the 14.1% mining dilution that was modelled for this Report is considerably higher than the 5% that was modelled in the previous Studies for the Whabouchi deposit. Although the advanced technique of using the MSO tool may account for an increase in the quantity of estimated mining dilution, the main explanation for the increase is the thickness of the dilution skin which increased from 0.25 m to 0.75 m.

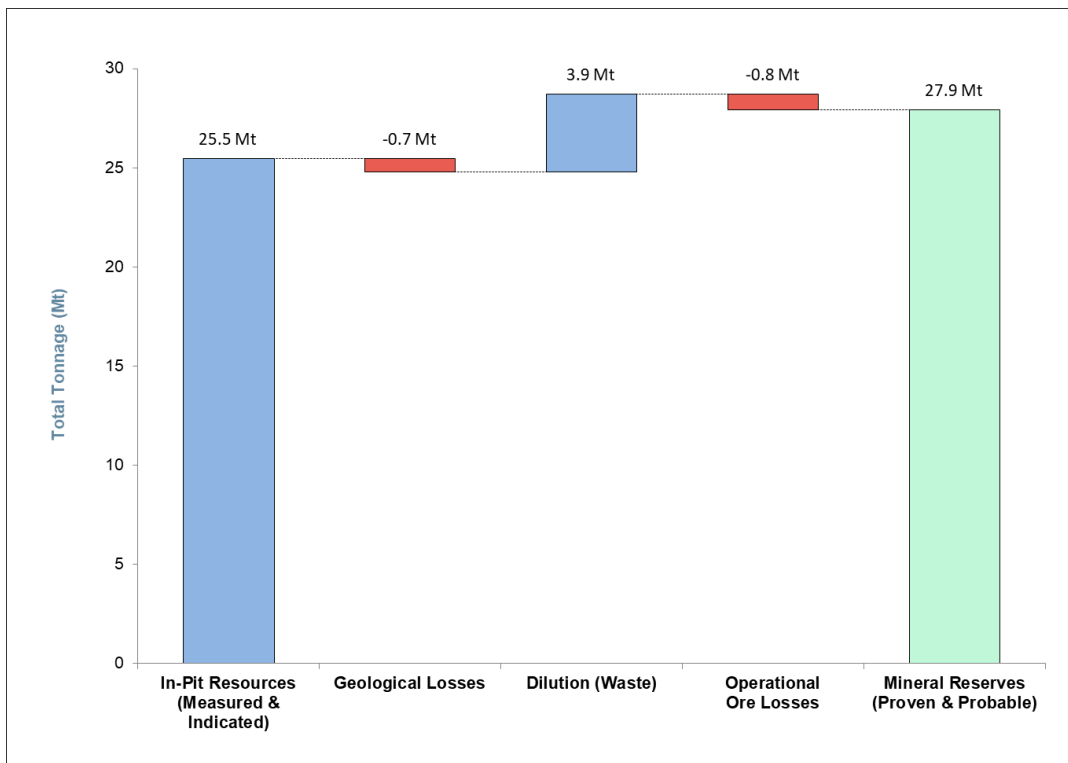
Based on BBA’s experience and following discussions with Nemaska, it was decided that a dilution skin of 0.75 m is more representative of what would be expected using a Komatsu PC1250 excavator with a 2.7 m wide bucket.

Mining dilution is a critical modifying factor when estimating Mineral Reserves since there is an added cost associated with the processing of the waste dilution material. In addition to the increased cost, the waste rock may contain deleterious elements that can be harmful in the ore concentration process. There may also be deleterious elements in the waste rock that may affect the quality of the concentrate produced.

In order to counter this, the Nemaska process flowsheet includes optical ore sorters whose purpose is to remove the amphibole dilution prior to the dense media separation process. Section 17 of this Report presents the process flowsheet and discusses how the ore sorters have been sized based on the mining dilution that has been modeled.



**Figure 15.3 - Waterfall Chart – Conversion of Mineral Resources to Mineral Reserves**



Although the amount of mining dilution is primarily controlled by the geological context of the orebody, the mining operations will have a certain amount of influence in the amount of mining dilution that is sent to the ore sorters. In order to reduce the amount of mining dilution BBA recommends for the mining operations to put a heavy focus on ore grade control and blast optimization. It is also important to note that high dilution ore can be stockpiled and processed in future years.

Upon completion of the mining dilution and mining recovery modelling, the sub blocked model was converted into a regularized model that was used for the pit optimization analysis and mine planning. Each block in the regularized model includes the quantities of in-situ mineralized tonnes and grades as well as the tonnages of mining dilution and ore loss.

### 15.3 Pit Optimization Analysis

The purpose of the pit optimization analysis is to determine the ultimate pit limits that satisfy one or a range of business objectives. For Nemaska Lithium, the overall objective is to maximize the net present value (NPV) of the project. The pit optimization analysis was carried out on the diluted regularized block model described in Section 15.2.2. This ensured that the mining selectivity criteria were accounted for in determining the ultimate pit shape.

The pit optimization was done using the MS Economic Planner module of Hexagon's MineSight software. The optimizer uses the pseudoflow algorithm to determine the economic pit limits based on input of mining and processing costs, revenue per block and operational and technical parameters

such as the mill recovery, concentrate grade, pit slopes and other imposed constraints. The pseudoflow algorithm provides similar results as the Lerchs-Grossman algorithm with the benefit of shorter computing times.

Since this Project estimates Mineral Reserves, in order to comply with NI 43-101 guidelines regarding the Standards of Disclosure for Mineral Projects, only blocks classified in the Measured and Indicated categories are allowed to drive the pit optimizer. Inferred resource blocks are treated as waste, bearing no economic value

Table 15.9 presents the parameters that were used for the pit optimization analysis with all dollar amounts being expressed in Canadian Dollars. The selling price considered in the optimization is \$800/t CAD of Spodumene concentrate delivered to the hydrometallurgical plant in Shawinigan.

The cost and operating parameters that were used are preliminary estimates for developing the economic pit and should not be confused with the operating costs subsequently developed for the Report and presented in Section 21.

The pit optimization uses the activity based costing methodology that distinguishes fixed costs from variable costs. Fixed costs are time related with no direct production drivers while variable costs are directly related to a production driver in the system. The total fixed costs per year are then allocated to the system bottleneck, which for the Whabouchi deposit is the concentrator capacity of 215,000 tonnes of concentrate per year.

Using the cost and operating parameters, a series of 51 pit shells was generated by varying the selling price (revenue factor) from \$350/t to \$1,000/t. Figure 15.4 shows a typical section through the deposit with several of the pit shells.

The tonnages and grades associated with each of the pit shells are presented in Table 15.10. The line highlighted in green is the selected pit shell and the line highlighted in brown is the revenue factor 1.0 pit shell. The Net Present Value (NPV) of each shell was calculated assuming a selling price of \$800/t CAD of concentrate, a discount rate of 8% and an annual production of 215,000 tonnes of concentrate.

Figures 15.5 and 15.6 present the results in a graphical format. It is important to note that the NPV's do not consider initial capital costs and should only be used for a relative comparison of the different pit shells.

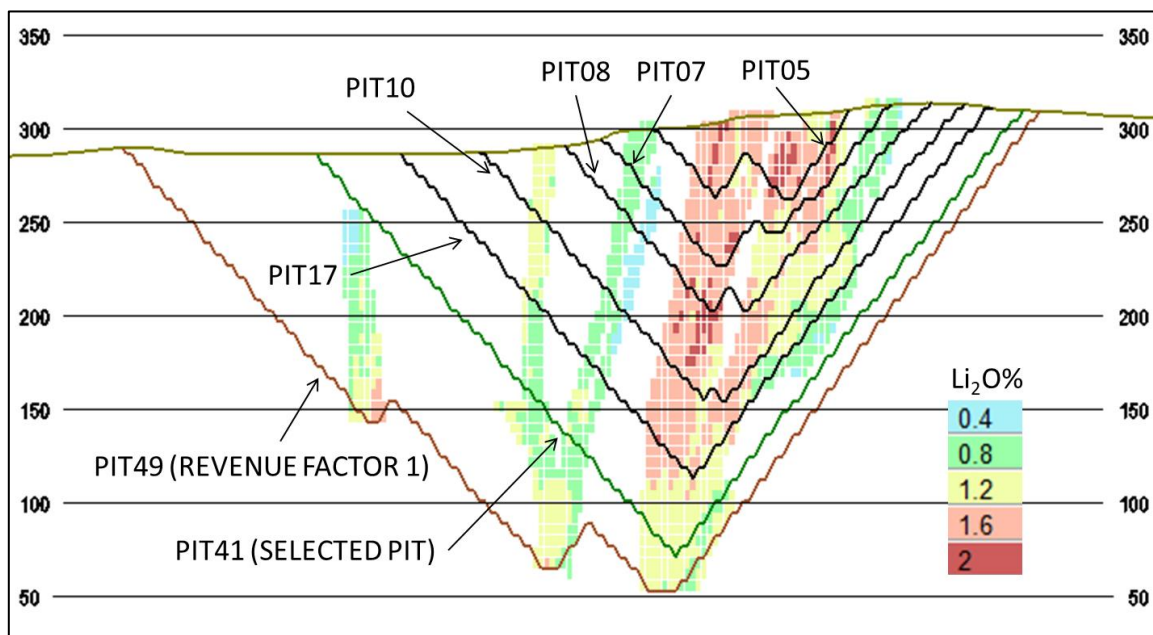
The pit shell that was selected to be used as a guide for the open pit design was the PIT41 which was run at a revenue factor of 0.675. This pit shell includes 30.1 Mt of ore at a stripping ratio of 2.3 to 1. PIT41 achieves 99.8% of the maximum NPV (PIT43), at a lower stripping ratio.

**Table 15.9 - Optimization Parameters**

Description	Units	Value
<b>Operating Costs - Variable</b>		
Mining Cost - Overburden	\$/t	1.92
Mining Cost – Ore <sup>1</sup>	\$/t	4.76
Mining Cost – Waste <sup>1</sup>	\$/t	3.39
Processing Costs	\$/t	16.31
Transportation Costs	\$/t conc.	50.00
NSR Royalty	\$/t conc.	6.90
<b>Operating Costs - Fixed</b>		
Mining Cost	\$/y	9,901,763
Processing Cost	\$/y	3,571,515
General & Administration	\$/y	15,434,279
Sustaining Capital	\$/y	17,201,760
<b>Total Fixed Cost</b>	<b>\$/y</b>	<b>46,109,318</b>
Bottleneck (Concentrate Production)	t/y	215,000
<b>Bottleneck Cost</b>	<b>\$/t conc.</b>	<b>214.46</b>
Spodumene Concentrate Price	\$/t conc.	800
Mill Recovery	%	85.2
Concentrate Grade	%	6.25
Discount Rate	%	8%
Overall Pit Slope - North Wall	deg	56
Overall Pit Slope - South Wall <sup>2</sup>	deg	48
<ol style="list-style-type: none"> <li>1. The mining cost for ore and waste was increased by \$0.015/t for each 6 m increment in pit depth. The unit rates presented in the table refer to those at a base elevation of 284 m.</li> <li>2. The shallower pit slope used for the South wall considers the eventual addition of the pit access ramp.</li> </ol>		

Upon completion of the Report, BBA confirmed that the pit optimization exercise was still valid using the updated cost estimate developed in the Report.

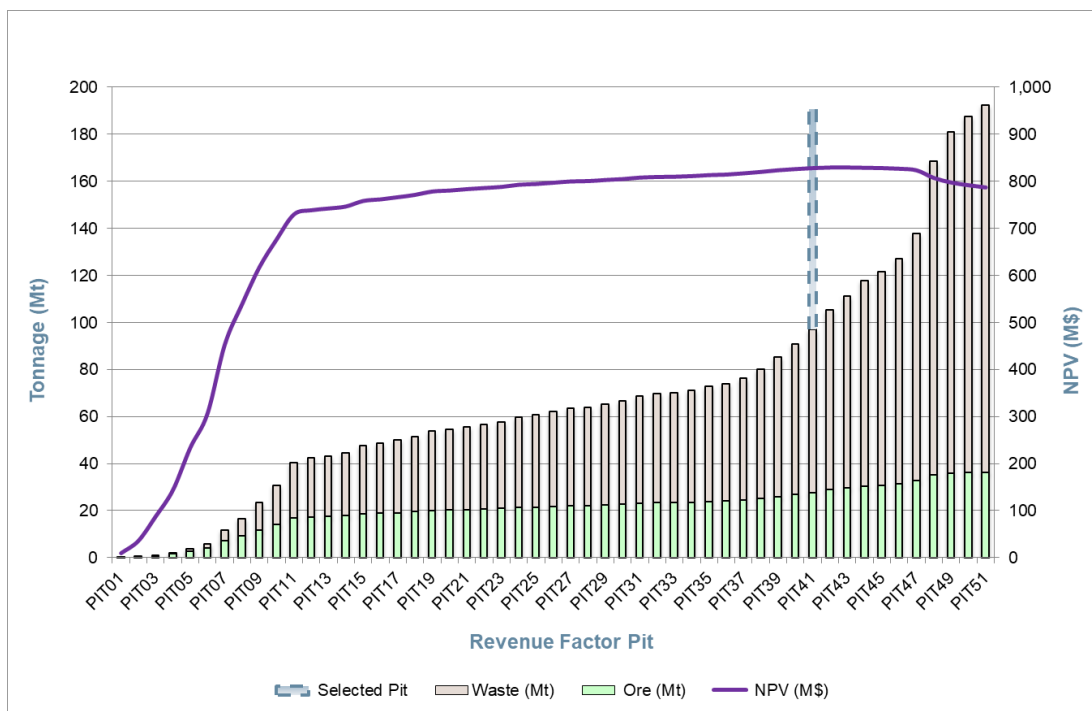
**Figure 15.4 - Pit Optimization Results (Typical Section)**



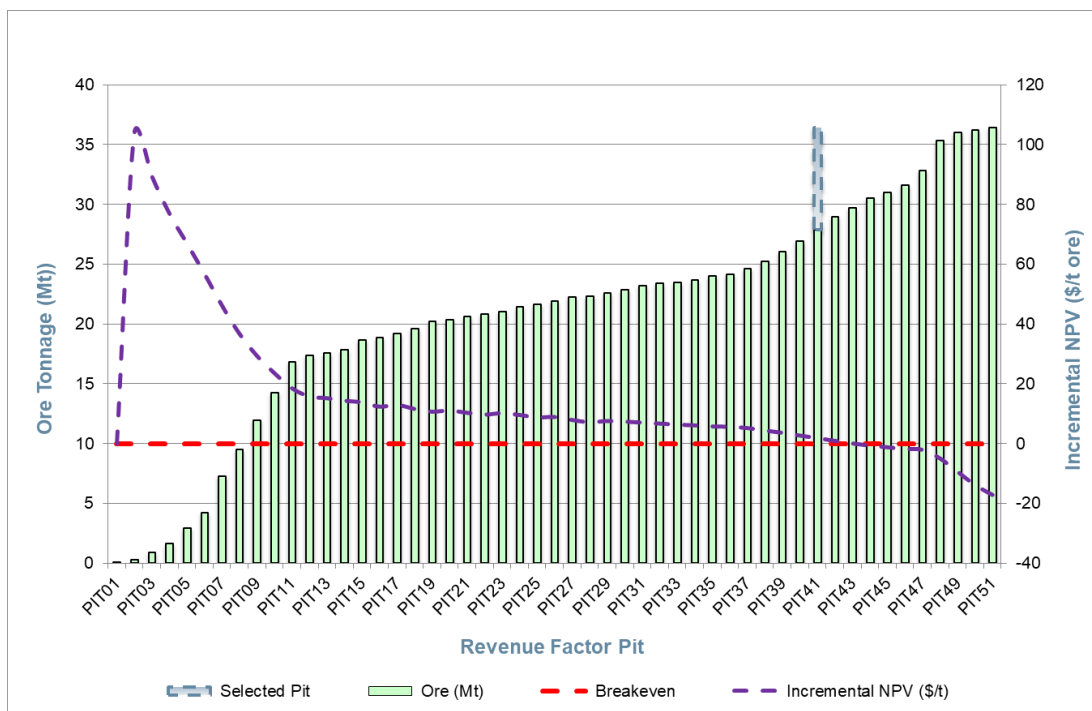
**Table 15.10 - Pit Optimization Results**

Pit Shell	Revenue Factor	ROM Feed (Mt)	Li <sub>2</sub> O (%)	Waste (Mt)	Strip Ratio	Incr. Strip Ratio	Mine Life (y)	NPV (M\$)	Incr. NPV (\$/t Ore)
PIT01	0.438	0.1	2.11	0.0	0.07	0.00	0.1	9.5	0.0
PIT02	0.450	0.3	1.92	0.0	0.09	0.10	0.4	35.6	103.8
PIT03	0.463	0.9	1.79	0.1	0.14	0.16	1.0	87.5	89.4
PIT04	0.475	1.6	1.70	0.3	0.19	0.26	1.7	143.8	77.0
PIT05	0.488	3.0	1.61	0.9	0.30	0.43	2.9	233.4	67.0
PIT06	0.500	4.3	1.56	1.7	0.39	0.61	4.1	306.5	56.9
PIT07	0.513	7.4	1.49	4.4	0.59	0.86	6.8	453.1	46.2
PIT08	0.525	9.8	1.46	7.2	0.74	1.21	8.8	538.8	36.8
PIT09	0.538	12.4	1.44	11.5	0.93	1.61	11.0	617.4	29.4
PIT10	0.550	15.0	1.42	16.6	1.11	2.02	13.0	676.7	23.6
PIT11	0.563	17.8	1.40	23.5	1.32	2.40	15.3	729.7	18.5
PIT12	0.565	18.4	1.40	25.1	1.36	2.77	15.8	738.5	15.8
PIT13	0.568	18.6	1.40	25.8	1.38	2.95	16.0	742.2	15.2
PIT14	0.570	18.9	1.40	26.6	1.41	2.78	16.2	746.5	14.4
PIT15	0.573	19.8	1.39	29.1	1.47	2.96	16.9	758.2	13.8
PIT16	0.575	20.0	1.39	29.7	1.48	2.24	17.1	761.6	12.4
PIT17	0.578	20.4	1.39	30.9	1.51	3.27	17.4	766.2	13.0
PIT18	0.580	20.8	1.39	32.0	1.54	2.66	17.7	771.2	11.6
PIT19	0.583	21.5	1.38	33.7	1.57	2.50	18.2	778.3	10.7
PIT20	0.585	21.7	1.38	34.3	1.58	3.23	18.3	780.4	11.1
PIT21	0.588	22.0	1.38	35.2	1.60	2.95	18.5	783.4	10.3
PIT22	0.590	22.2	1.38	35.8	1.61	2.85	18.7	785.7	9.7
PIT23	0.593	22.5	1.38	36.7	1.64	3.70	18.9	788.2	10.2
PIT24	0.595	22.9	1.37	38.4	1.68	3.64	19.2	792.6	9.6
PIT25	0.598	23.1	1.37	39.1	1.69	3.35	19.4	794.3	8.8
PIT26	0.600	23.4	1.37	40.2	1.72	3.92	19.6	797.0	8.9
PIT27	0.603	23.8	1.37	41.4	1.74	3.26	19.9	799.7	7.9
PIT28	0.605	23.9	1.37	41.6	1.75	2.66	19.9	800.5	7.2
PIT29	0.608	24.2	1.37	42.7	1.77	3.59	20.2	802.8	7.6
PIT30	0.610	24.4	1.36	43.8	1.79	3.90	20.4	804.7	7.4
PIT31	0.613	24.9	1.36	45.5	1.83	3.91	20.7	807.9	7.1
PIT32	0.615	25.1	1.36	46.3	1.85	4.03	20.9	809.2	6.7
PIT33	0.618	25.2	1.36	46.6	1.85	4.00	20.9	809.8	6.4
PIT34	0.620	25.4	1.36	47.4	1.87	3.89	21.1	811.0	6.1
PIT35	0.623	25.7	1.36	48.9	1.90	3.93	21.3	813.2	5.8
PIT36	0.625	25.9	1.36	49.7	1.92	4.16	21.5	814.3	5.7
PIT37	0.631	26.4	1.35	51.9	1.96	4.29	21.8	816.9	5.2
PIT38	0.638	27.1	1.35	54.8	2.02	4.29	22.3	819.9	4.4
PIT39	0.650	28.1	1.34	59.2	2.11	4.50	23.0	823.5	3.6
PIT40	0.663	29.0	1.34	63.9	2.20	4.92	23.7	826.1	2.7
<b>PIT41</b>	<b>0.675</b>	<b>30.1</b>	<b>1.33</b>	<b>69.4</b>	<b>2.30</b>	<b>5.15</b>	<b>24.4</b>	<b>828.0</b>	<b>1.8</b>
PIT42	0.688	31.4	1.32	76.4	2.43	5.27	25.3	829.3	0.9
PIT43	0.700	32.3	1.32	81.5	2.52	5.71	25.9	829.3	0.1
PIT44	0.713	33.3	1.31	87.3	2.62	6.16	26.6	828.7	-0.7
PIT45	0.725	33.8	1.31	90.7	2.68	5.96	27.0	828.0	-1.2
PIT46	0.738	34.6	1.30	95.6	2.76	6.30	27.5	826.7	-1.8
PIT47	0.750	36.3	1.29	105.0	2.90	5.78	28.5	823.3	-2.1
PIT48	0.875	39.5	1.27	133.3	3.37	8.62	30.6	807.2	-4.9
<b>PIT49</b>	<b>1.000</b>	<b>40.6</b>	<b>1.27</b>	<b>145.2</b>	<b>3.58</b>	<b>11.50</b>	<b>31.2</b>	<b>797.4</b>	<b>-9.4</b>
PIT50	1.125	41.0	1.26	151.4	3.69	14.86	31.5	791.7	-13.8
PIT51	1.250	41.3	1.26	156.0	3.78	16.58	31.7	787.0	-17.1

**Figure 15.5 - Pit Optimization Results (NPV)**



**Figure 15.6 - Pit Optimization Results (Incremental NPV)**





### 15.3.1 OPEN PIT DESIGN

Using the results of the pit optimization analysis, BBA designed an operational pit that forms the basis of the life of mine production plan. This pit design uses the selected pit shell as a guide and includes smoothing the pit wall, adding ramps to access the pit bottom and ensuring that the pit can be mined safely and efficiently. The following section provides the parameters that were used for the open pit design and presents the results.

#### 15.3.1.1 Geotechnical Pit Slope Parameters

The geotechnical pit slope parameters were provided by Journeaux Assoc. in a report titled “*Open Pit Slope Confirmation Study Whabouchi Lithium Mine, February 27, 2019*”. This report was an update to the previous pit slope analysis study that was completed in 2012 and is based primarily on the addition of six (6) oriented boreholes that were drilled in 2018.

For the final pit walls, assuming the use of preshear blasting, the report recommends a maximum inter ramp angle of 54 degrees on the North Wall and 60 degrees on the South Wall. Table 15.11 presents the pit wall configuration that is proposed to achieve the inter ramp angles as well as the overall pit slope that is expected to result from the open pit design.

**Table 15.11 - Pit Slope Recommendations**

Description	Bench Height (m)	Bench Face Angle (°)	Inter-Ramp Angle (°)	Catch Bench Width (m)	Overall Pit Slope (°)
North Wall	20	75	54	9.0	56
South Wall	24	80	60	9.5	59

Following an evaluation of the equipment fleet proposed for the Whabouchi Project it was determined that 12 m bench heights mined in 6 m high flitches would provide the optimum balance between productivity and minimizing mining dilution. The flitch height may be adjusted as the operation evolves and depending on the nature of the specific mineralization.

BBA, therefore, adapted the pit slope configuration of the North wall to include stacking two (2), 12 m high benches while respecting the inter ramp angle and overall pit slope recommended in the geotechnical report. The modified configuration which is presented in Table 15.12 results in a catch bench width of 10.8 m. In order to keep the catch bench width constant around the entire pit, BBA also adjusted the inter ramp angle of the South wall to 58 degrees.

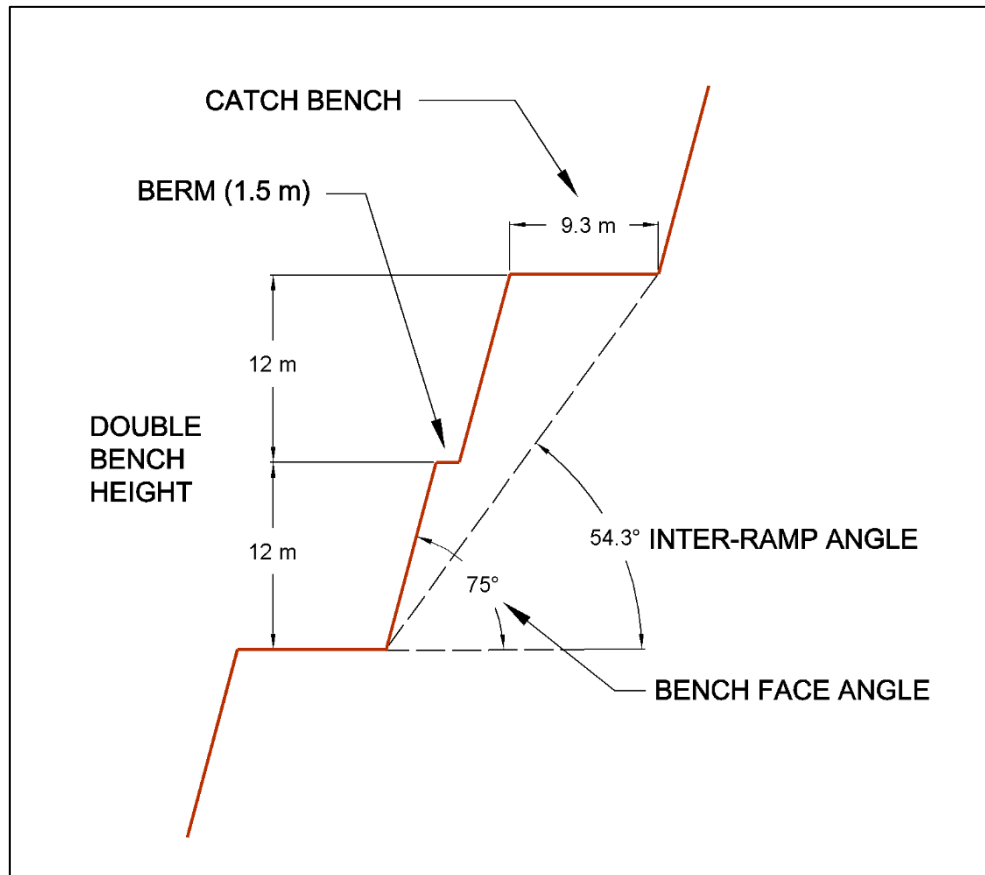
Figure 15.7 presents the pit wall configuration which identifies that the pit wall will incorporate the stacking of two (2), 12 m high benches. In order to achieve this bench stacking, a 1.5 m wide berm is required between the benches to allow the safe drilling of the final row of blastholes.

An overall slope of 26.5 degrees (2H:1V) was used in the overburden.

**Table 15.12 - Pit Wall Configuration**

Description	Bench Height (m)	Bench Face Angle (°)	Inter-Ramp Angle (°)	Catch Bench Width (m)
North Wall	24	75	54.3	10.8
South Wall	24	80	58.0	10.8

**Figure 15.7 - Pit Wall Configuration**

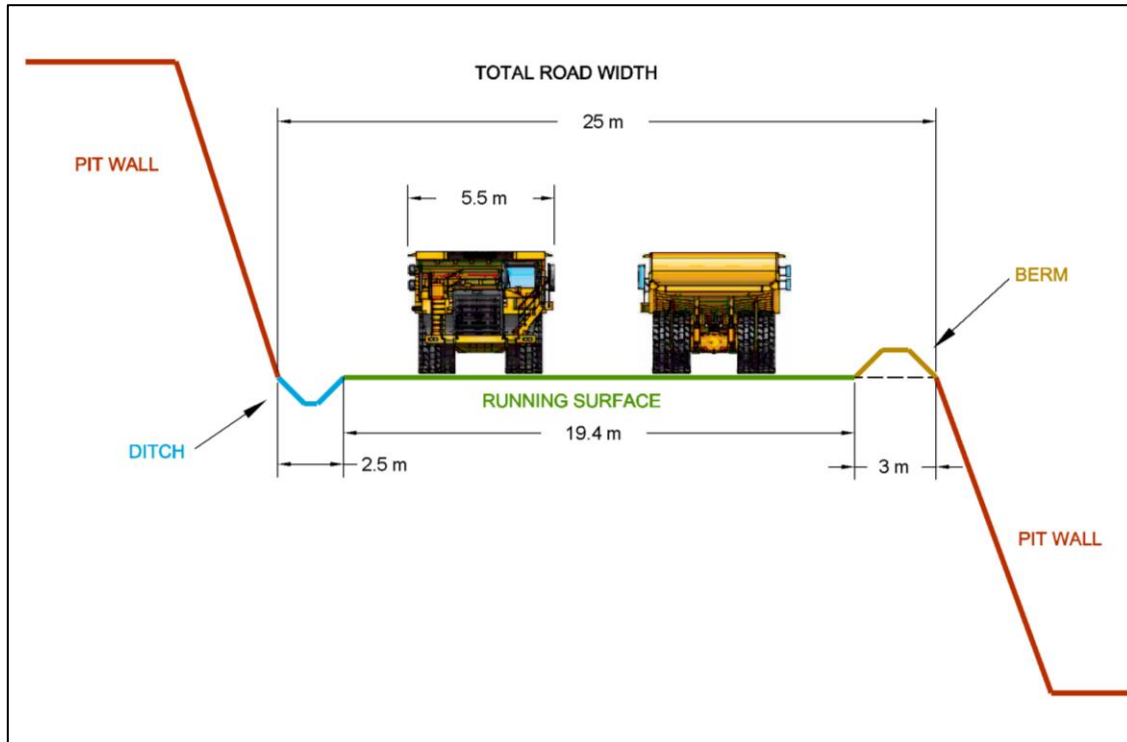


#### 15.3.1.2 Haul Road Design

The ramps and haul roads were designed with an overall width of 25 m. For double lane traffic, industry practice indicates the running surface width to be a minimum of 3½ times the width of the largest truck. The overall width of a 64-tonne rigid frame haul truck is 5.5 m which results in a running surface of 19.4 m. The allowance for berms and ditches increases the overall haul road width to 25 m. The ramp width was reduced to a width of 18 m for single lane traffic for the final four (4), 12 m benches.

A maximum ramp grade of 10% was used which is acceptable for a 64-tonne rigid frame haul truck. Figure 15.8 presents a typical section of the in-pit ramp design.

**Figure 15.8 - Ramp Design**



#### 15.3.1.3 Minimum Mining Width

A minimum mining width of 30 m was considered for the open pit design. The minimum mining width considers the nominal working widths required for a PC1250 backhoe and a HD605 haul truck plus additional margins for safety.

#### 15.3.1.4 Open Pit Design Results

The open pit that has been designed for the Whabouchi deposit is approximately 1,300 m long and 350 m wide at surface. The total surface area of the pit is roughly 42 ha. The pit ramp enters at the 296 m elevation on the east side of the pit and runs down the southern wall with a switchback at the 143 m elevation. From that point, the ramp becomes single-lane access at 18 m wide and heads towards the East along the South wall until the bottom of the pit which is at the 95 m elevation. The deepest part of the pit is 210 m below surface.

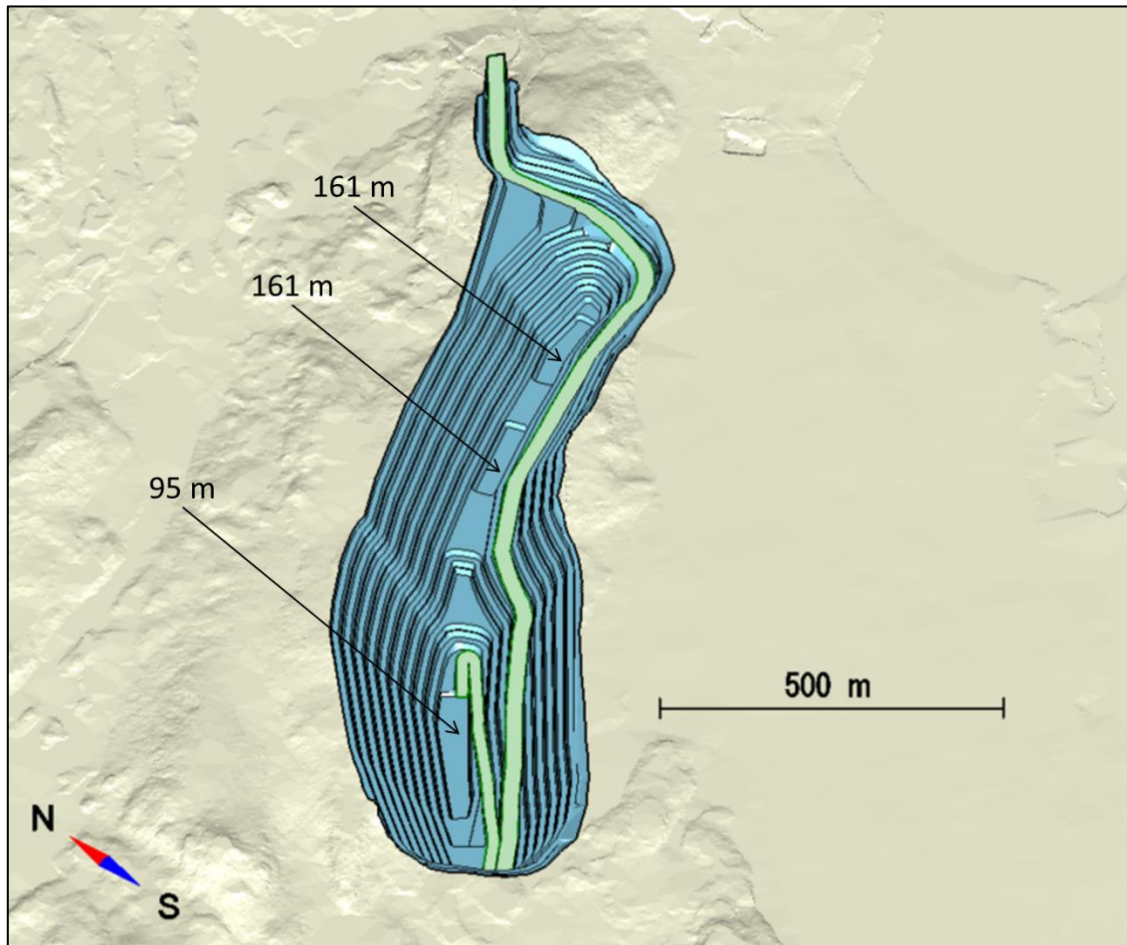
The open pit design attempts to avoid the wetlands that are located on the south side of the pit as much as possible while not losing a significant amount of resources that fall within the optimized pit shell.

The overburden thickness within the open pit ranges from 0 m to a maximum of 10 m and averages 2.7 m thick. The overburden is mostly present on the south side of the pit.

Accounting for mining dilution and loss, the open pit design for the Whabouchi deposit includes 18.3 Mt of Proven Mineral Reserves at an average grade of 1.41%  $\text{Li}_2\text{O}$  and 9.6 Mt of Probable Mineral Reserves at an average grade of 1.18%  $\text{Li}_2\text{O}$  for a total Proven and Probable Mineral Reserves of 27.9 Mt at an average grade of 1.33%  $\text{Li}_2\text{O}$ . In order to access these Mineral Reserves, 1.3 Mt of overburden and 75.2 Mt of waste rock must be mined, resulting in a stripping ratio of 2.7:1.

Figure 15.9 presents the open pit design.

**Figure 15.9 - Open Pit Design**



## 15.4 Underground Mineral Reserves

### 15.4.1 ECONOMIC, DESIGN, AND OPERATING PARAMETERS

The underground mine design is characterised by its access via a mine portal located at elevation - 167 m and a main ramp that connects to the seven (7) haulage drifts sub-levels located on the footwall side of the orebody.

The sub-levels are spaced every 30 m in elevation located at levels 185 m, 155 m, 125 m, 95 m, 65 m, 35 m, and 5 m. The stopes access drifts aligned perpendicularly from the haulage drift will be excavated at every 30 metres.

A slightly inclined ventilation raise provides the fresh air feed to the mine via a push type/air heater surface ventilation system. The exhaust air vertical raise conveys the air towards the exit point located on the footwall of the open pit at elevation 172.5 m.

The haulage drift located at elevation 95 m will host the main utility rooms such as the HME maintenance and fueling rooms, the safety/lunch, the explosive product and detonator rooms, the MCC and the sump rooms. A second sump room will be located on a lower elevation haulage drift (Level 2 m). Safety bays, located at every 30 m of haulage ways (haulage drifts and main ramp), will enable the crossing of the vehicles in the single lane hallways (5 m width). Figure 15.10 to Figure 15.12 illustrate the three-dimensional and the longitudinal section of the underground mine design respectively.

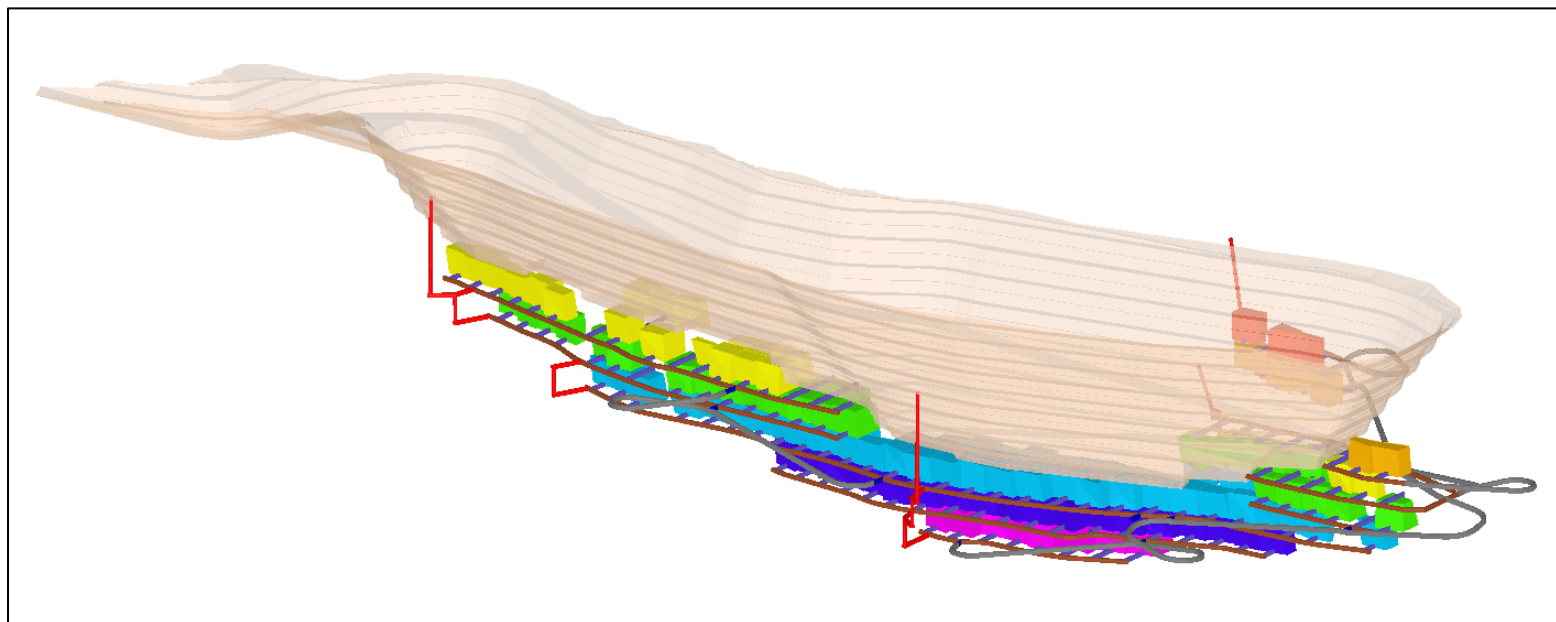
### 15.4.2 CUT-OFF GRADE

Using the economic parameters that were presented in Table 15.7, as well as an underground mining cost of \$23.69 /tonne, which was estimated at the start of the study, the underground cut-off grade was calculated to be 0.60% Li<sub>2</sub>O. The cut-off grade is used to determine at what point material being mined will generate a profit after paying for the mining, processing, transportation and G&A costs.

### 15.4.3 MINE DILUTION AND ORE LOSS

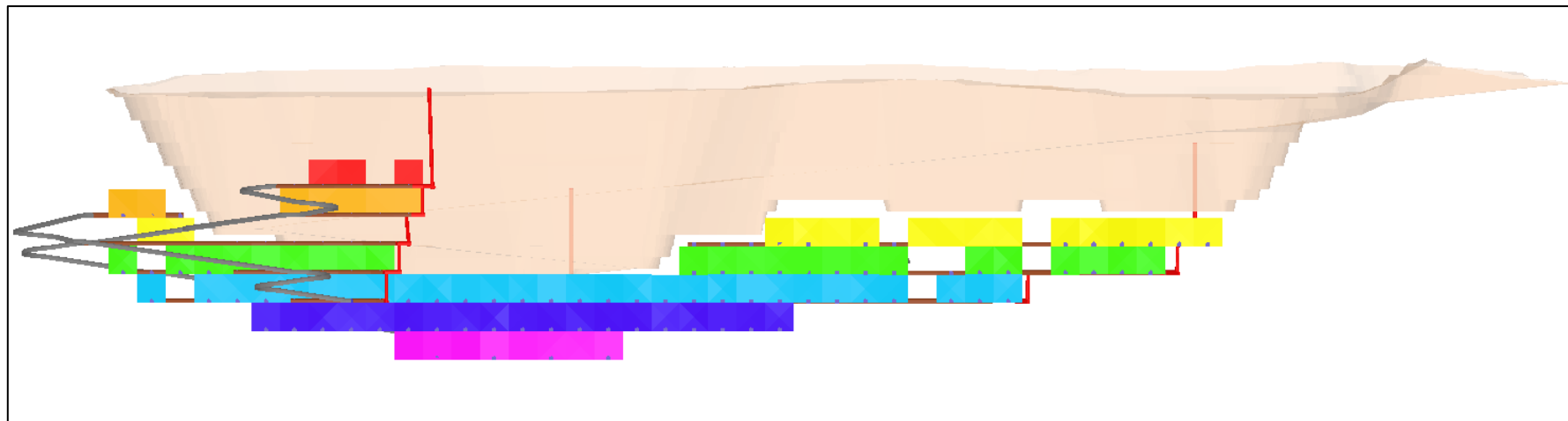
The inherent nature of the underground operation and the known level of precision of the drilling and the blasting is such that the ore will be diluted with some of the host rock along the edges of the mineralization zone. The ore dilution factor estimation was calculated by extending the width dimension of the stope by 0.5 m outside of the mineralized envelope on each side of the stope. This results in an average additional volume of 10% of material having a grade of 0.60% Li<sub>2</sub>O diluting the ore. Figure 15.13 illustrates an example of the extended width dimension of the stope outside of the mineralized envelope for the dilution factor calculation.

**Figure 15.10 –Three-Dimensional View of the Underground Mine Design**

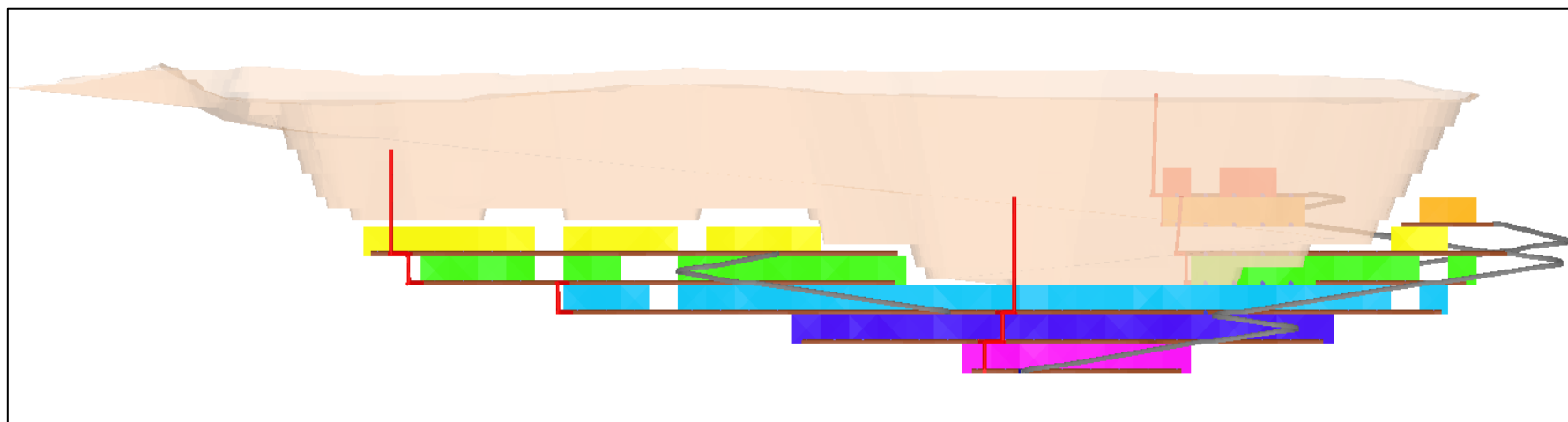




**Figure 15.11 –Longitudinal View (Looking North)**



**Figure 15.12 –Longitudinal View (Looking South)**

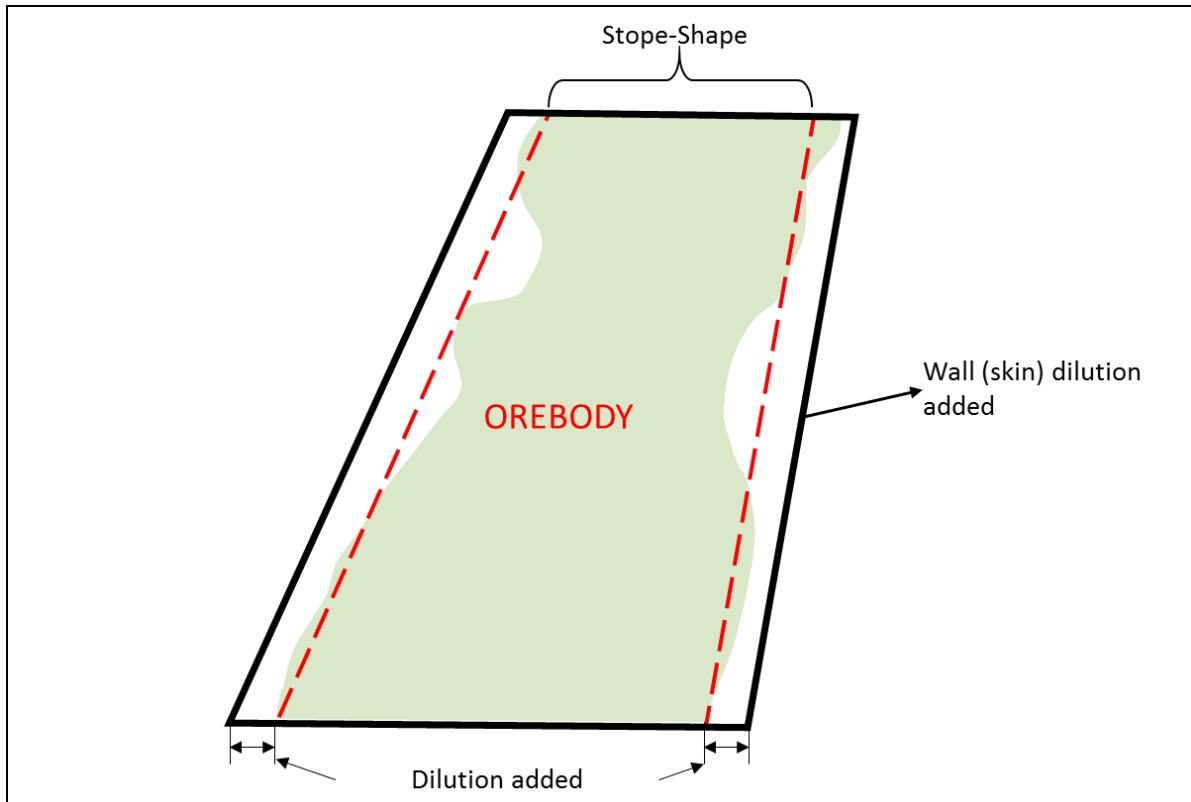


#### 15.4.4 MINEABLE SHAPE OPTIMIZER.

Based on economical and geometrical parameters presented in Table 15.13, the next step in the underground mineral reserve estimation process is to produce mineable stope shapes and stope inventory that maximize recovered resources above the cut-off grade. The minable shape optimizer follows the key geometry parameters illustrated in Figure 15.14.

The Mineable Stope Shape Optimizer was done using the MSO module of Datamine® Mining software. The MSO uses an algorithm to provide the optimal stope shape design to maximize the value of an orebody. In order to comply with NI 43-101 guidelines regarding the Standards of Disclosure for Mineral Projects, only blocks classified in the Measured and Indicated categories are allowed to drive the stope shape optimizer. Inferred resource blocks are treated as waste, bearing no economic value.

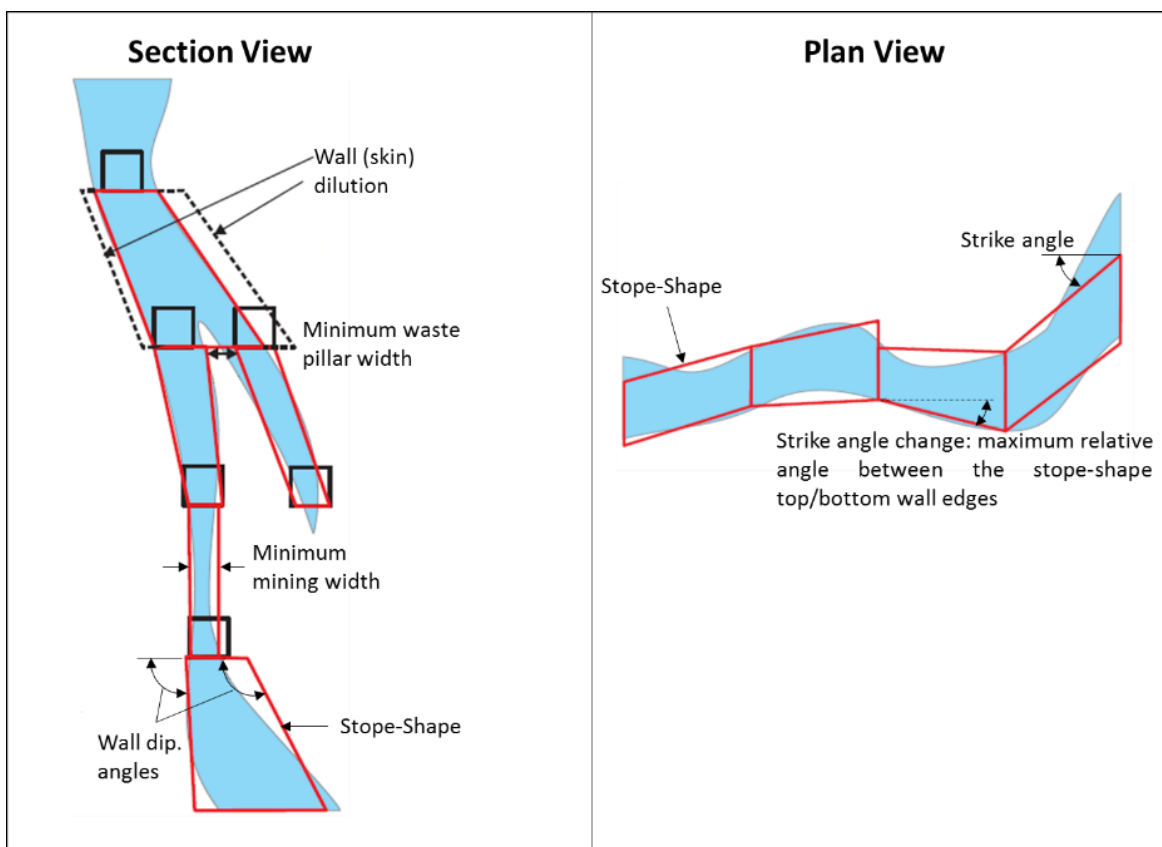
**Figure 15.13 – Stope Dilution Orientation**



**Table 15.13 – Mineable Shape Optimizer Parameters**

Item	Unit	Value
Cut-off Grade	%Li <sub>2</sub> O	0.60
Minimum Stope Thickness (mining width)	m	3.00
Footwall Dilution	m	0.50
Hanging Wall Dilution	m	0.50
Level Spacing	m	30.0
Stope Width Along Strike	m	30.0

**Figure 15.14 – Key Geometry Parameters**



#### 15.4.5 UNDERGROUND MINERAL RESERVES ESTIMATE

A total of 0.7 Mt of Proven Mineral and 8.0 Mt of Probable Mineral within 157 stopes with an average width of 45 m are the result of the stope-shape optimizer, with a Li<sub>2</sub>O average of 1.21%. Table 15.14 presents the underground tonnage Proven and Probable Mineral Reserves for the Whabouchi deposit above a cut-off grade of Li<sub>2</sub>O ≥ 0.60%.

**Table 15.14 - Whabouchi Underground Mineral Reserves**

Category	Tonnes (Mt)	Li <sub>2</sub> O Grade (%)
Proven	0.7	1.42
Probable	8.0	1.20
<b>Proven and Probable</b>	<b>8.7</b>	<b>1.21</b>

## 16 MINING METHODS

### 16.1 Open Pit Mining

#### 16.1.1 OPEN PIT MINING METHOD

The mining method selected for the Project is a conventional open pit, truck and shovel, drill and blast operation. Vegetation, topsoil and overburden will be stripped and stockpiled for future reclamation use. The ore and waste rock will be drilled and blasted with 12 m high benches and loaded into haul trucks using mining backhoes and 6 m flitches.

#### 16.1.2 GEOTECHNICAL PIT SLOPE PARAMETERS

The geotechnical pit slope parameters were presented in Section 15.3.

#### 16.1.3 HYDROGEOLOGY AND HYDROLOGY PARAMETERS

The following section presents the hydrogeology and hydrology parameters for the Whabouchi Project. It is important to note that the calculations for the mine dewatering requirements were not updated for this Technical Report. This was considered acceptable since the surface area and depth of the open pit have not significantly changed since the Feasibility Study with the effective date of November 7, 2017.

The four (4) sources of water that affect the mining operation are surface run-off, rainfall, snowmelt and groundwater. The quantity for each of these sources of water was estimated for each period of the mine plan in order to calculate the mine dewatering requirements:

##### 16.1.3.1 *Surface Run-off*

In order to limit the surface run-off from entering the pit, a berm will be established around the limits of the pit to capture the surface water before it enters into the mining area. Water collected in the ditch system will be directed to the sedimentation pond that is located on the west side of the pit, where it will be treated and sampled prior to discharge into the environment. Perimeter ditches will also be established around the co-disposal/waste piles and overburden stockpile to capture water run-off.

##### 16.1.3.2 *Rainfall and Snowmelt*

The amount of rainfall and snowmelt was estimated using historical meteorological data that was presented in Nemaska's report titled "*Étude des impacts sur l'environnement et le milieu social, mars 2013*". Using this data, it has been estimated that an average of 772 mm of precipitation can be expected each year. Evaporation was estimated to account for the removal of 335 mm of this water per year.

Using the surface area of the open pit for each period of the mine plan, it has been estimated that the amount of precipitation that is expected to be collected in the open pit will range from 92 m<sup>3</sup>/d at the start of the operation to a maximum of 285 m<sup>3</sup>/d in later years. These figures are averages and

do not represent years of extreme precipitation. The mine may have to shut down temporarily during periods of extreme rainfall.

#### 16.1.3.3 Groundwater

DRA/Met-Chem prepared a conceptual hydrogeological model in order to estimate the quantity of groundwater that is expected to infiltrate into the open pit. The data that was used for this model was obtained from the report prepared by Wesa Envir-Eau, titled "*Étude Hydrogéologique Projet Whabouchi, February 2012*". The report presented the results from the 2011 hydrogeological field investigations which included pumping tests and the installations of piezometers.

DRA/Met-Chem estimated the hydraulic conductivity for the Whabouchi deposit to be  $6.2 \times 10^{-7}$  m/s. Using the equation for Darcy's Flow and the surface area of the exposed pit wall for each period of the mine plan, DRA/Met-Chem estimated that the amount of groundwater that is expected to be collected in the open pit will range from 108 m<sup>3</sup>/d at the start of the operation to a maximum of 1,591 m<sup>3</sup>/d in later years.

Therefore, the total amount of water that will be required to be evacuated out of the open pit is expected to range from 200 m<sup>3</sup>/d at the start of the operation to 1,877 m<sup>3</sup>/d. This amount of water will be collected in a sump that will be established on the lowest point of the pit floor. The water will be pumped from the sump to the surface and directed to the sedimentation basin.

The pump that was selected for the mine dewatering is a diesel powered motor. Based on the flow rate, pumping distance and head, 4 to 6 pumps will be required for this operation. The cost to purchase and operate the pumps as well as piping and other accessories was included in the mine capital and operating cost estimate presented in Section 21.

#### 16.1.4 PHASE DESIGNS

Phases, also referred to as pushbacks, have been designed to access ore quicker and to defer waste stripping. The phase design process was guided by the smaller revenue factor pit shells from the open pit optimization analysis as a guide. A minimum working width of 40 m between phases was considered acceptable based on the size of the mining equipment and the proposed scale of mining operations. The phase designs use the same pit wall configurations that were presented in Section 15.3.

A total of four (4) phases were designed for the LOM as well as a small starter pit that will be mined during pre-production in order to access waste rock for road and infrastructure construction. This starter pit is located on the East side of the open pit and contains approximately 400,000 tonnes of waste rock.

Phase 1 runs the length of the open pit and its width ranges from 50 to 100 m. The lowest elevation of Phase 1 is 257 m where it reaches a depth of 60 m from surface. Phase 1 includes 3.5 Mt of ore at a stripping ratio of 1.2 to 1. The only final pit wall developed during Phase 1 is at the far west end of the pit.



Phase 2 establishes the north wall of the final pit limits and reaches an elevation of 209 m. The phase is accessed via a temporary ramp that follows the south wall. Phase 2 includes 6.3 Mt of ore at a stripping ratio of 2.8 to 1.

Phase 3 continues to establish the north wall of the final pit limits and reaches an elevation of 149 m. The phase is accessed via a new temporary ramp that follows the south wall. Phase 3 includes 7.0 Mt of ore at a stripping ratio of 2.5 to 1.

Phase 4 establishes the final pit ramp and walls and includes 11 Mt of ore at a stripping ratio of 3.2 to 1.

Table 16.1 presents the Mineral Reserves for each phase. Figure 16.1 presents a typical section showing the phases. The figure includes the Measured and Indicated Resources above the cut-off grade of 0.4% Li<sub>2</sub>O. Figure 16.2, Figure 16.3, Figure 16.4, and Figure 16.5 show the designs for Phase 1, Phase 2, Phase 3, and Phase 4 respectively.

**Table 16.1 – Mineral Reserves by Phase**

Phase	Ore		Waste & OB	Strip Ratio
	Tonnes (Mt)	Li <sub>2</sub> O (%)	Tonnes (Mt)	
Phase 1	3.5	1.45	4.1	1.2
Phase 2	6.3	1.29	17.9	2.8
Phase 3	7.0	1.36	17.8	2.5
Phase 4	11.0	1.30	35.4	3.2
<b>Total</b>	<b>27.9</b>	<b>1.33</b>	<b>75.2</b>	<b>2.7</b>

#### 16.1.5 OVERBURDEN STOCKPILE

The overburden stripped from the open pit will be placed in the overburden stockpile and used for future closure and reclamation activities. The overburden stockpile is located to the east of the open pit and south of the concentrator facilities.

#### 16.1.6 WASTE ROCK AND TAILINGS CO-DISPOSAL

The waste rock excavated from the open pit will be hauled to and placed with the tailings in the co-disposal storage facilities. Information about the co-disposal storage facilities is provided in Section 18.1.2 of the Report.

Figure 16.1 - Phase Design Typical Section

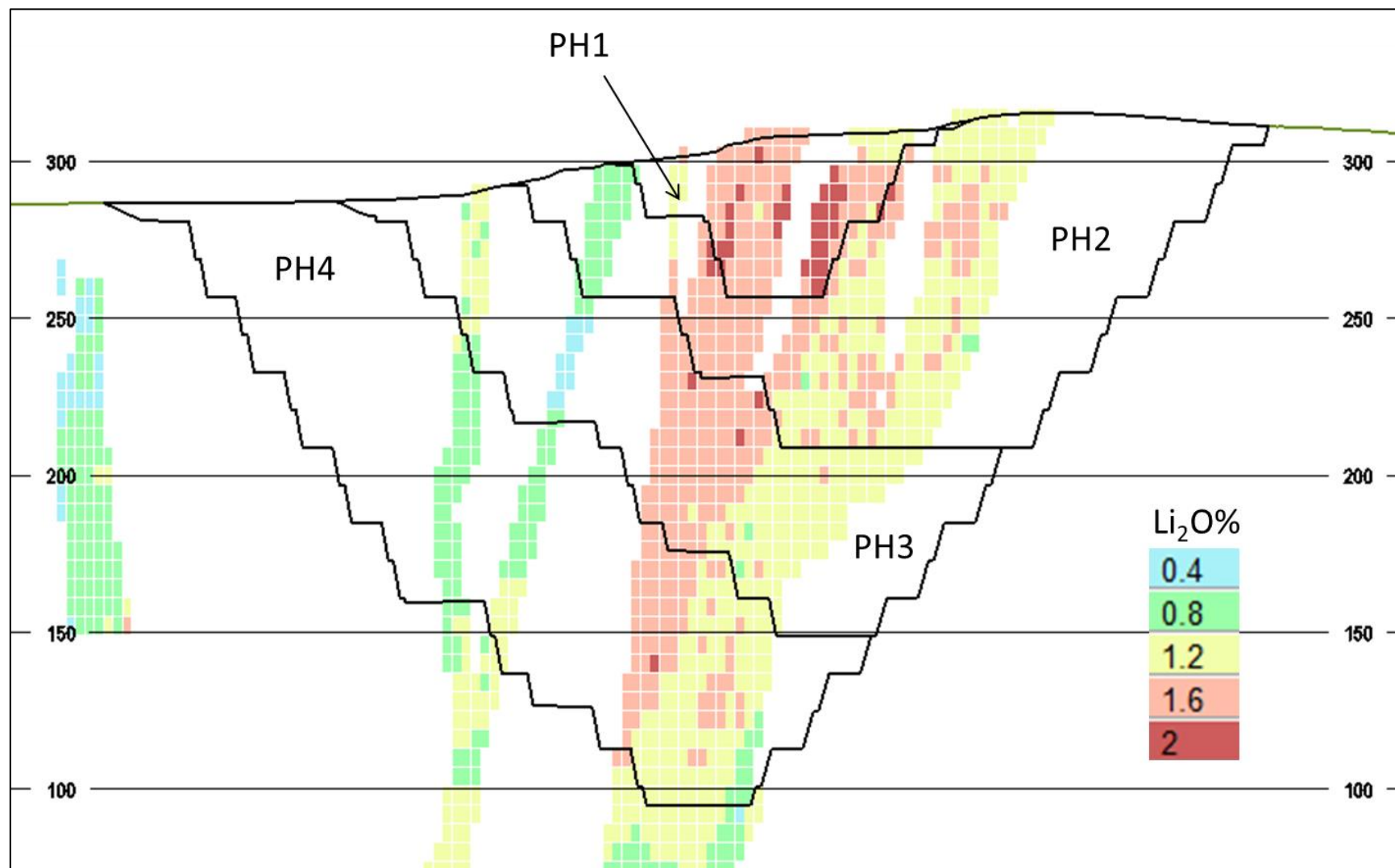


Figure 16.2 – Phase 1

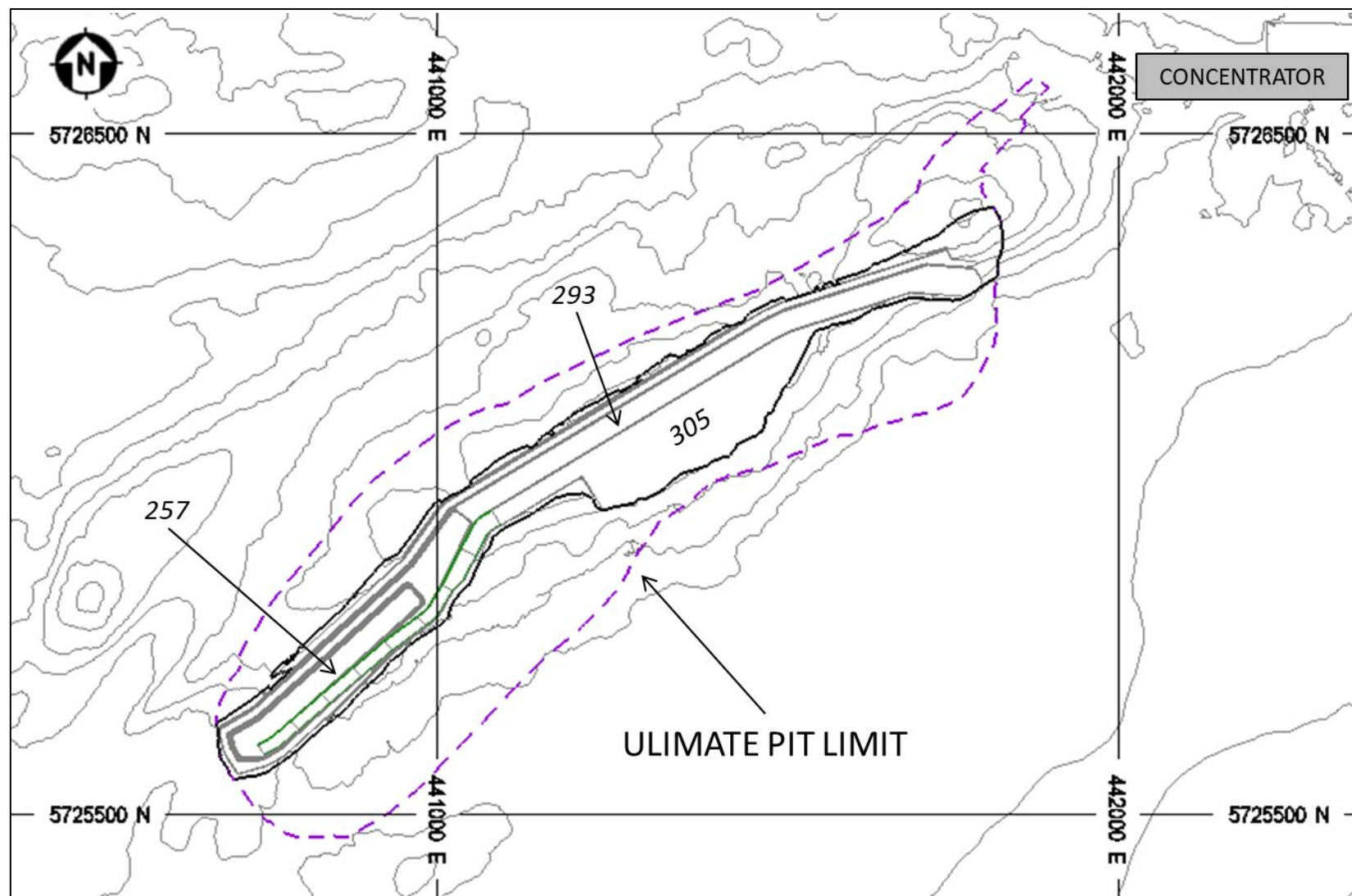


Figure 16.3 – Phase 2

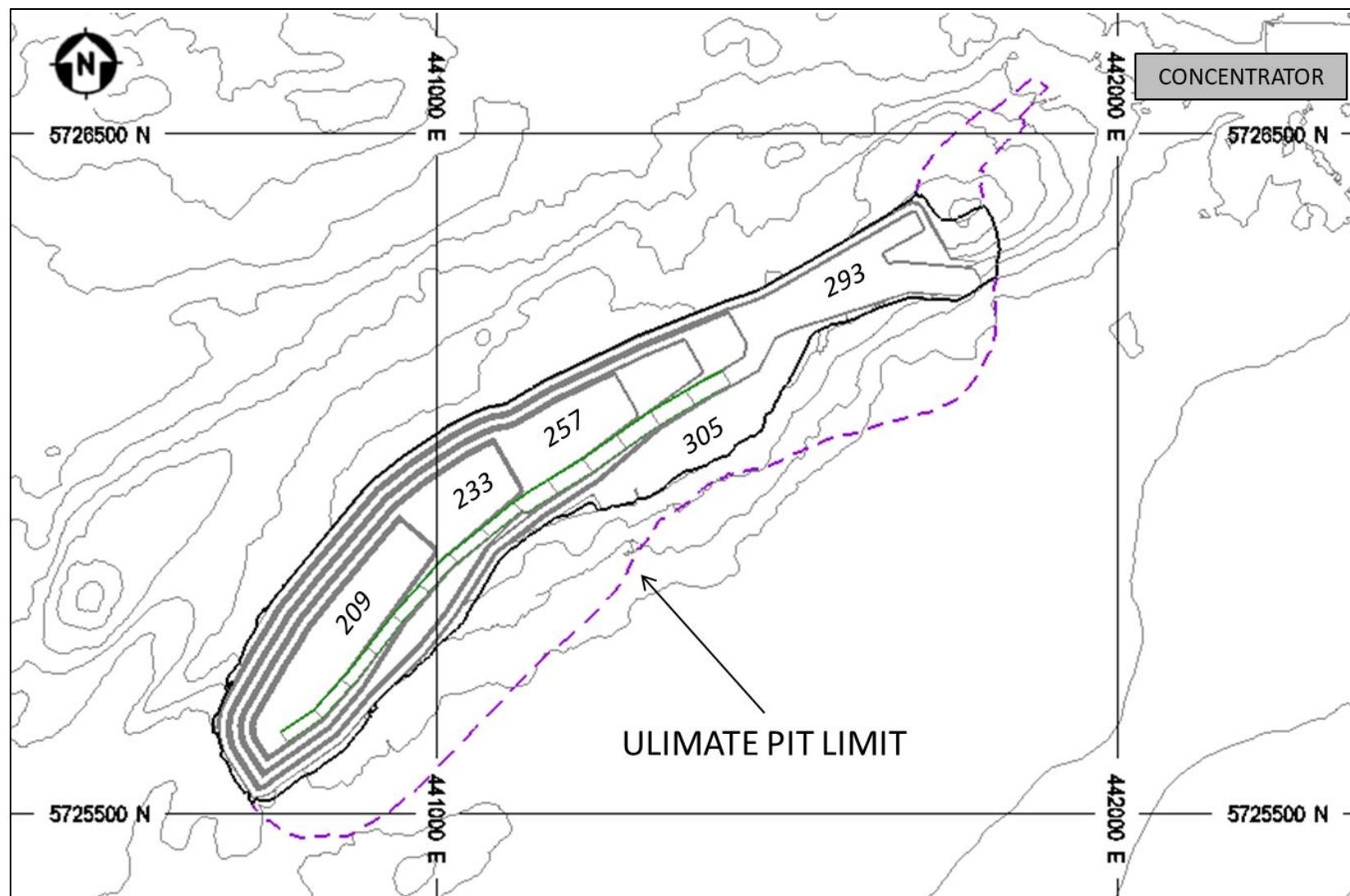




Figure 16.4 – Phase 3

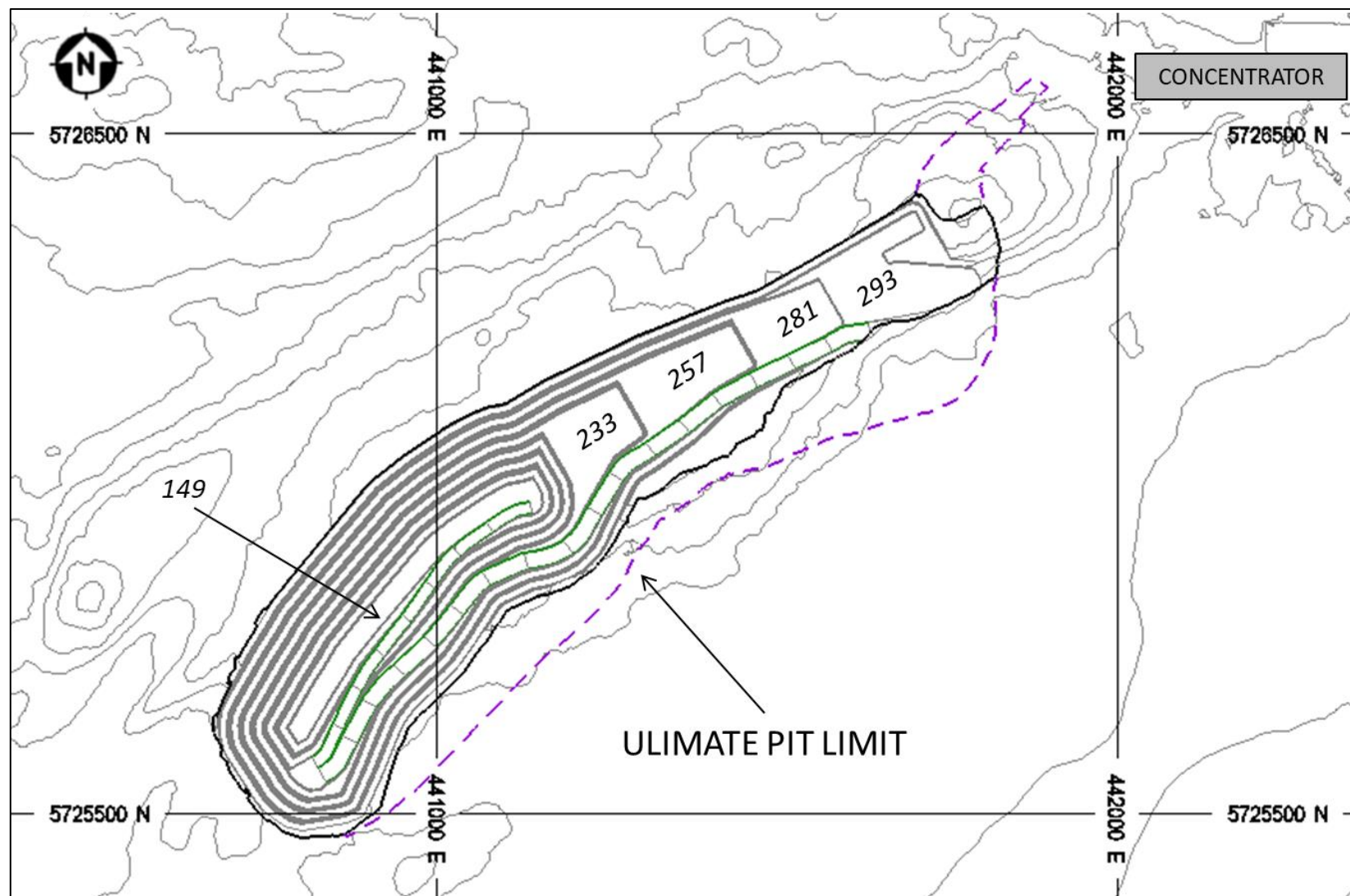
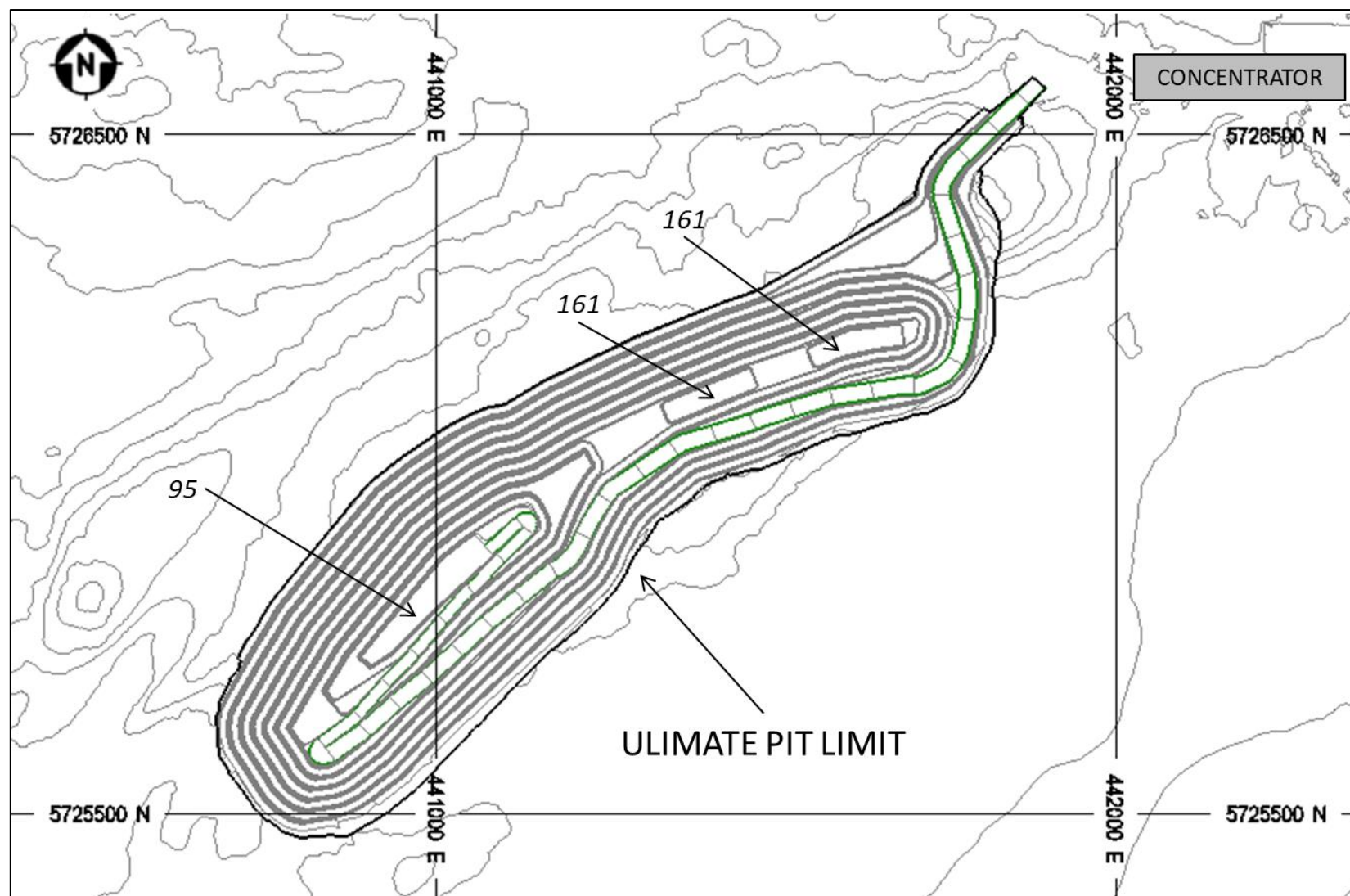


Figure 16.5 – Phase 4





## 16.2 Mine Production Schedule

The following section discusses the mine plan that was prepared for the open pit component of the Technical Report. This mine plan forms the basis for the mining capital and operating costs presented in Section 21.

The mine plan was completed using MSSO (MineSight Schedule Optimizer) and was scheduled monthly for the first four (4) years and annually thereafter. The reason for the additional detail in the early years of the mine plan was for the purpose of de-risking the project. The objective selected for the mine planning optimizer was to maximize NPV.

The mine plan includes a pre-production period of ten (10) months, which begins in June 2019 with a limited crew and lasts until March 2020. The pre-production phase will be used to build the haul roads, prepare the co-disposal storage facility, stockpile 80,000 tonnes of ore, and to develop the open pit for mine production. During pre-production only one shift per day will be in operation. The concentrator is scheduled to begin to receive ore feed in April 2020 and will gradually ramp up to 100% of its nominal production capacity which is targeted for February 2021.

The ore production in the mine plan is limited to the maximum feed of the DMS plant which is 949 kt per year. A 5% increase in the DMS plant capacity was considered as of 2023, bringing the annual limit to 996 kt.

Concentrate production in the mine plan was calculated considering the following parameters which were provided to BBA by Nemaska personnel and DRA/Met-Chem:

- Following the primary crushing, 11.74% of the ore will be considered as fine material and will bypass the ore sorters;
- The remaining 88.3% which is coarse ore will be processed by the ore sorters and 95.3% of the amphiboles will be rejected. Of the lithium in the coarse ore that is fed to the ore sorters, 1.1% will be rejected;
- The fines that bypass the ore sorters and the material accepted from the ore sorters will be fed to the DMS plant;
- The mill recovery, which is applied to the DMS plant feed has been estimated to equal  $24.1306 \times (\text{Feed Grade in } \%) + 0.4544$ , prior to 2023;
- As of 2023, following the installation of a scavenger unit, the mill recovery will increase and be equal to  $[3,211.5338 \times (\text{Feed Grade in } \%)^2 - 76.9846 \times (\text{Feed Grade in } \%) + 1.2853]$ ;
- The grade of the concentrate has been calculated as the minimum of either 6.20% or  $3.0248 \times (\text{Feed Grade in } \%) + 2.21\%$ .

In order to align with the capacity of the hydrometallurgical plant in Shawinigan an additional constraint was put on the mine plan such that the concentrate production cannot exceed 215,000 tonnes per year.

Upon completion of the mine plan, the mill constraints were satisfied and the material movement requirements, as well as the bench sinking rates, were deemed to be reasonable for the fleet of mining equipment.

Beginning in 2021, ore which is above the cut-off grade of 0.40% Li<sub>2</sub>O but below 0.90% Li<sub>2</sub>O will be placed in a low grade stockpile and re-handled in later years. The elevated cut-off grade policy allows for an adequate feed grade to be sent to the mill, increasing the project economics and ensuring the production of a concentrate that meets the quality specifications. The maximum amount of ore in the low grade stockpile never exceeds 570,000 tonnes and in total, just over 2 million tonnes of ore will be hauled to and re-handled from this stockpile over the life of mine.

Mining will begin in Phase 1 and a total of 773,000 tonnes of material will be mined during pre-production which includes 106,000 tonnes of overburden, 588,000 tonnes of waste rock, and 80,000 tonnes of ore. The total material mined gradually ramps up from 460,000 tonnes in 2019 to 1.4 Mt in 2020, 2.9 Mt in 2021, 3.5 Mt in 2022 and 2023, 4.8 Mt in 2024, 5.2 Mt in 2025, reaches a peak of 5.4 Mt per year in 2026 and remains at that level for eleven (11) years before declining.

The mine plan produced for the Report also aims at keeping both the lithium grade and the amount of mining dilution in the ore feed at relatively constant levels. The average grade of the ore mined from the open pit averages 1.33% Li<sub>2</sub>O over the life of mine and varies between a low of 1.25% to a high of 1.49% on an annual basis. The percentage of mining dilution in the ore mined from the open pit averages 13.8% over the life of mine and varies between 8.6% and 17.1%.

Table 16.2 presents the mine production schedule for the open pit and Table 16.3 presents the ore and concentrate production schedule. The tonnages presented are all on a dry basis and the totals may not add up due to rounding. It is also important to note that although 100% of the ore will be hauled to the ROM Stockpile and then subsequently re-handled, the ROM to Stockpile and ROM Stockpile re-handle numbers presented in the table refer only to the initial tonnages that are hauled to the ROM Stockpile during the pre production phase.

Figure 16.6 to Figure 16.13 present various charts which display the mine production schedule. Figure 16.14 to Figure 16.17 present the pit advances for at the end of 2023, 2025, 2030, and 2035 respectively.

Concentrate production in the mine plan was calculated considering the following parameters which were provided to BBA by Nemaska personnel and DRA/Met-Chem. It should be noted that the mine plan was developed using these assumptions which were then adjusted by DRA/Met-Chem upon completion of the mine plan.

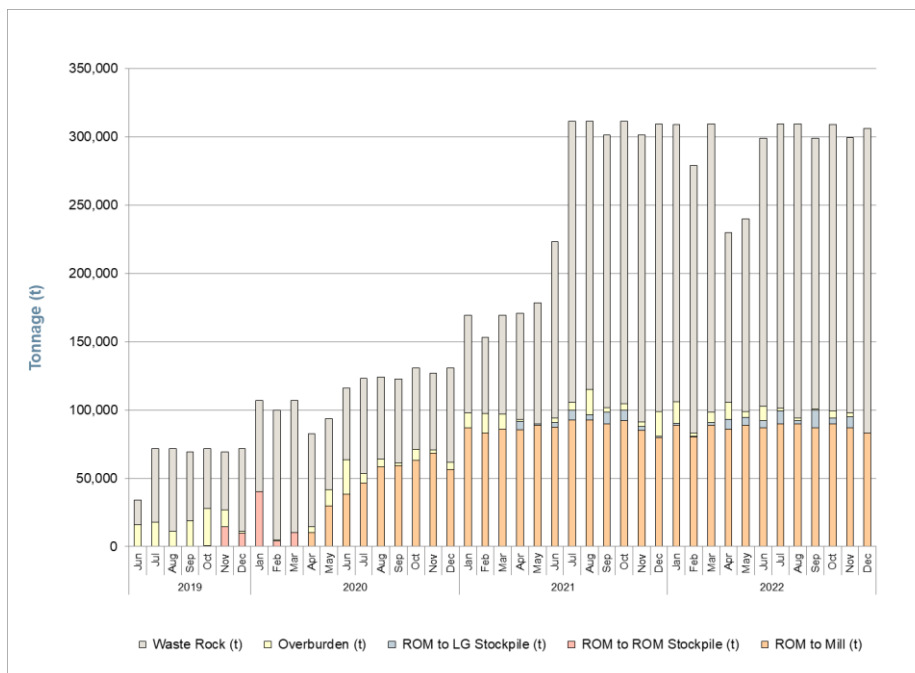
**Table 16.2 – Mine Production Schedule (Material Movement)**

Description	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034 - 2036	2037 - 2039	2040 - 2042	2043 - 2045	Total
<b>Run of Mine</b>																					
ROM to Mill	Mt	0.0	0.4	1.1	1.0	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.2	3.2	3.0	2.3	<b>25.8</b>
ROM to ROM Stockpile	Mt	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.1</b>
ROM to LG Stockpile	Mt	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.2	0.0	<b>2.0</b>
Overburden	Mt	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.2	0.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<b>1.3</b>
Waste Rock	Mt	0.3	0.8	1.7	2.3	2.2	3.6	4.0	4.0	4.1	4.0	4.1	4.3	4.2	4.2	4.2	12.6	9.2	4.1	1.3	<b>75.2</b>
<b>Total ROM</b>	<b>Mt</b>	<b>0.5</b>	<b>1.4</b>	<b>2.9</b>	<b>3.5</b>	<b>3.5</b>	<b>4.8</b>	<b>5.3</b>	<b>5.4</b>	<b>5.4</b>	<b>5.4</b>	<b>5.4</b>	<b>5.4</b>	<b>5.4</b>	<b>5.3</b>	<b>5.4</b>	<b>16.1</b>	<b>12.7</b>	<b>7.3</b>	<b>3.6</b>	<b>104.4</b>
Stripping Ratio		17.3	1.8	1.7	2.2	1.9	3.1	3.3	3.5	3.7	3.9	3.7	3.7	3.6	3.6	3.6	3.6	2.7	1.3	0.5	<b>2.7</b>
<b>Re-handle</b>																					
ROM Stockpile to Mill	Mt	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	<b>0.1</b>
LG Stockpile to Mill	Mt	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	<b>2.0</b>
<b>Total Re-handle</b>	<b>Mt</b>	<b>0.0</b>	<b>0.1</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.1</b>	<b>0.0</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.2</b>	<b>0.2</b>	<b>0.3</b>	<b>0.4</b>	<b>2.1</b>
<b>Total Material Moved</b>	<b>Mt</b>	<b>0.5</b>	<b>1.4</b>	<b>2.9</b>	<b>3.5</b>	<b>3.5</b>	<b>4.9</b>	<b>5.3</b>	<b>5.4</b>	<b>5.5</b>	<b>5.5</b>	<b>5.5</b>	<b>5.5</b>	<b>5.5</b>	<b>5.4</b>	<b>5.5</b>	<b>16.3</b>	<b>12.9</b>	<b>7.6</b>	<b>4.0</b>	<b>106.5</b>
<b>Additional Haulage</b>																					
Ore Sorter Rejects	Mt	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.5	0.4	0.3	0.3	<b>3.3</b>
Tailings Haul	Mt	0.0	0.4	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	2.4	2.4	2.4	2.0	<b>19.7</b>

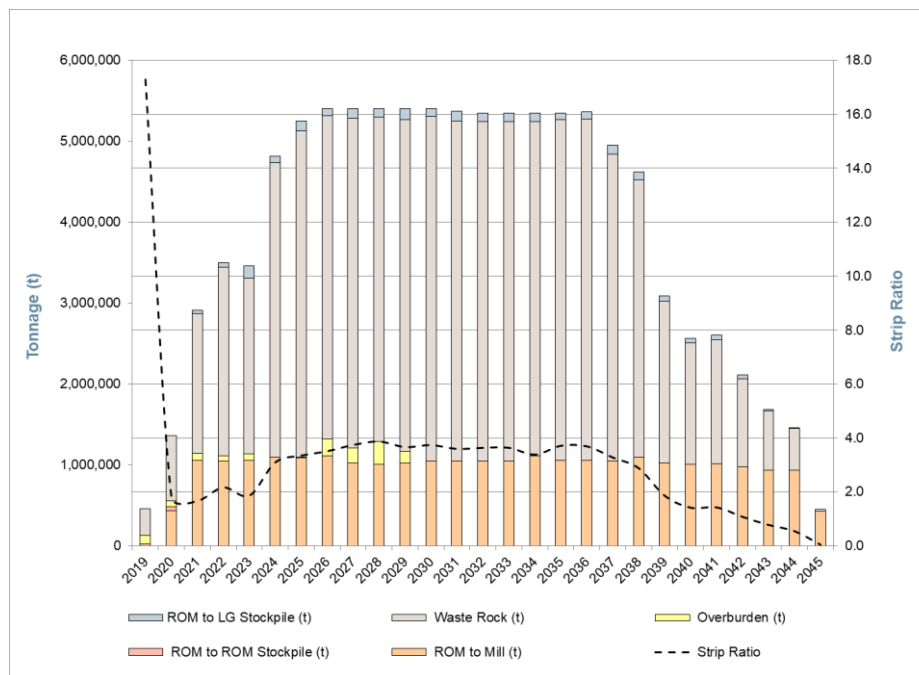
**Table 16.3: Mine Production Schedule (Ore Feed)**

Description	Units	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034 - 2036	2037 - 2039	2040 - 2042	2043 - 2045	Total
<b>To Crusher</b>																					
Ore to Crusher	Mt	0.0	0.5	1.1	1.0	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	3.5	3.4	3.3	2.7	<b>27.9</b>
Ore Grade (Li <sub>2</sub> O%)	%	0.00	1.46	1.41	1.49	1.42	1.29	1.32	1.30	1.31	1.37	1.33	1.26	1.27	1.28	1.29	1.29	1.32	1.37	1.32	<b>1.33</b>
Amphibole Quantity	%	0.0	11.6	13.2	11.0	12.2	14.1	14.7	17.1	13.3	12.2	13.2	15.7	15.7	15.4	15.6	16.5	14.7	11.1	11.1	<b>13.8</b>
<b>To DMS Plant</b>																					
Ore to DMS	Mt	0.0	0.5	0.9	1.0	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	3.0	3.0	2.5	<b>24.7</b>
Feed Grade (Li <sub>2</sub> O%)	%	0.00	1.60	1.57	1.62	1.57	1.45	1.49	1.50	1.46	1.51	1.48	1.44	1.45	1.45	1.47	1.49	1.49	1.50	1.44	<b>1.49</b>
Mill Recovery	%	0.0	84.0	83.4	84.7	83.4	84.4	85.1	85.3	84.7	85.4	84.9	84.3	84.5	84.5	84.7	85.1	85.1	85.4	84.4	<b>84.8</b>
<b>Concentrate Production</b>																					
Concentrate Grade	%	0.00	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	6.20	<b>6.20</b>
Concentrate Produced	Mt	0.000	0.098	0.199	0.211	0.201	0.197	0.204	0.206	0.199	0.207	0.202	0.195	0.197	0.197	0.200	0.610	0.610	0.617	0.480	<b>5.031</b>

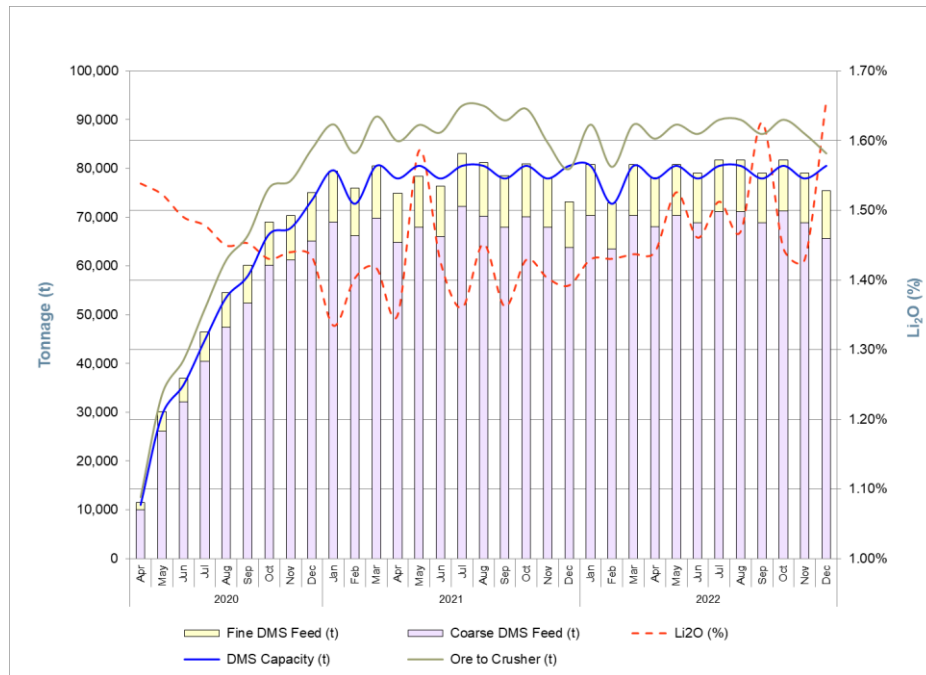
**Figure 16.6 – Mine Production Schedule (Total ROM 2019 - 2022)**



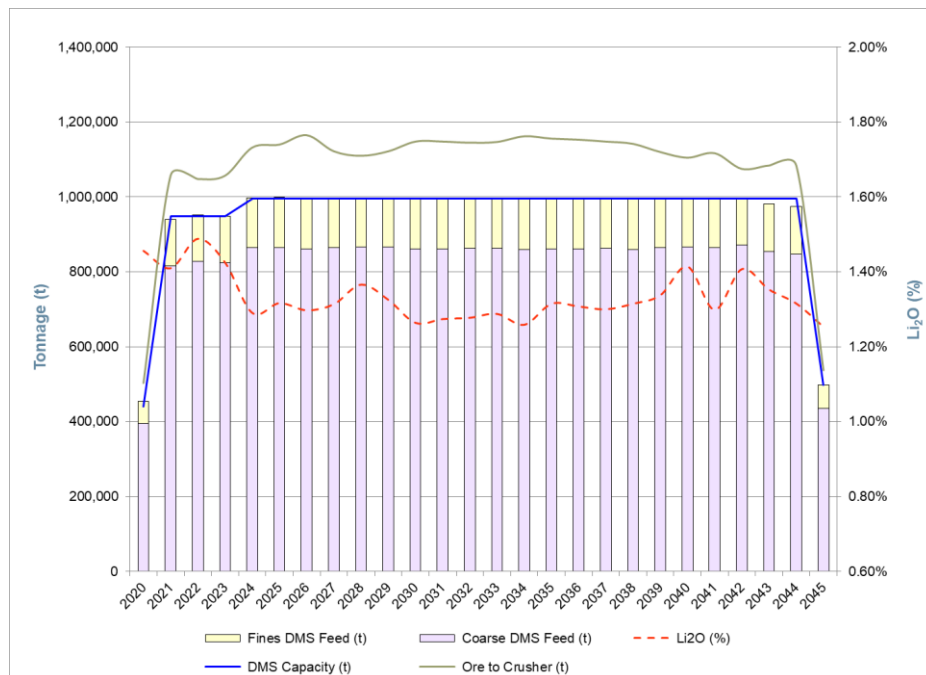
**Figure 16.7 – Mine Production Schedule (Total ROM Life of Mine)**



**Figure 16.8 – Mine Production Schedule (Ore Feed 2020 - 2022)**

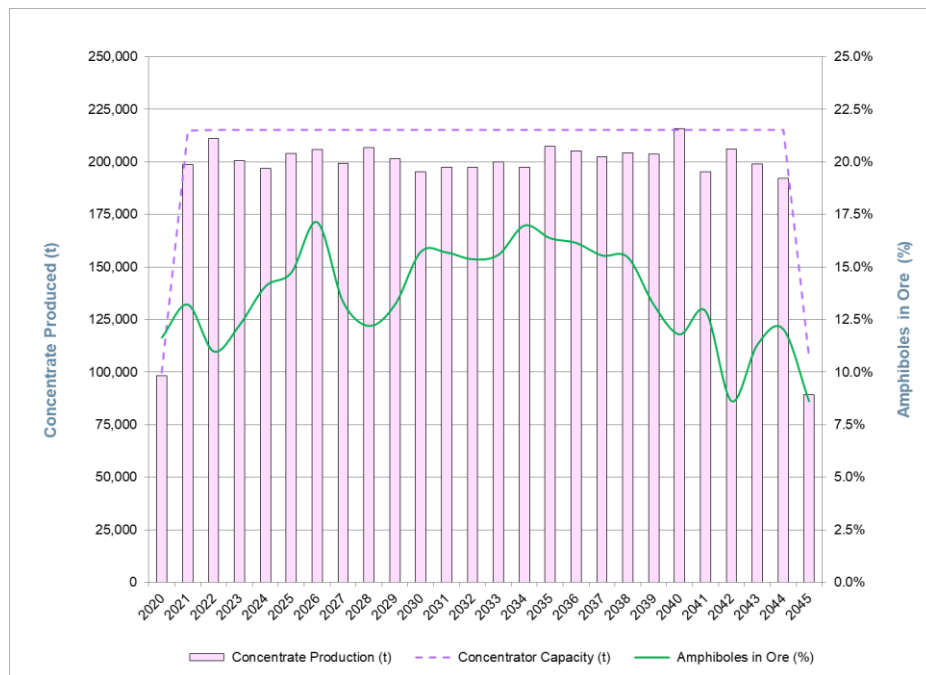


**Figure 16.9 – Mine Production Schedule (Ore Feed Life of Mine)**

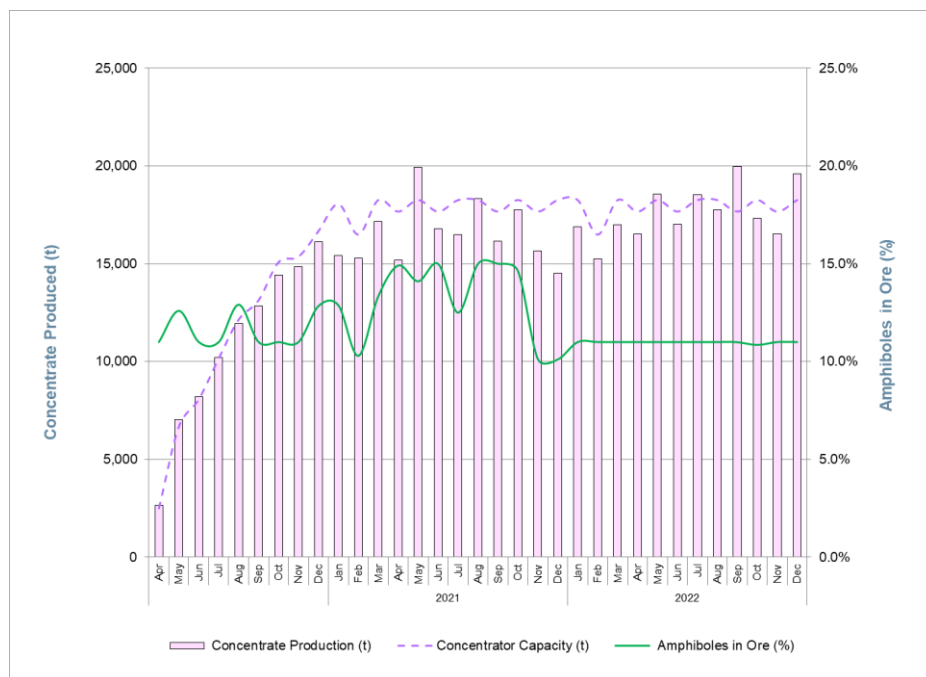




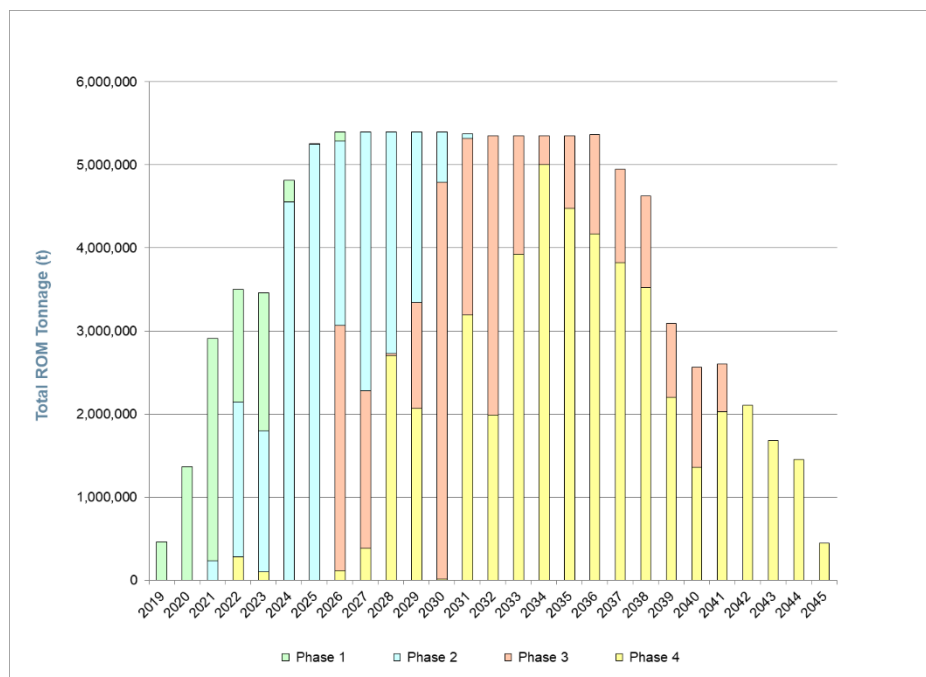
**Figure 16.10 – Mine Production Schedule (Concentrate Production 2020 - 2022)**



**Figure 16.11 – Mine Production Schedule (Concentrate Production Life of Mine)**



**Figure 16.12 – Mine Production Schedule (Total ROM by Phase)**



**Figure 16.13 – Mine Production Schedule (Mineral Reserve Category)**

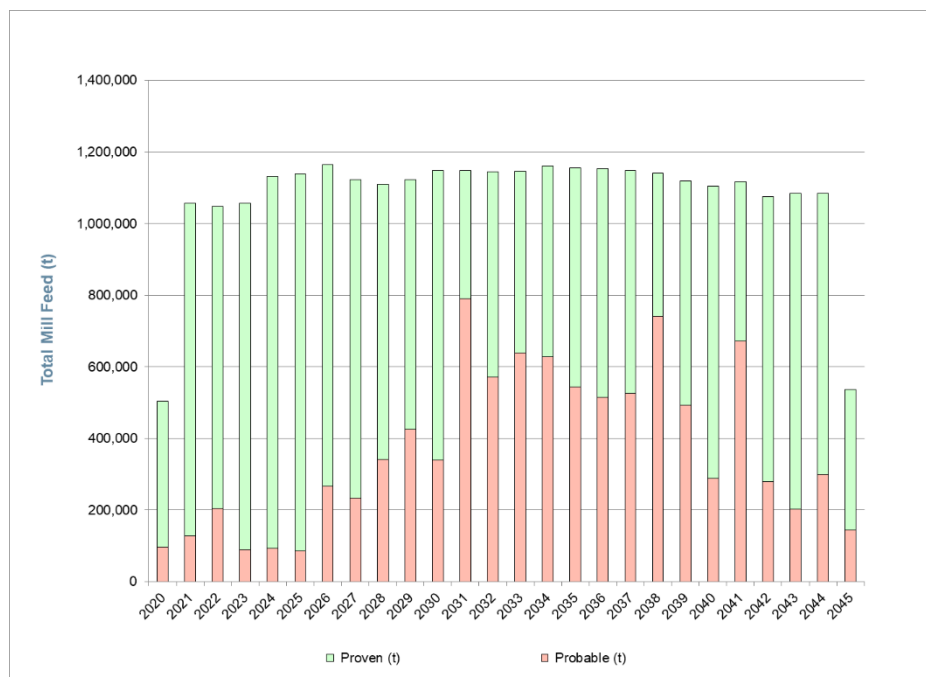


Figure 16.14 – End of 2023

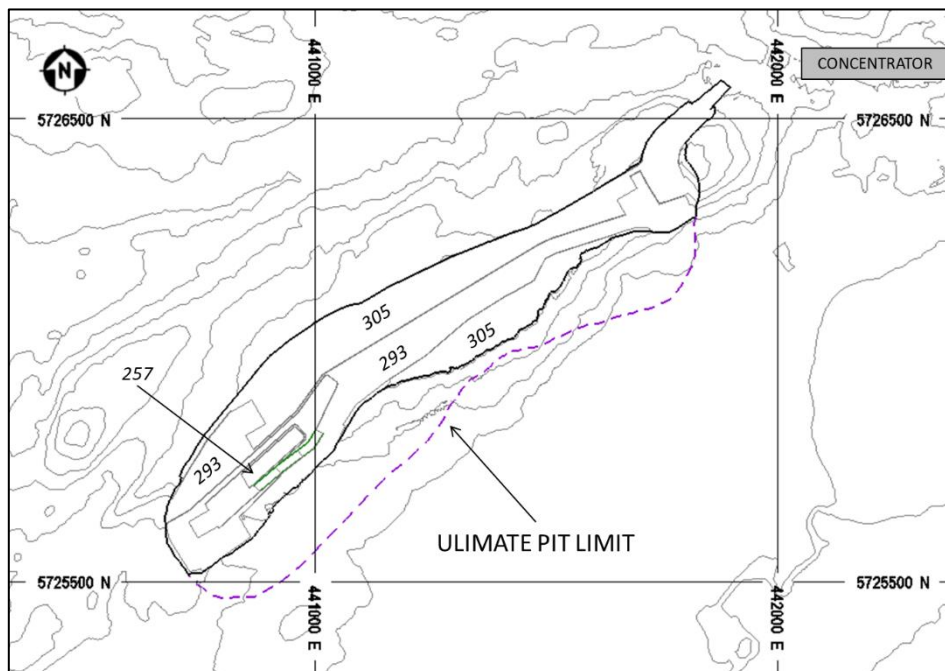


Figure 16.15 – End of 2025

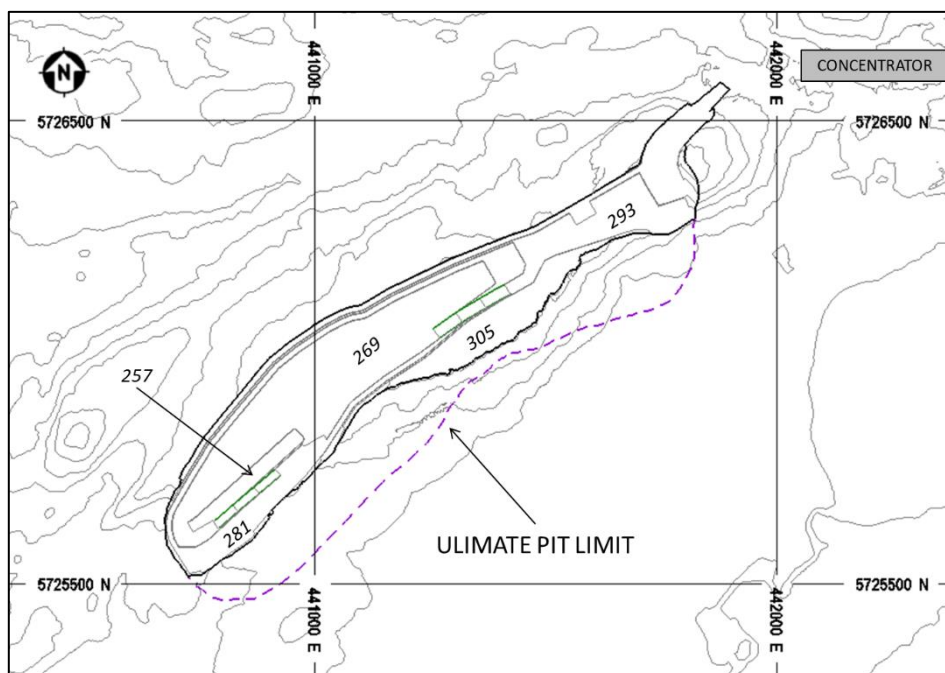


Figure 16.16 – End of 2030

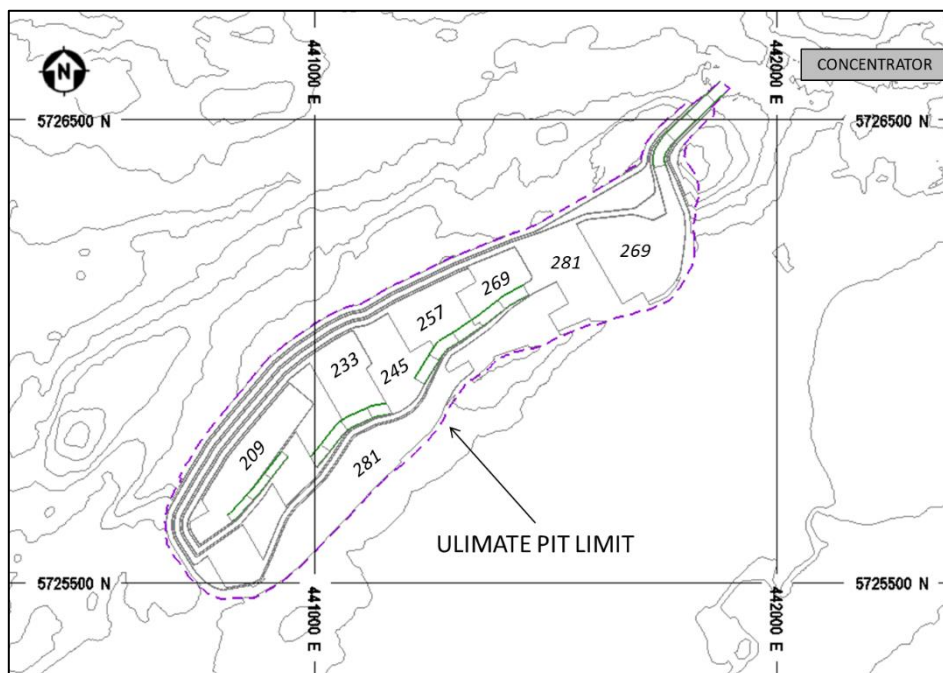
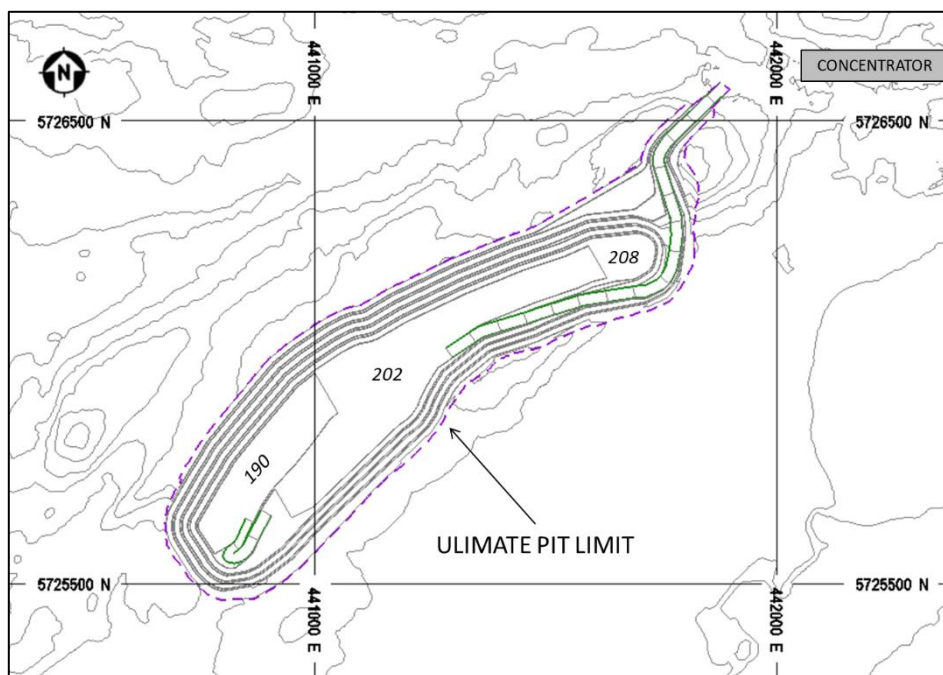


Figure 16.17 – End of 2035



## 16.3 Mine Equipment Fleet

The following section discusses equipment selection and fleet requirements in order to carry out the mine plan for the open pit. Other than the production drilling which will be carried out on contract, the mine will be owner operated with the fleet presented in Table 16.4. Several units of the equipment listed below are already on site while others will be purchased in the coming months and years.

**Table 16.4 – Mining Equipment Fleet**

Equipment	Model	Description	Units
Haul Truck	Komatsu HD605-8	Payload – 64 t	7
Mining Backhoes	Komatsu PC1250SP-11	Bucket Payload – 12t	2
Wheel Loader (Crusher)	Komatsu WA600-8	Net Power – 395 kW	3
Track Dozer	Komatsu DX155-AX	Net Power – 264 kW	3
Road Grader	CAT 16M	Operating Weight – 32t	2
Wheel Loader (Plant)	Komatsu WA470-8	Net Power – 203 kW	1
Utility Excavator	Komatsu PC650LC-8	Net Power – 325 kW	2
Water Truck	n/a	n/a	1
Sand Truck	n/a	n/a	1
Small Loader (Stemming)	TW80	n/a	1
Lighting Plant	n/a	n/a	6
Fuel Truck	n/a	n/a	1
Mechanic Service Truck	n/a	n/a	1
Service Truck	n/a	n/a	1
Boom Truck	n/a	n/a	1
Pickup Truck	GMC HD 2500	n/a	20
Dewatering Pump	n/a	n/a	6

### 16.3.1 EQUIPMENT UTILIZATION MODEL

The schedule for the open-pit operations is based on two (2) 12-hour shifts per day, seven (7) days per week, for 50 weeks per year. The fleet calculations consider seven (7) days of lost mine production due to inclement weather. Table 16.5 presents the equipment hour utilization model that was used for the Project. The mine will operate on day shift only until June 2020 when the night shift operations will begin.

**Table 16.5 – Equipment Hour Utilization Model**

	Scheduled Time						
	Available Time					Down Time	
	Utilized lime (GOH)				Standby Time	Planned Loss	Breakdown Loss
	Operating lime (NOH)		Operating Delay				
Examples for Trucks and Shovels	Shovels	Trucks	Shovels	Trucks	Shovels & Trucks	Shovels & Trucks	Shovels & Trucks
	Spot	Travel empty	Wait on Truck	Wait on Shovel	Shift Change	Scheduled Maint.	Breakdown
	Fill	Spot @ Shovel	Relocating	Positioning	Lunch & Coffee	Inspections / PM's	Wait for Parts
	Swing	Loading	Face Prep.	Crusher Down	Refueling		Repair Time
	Dump	Travel Full	Highwall Scaling	Loader Moving	Pre-start Check		
	Return	Spot@ Dump	Positioning	Queuing	No Operator		
		Dumping			Weather Delays		

The following definitions are used for each time component in the utilization model;

- Scheduled Time – full calendar year less unplanned shutdowns;
- Down Time – the unit is inoperable due to either a scheduled maintenance or an unplanned breakdown;
- Available Time – scheduled time less down time;
- Standby Time – the unit is available mechanically but not being used (the engine will typically be shut off while the unit is on standby);
- Utilized Time – available time less standby time. This time is also referred to as the Gross Operating Hours (GOH);
- Operating Delays – the unit is available and not on standby but not effectively producing (the engine will be running during the operating delays);
- Operating Time – utilized time less operating delays. This time is also referred to as the Net Operating Hours (NOH).

The following Key Performance Indicators (KPI) can be calculated from the different time components;

- Availability –  $(NOH + Op. Delays + Standby) / (NOH + Op. Delays + Standby + Down)$ ;
- Use of Availability –  $(NOH + Op. Delays) / (NOH + Op. Delays + Standby)$ ;
- Machine Utilization –  $(NOH + Op. Delays) / (Calendar Time)$ ;



- Operating Efficiency – (NOH) / (NOH + Op. Delays);
- Effective Utilization – (NOH) / (Calendar Time).

The KPI's and time assumptions that were used for the fleet of backhoes, trucks and drills are presented in Table 16.6. The table presents the average mechanical availability although the Technical Report considered a declining availability for the trucks and backhoes as the equipment ages.

**Table 16.6 – Equipment Utilization Assumptions**

Description	Units	Trucks	Backhoes
Availability	%	85.0	85.0
Use of Availability	%	81.8	83.5
Machine Utilization	%	69.3	71.0
Operating Efficiency	%	87.9	75.1
Effective Utilization	%	60.9	53.3
Scheduled Time	h/y	8,424	8,424
Down Time	h/y	1,314	1,314
Standby Time	h/y	1,372	1,227
Operating Delays	h/y	737	1,547
Utilized Time (GOH)	h/y	6,074	6,219
Operating Time (NOH)	h/y	5,338	4,671

#### 16.3.1.1 Haul Trucks

The haul truck selected for the Project is the Komatsu HD605-8, a rigid frame mining truck with a nominal payload of 64 tonnes and a heaped volume capacity of 42.2 m<sup>3</sup>. A fleet of three (3) trucks is required during the first two (2) years of operation and reaches a maximum of seven (7) in 2030. The haul truck fleet will haul the ore, waste and overburden, as well as the ore sorter rejects and the dry tailings. The payloads have been adjusted for the truck calculations to consider a 2% carry back for ore, waste and ore sorter rejects and 5% for overburden and tailings.

The truck travel times were generated in MineSight using the MS Haulage application. This application calculates the travel times using the rimpull, deceleration and acceleration curves for the haul truck and considers the source location and destination for each cut being mined. The travel times consider a maximum speed of 25 km/h on the bench, 40 km/h on the roads, and a rolling resistance of 3%.

Table 16.6 shows the various components of a truck's cycle time. The load times for ore, waste and overburden were calculated using a PC1250 mining backhoe with a 6.7 m<sup>3</sup> (12-tonne) bucket as the loading unit. This size backhoe, which is discussed in the following section, loads ore, waste rock

and overburden in a 64-tonne haul truck in six (6) passes. The load times for the ore sorter rejects and dry tailings were calculated using a WA600 wheel loader with a 6.4 m<sup>3</sup> (14-tonne) bucket as the loading unit. This size loader, which is discussed in a subsequent section, can load the ore sorter rejects in five (5) passes and the dry tailings in four (4) passes.

**Table 16.7 – Truck Cycle Time (Ore and Waste)**

Description	Seconds
Spot @ Backhoe	42
Load Time <sup>(1)</sup>	240
Travel Time	Calculated by MS Haulage
Spot at Dump	30
Dump Time	42

(1) Six passes at 40 sec/pass.

Haul productivities were calculated using the truck payload and cycle time for each haul. Truck hour requirements were then calculated by applying the tonnages hauled to the productivity for each haul route.

The following are the average one-way haul distances for the open pit over the life of mine:

- Ore to the Ore Stockpile - 1.6 km;
- Ore to the Low Grade Stockpile – 1.4 km;
- Waste Rock to the Co-disposal Storage Facility – 3.2 km;
- Overburden to the Overburden Stockpile – 1.5 km;
- Ore Sorter Rejects to the Co-disposal storage facility – 1.8 km;
- Dry Tailings to the Co-disposal storage facility – 1.8 km.

### 16.3.2 MINING BACKHOES

The primary loading machines selected for the Project are diesel powered Komatsu PC1250SP-11 mining backhoes, equipped with 6.7 m<sup>3</sup> buckets and a maximum payload of 12 tonnes. The machines will be setup in a backhoe configuration for upper bench loading (the shovel resting on top of the muck pile and the trucks on the bench floor below). At the time of writing this report, there are already two (2) PC1250SP-11 backhoes on site. The calculations based on the mine plan for the Technical Report result in one (1) backhoe being required at the start of the operations with a second unit required mid-way through 2021. The second backhoe will remain idle until it is required but the leasing payments for both backhoes, which have begun in 2019, are accounted for in the mine operating cost model.

### 16.3.3 WHEEL LOADERS

A fleet of WA600-8 front end wheel loaders will be used to tram ore from the ore stockpile to feed the primary crusher, re-handle from the low grade ore stockpile, load the ore sorter rejects, load the dry tailings, and feed the DMS with the material that passes the ore sorters. These loaders will also assist with loading in the open pit and will be used for road maintenance and miscellaneous work. One (1) loader will be used in 2019, a second one is needed in 2020 and a third one on 2021.

### 16.3.4 DRILLING AND BLASTING

Production drilling will be carried out by a contractor and blasting services will be provided by an explosives manufacturer. Currently, the drilling contract has been awarded to Dynamitage Castonguay Ltd. and the blasting services to Dyno Nobel Canada Inc.

Production drilling for ore and waste rock will be carried out with diesel powered down-the-hole track drills, drilling 114 mm (4. 5") holes. Using a pure penetration rate of 35 m/h, each hole will take an average of 30 to 35 minutes to drill which includes the time for manipulating the drill rods and tramming between holes. Considering these drilling productivity times and a re drill factor of 5%, it was estimated that one (1) drill will be required at the start of operations and a second one will be added mid-way through 2021.

Costs for the drilling contract are included in the mine operating cost estimate presented in Section 21. The diesel fuel required for both the drilling and blasting service contracts will be supplied by Nemaska.

Final pit walls as well as the temporary pit walls during the phasing will be pre-split.

Bulk emulsion will be used for blasting and the calculations have been done assuming an explosive density of 1.20 g/cm<sup>3</sup>. The explosives supplier is responsible for the supply and storage of the explosives and accessories as well as the loading of the blast holes. Nemaska will have a blaster on dayshift.

The bulk emulsion will be transported to site in 20,000 kg tankers that will remain on site as the storage facility. The explosives supplier will install a garage which will be operated using a diesel generator until 2021 when an electrical line will be erected. Two (2) additional sites have been allocated for the storage of the explosive caps and detonators as well as for packaged explosive products. The three (3) facilities are located on the northwest side of the open pit. Refer to Section 18.1 for more layout information.

The site selection meets the minimum distance requirement as specified by Natural Resources Canada Explosives Regulatory Division. These same three (3) facilities will be used for the underground mining operation.

All costs associated with the purchase, storage and loading of the explosives are included in the mine capital and operating cost estimate presented in Section 21. Table 16.8 presents the drilling and blasting parameters that have been designed for the Technical Report.

**Table 16.8 – Drilling and Blasting Parameters**

Description	Units	Ore	Waste
Bench Height	m	12	12
Blasthole Diameter	mm	114	114
Burden	m	3.1	3.5
Spacing	m	3.1	3.5
Sub-drilling	m	1.2	1.2
Stemming	m	1.5	1.5
Powder Factor	kg/t	0.46	0.32

#### 16.3.5 AUXILIARY EQUIPMENT

A fleet of support equipment including track dozers, road graders, utility excavators, a water truck, a sand truck, and a small loader for stemming of the drillholes have been included in the fleet. The fleet of mining equipment also includes a fuel truck, a mechanic service trucks, a boom truck, light plants, pickup trucks, and dewatering pumps.

One of the track dozers and one of the utility excavators will be dedicated to the co disposal storage facility. Certain equipment such as the water truck and fuel truck are not planned to be purchased until 2021. A contractor will be used for these services from the start of pre-production up to the point when they will be purchased.

#### 16.4 Mine Manpower Requirements

The mine workforce for the open pit will total 44 employees at the start of pre-production and will reach a peak of 129 employees between 2030 and 2038. The workforce for the mine has been categorized into Mine Operations, Mine Maintenance, and Mine Technical Services. The drilling contractor will have four (4) employees and the explosives supplier will have one (1) employee on site at all times. The mine operations will be composed of four (4) crews in order to provide a 24 h/d continuous operation.

Table 16.9 presents the workforce requirements for the open pit during peak production.

**Table 16.9 – Mine Manpower Requirements**

Description	Number
Mine Operations	
Mine Manager	1
Supervisor	4
Shovel Operator	8
Truck Operator	28
Loader Operator	8
Grader / Dozer Operator	8
Fuel / Water / Excavator Operator	4
Tailings Dozer Operator	4
Tailings Excavator Operator	2
Trainer	1
Labourer	4
Blaster	2
Mine Maintenance	
Mobile Maintenance Lead	1
Maintenance Planner	2
Supervisor	4
Mechanic	28
Welder	4
Light Vehicles	2
Labourer	2
Mine Technical Services	
Operations Lead	1
Assistant Operations Lead	1
Mining Engineer	2
Mining Technician	2
Geologist	2
Geology Technician	2
Surveyors	2
<b>Total</b>	<b>129</b>

## 16.5 Underground Mining

### 16.5.1 UNDERGROUND MINING METHOD

The ore extraction will switch from an open pit operation to an underground mine located underneath the pit floor. The duration of the underground mining is seven years and planned to be in operation from second quarter of 2046 to the end of 2053. An underground mine production ramp up period of 4 months is planned during the second and third quarters of 2046 to reach the annual production rate of 1.3 M tonnes of ROM.

The underground mine development and operation will be awarded to a mining contractor who will excavate and haul the ore and waste from underground to a rolling stockpile located at the bottom of the open pit. Hauling of the ore and waste from the bottom of the pit to the crusher and the waste disposal area along with the mine tailings operation will continue to be managed directly by the owner's personnel and the mobile equipment fleet from the open pit operation. The underground mine will be operated on two (2) shifts of ten (10) hours, seven (7) days per week.

The Owner will have a small management and engineering team to supervise and provide design criteria to the contractor to ensure work efficiency and safety.

The mining methodology selected is 30 m high long-hole type stopes. Based on the favorable geotechnical and hydrogeological conditions, backfilling of the excavated stopes will not be required. However, in order to ensure the rock mass stability and work safety within the underground excavation zone, a main central crown pillar will be maintained until the last stages of the operation. The very last excavation phase consists of mining the 30 m thick remaining crown pillar from the open pit floor.

The mine design is purposely kept as simple as possible in order to minimize the development capital expenditure due to the period of seven (7) years of the remaining life of mine of the project. Halfway down in the western area of the open pit, an underground entry portal to a main ramp driven downward will provide access to the six (6) horizontal haulage drifts which in turn provides access to the draw points of the various stopes.

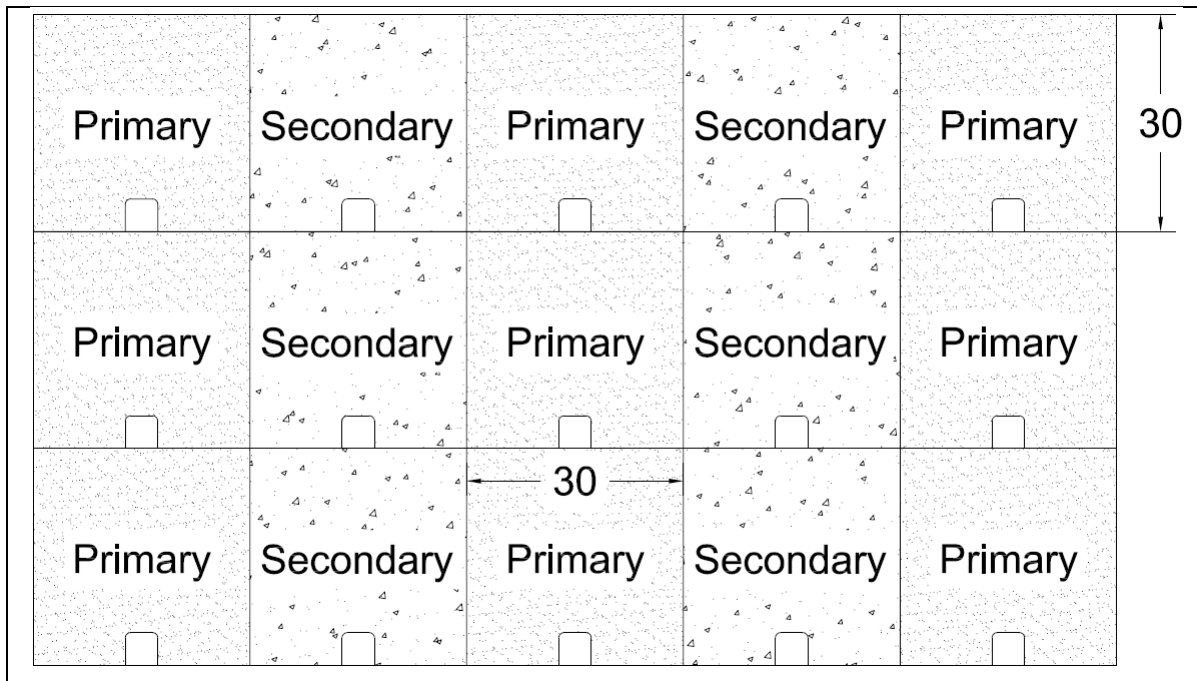
#### 16.5.1.1 Stopping method

Traverse Longhole stoping, followed by paste backfill, is the mining method selected for the ore extraction located underneath the crown pillar. The stope dimensions along the longitudinal axis are 30 m long and 30 m high. The stope width dimension varies between 6 m and 80 m depending on the thickness of the mineralized zone.

Figure 16.18 illustrates the stope mining method with cross sections.



**Figure 16.18 – Stope Cross Section of Stope**



An access drift, connecting the upper portion of the stope to the haulage drift, provides access to the drilling and blasting crews while the access drift connecting to the bottom portion of the stope to the haulage drift enables the reclaiming of the blasted ore. The primary stopes are mined and backfilled with paste. Once the backfill is cured, the adjacent secondary stopes can be mined. The mining will start from the bottom up to the top ending with the surface pillar recovery.

#### 16.5.1.2 Production Rate

The evaluation of the required work force, equipment and mining cost, is based on the following criteria of the underground mine work schedule, annual production requirement, mill recovery and concentrate grade.

##### a. Work Schedule:

The underground mine work schedule is similar to the open pit operation and based on the following parameters:

- 51 weeks per year (with a planned mine shut down period of 1 week);
- 7 days per week;
- 2 shifts of 12 hours per day for the development period (Phase I);
- 2 shifts of 10 hours per day for the production period (Phase II).

b. Annual Production Requirement:

The annual production requirement is the same as the full regime of the open pit extraction period with yearly lithium concentrate production ranging from 201 to 221 k tonnes. An overlapping underground mine ramp-up production period of four (4) months with a target ROM production of 300 k tonnes is planned with the open pit ore extraction finishing during 2046. This will ensure an uninterrupted ROM feed to the concentrator.

c. Mill Recovery and Concentrate Grade:

The amount of concentrate that is produced from the run of mine is the same as the calculation used for the open pit extraction period (see Section 16.1). The underground run of mine is affected by a greater mine dilution and recovery factor than the open pit.

## 16.5.2 UNDERGROUND DEVELOPMENT

### 16.5.2.1 Main Ramp

The main ramp is characterized by a sub-arch section design having an area of 5 m x 5 m with a maximum 15% inclination that connects the portal at elevation 167 m to the lowermost haulage drift located at elevation 2 m. The main ramp cross section area, present in Figure 16.19, has been designed to provide sufficient provision to accommodate the largest production equipment which is the 50-tonnes haul truck along with the roof suspended secondary ventilation ducting (diameter of 1.52 m). The overall length of the main ramp is 2,749 metres.

### 16.5.2.2 Haulage Drifts

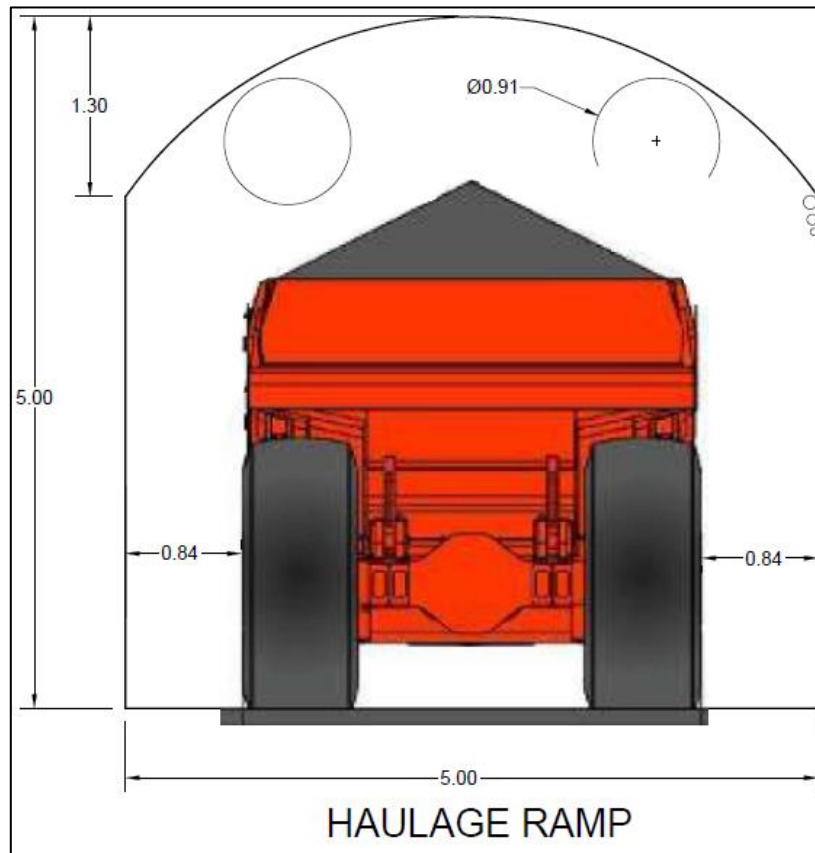
A total of seven (7) haulage drifts will be developed at a 30 m interval along the vertical axis. The haulage drifts are located on the footwall side of the orebody at an average of 30 m from the mineralization contact.

Figure 16.20 presents a longitudinal section view (looking south) where each drift elevation is detailed.

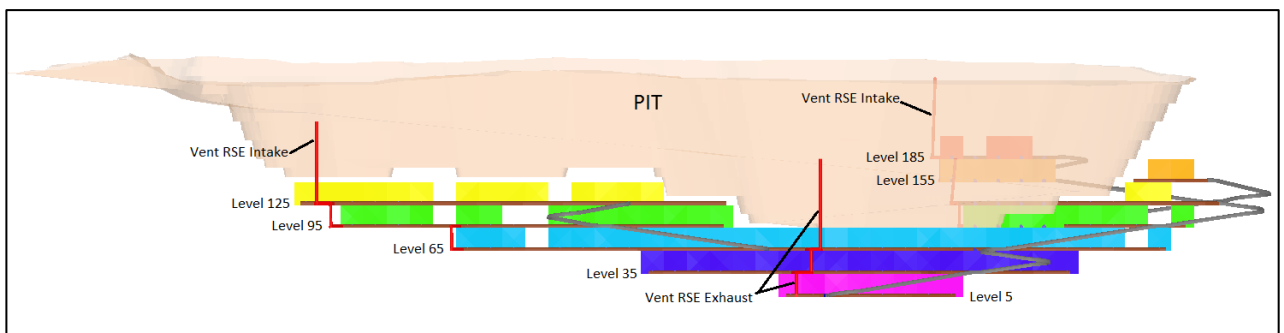
The cross-section area and wall supporting method is the same as the main ramp. The elevation location and lengths of the haulage drifts are:

- Haulage Drift @ Elevation Level 185 m: Total length = 145 m;
- Haulage Drift @ Elevation Level 155 m: Total length = 228 m;
- Haulage Drift @ Elevation Level 125 m: Total length = 1,165 m;
- Haulage Drift @ Elevation Level 95 m: Total length = 828 m;
- Haulage Drift @ Elevation Level 65 m: Total length = 1,043 m;
- Haulage Drift @ Elevation Level 35 m: Total length = 575 m;
- Haulage Drift @ Elevation Level 5 m: Total length = 232 m.

**Figure 16.19 – Main Ramp Cross Section**



**Figure 16.20 – Longitudinal Section View of the Underground Mine Design**



#### 16.5.2.3 Drift Access

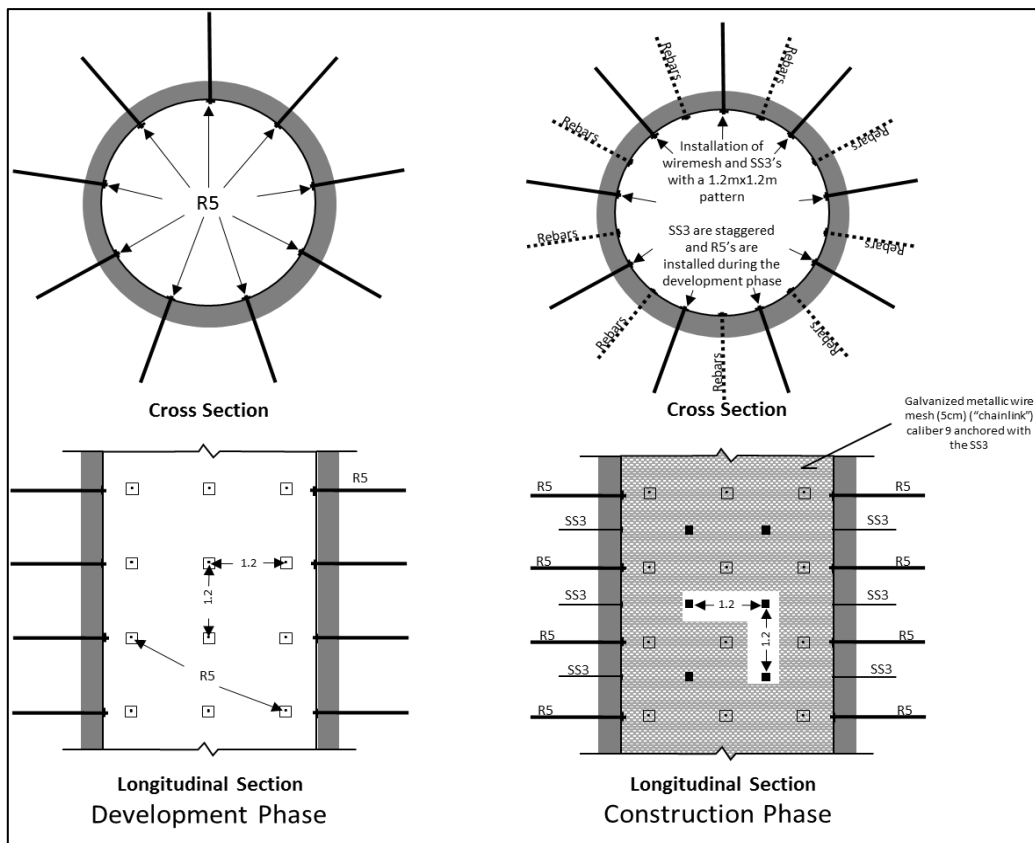
Drift accesses have a cross section surface area of 5 m x 5 m (similar to the main ramp and haulage drifts) and are excavated perpendicularly between the haulage drift and the mineralization contact. Their length is approximately 30 m and each one of the drifts is spaced at 30 m intervals along the length of the haulage drift. These drift accesses will be used for the drilling and blasting of the stopes as well as a muckpile drawing points.

#### 16.5.2.4 Ventilation Raises

Two (2) ventilation raise intakes each with a 3.35 m diameter circular cross section area are excavated. The first one, in the south-west area, is vertical from the ground surface down to elevation 185 m. A second raise, in the north-east area, is inclined, 67 degrees from the horizontal, from the ground surface down to elevation 155 m.

The remaining intermediate air intake raise segments are vertical with a square cross section of 3 m x 3 m that connects the haulage drifts from level 185 m down to level 65 m in the south area and from level 155 m to level 95 m in the north area. For the levels below than 95 m, the main ramp will combine the fresh air from the two ventilation intakes. Figure 16.21 presents the details of main ventilation intake wall support.

**Figure 16.21 – Main Ventilation Raise Intake Wall Support**



The main ventilation air exhaust is vertical with a circular (diameter of 3.35 m) cross section that connects the haulage drift level 95 m to the final exit point located at elevation 172.5 m. The remaining intermediate air exhaust segment raises are vertical with a square cross section of 3 m x 3 m that connects the haulage drifts from level 155 m down to level 2 m.

### 16.5.3 GEOTECHNICAL PARAMETERS AND GROUND SUPPORT

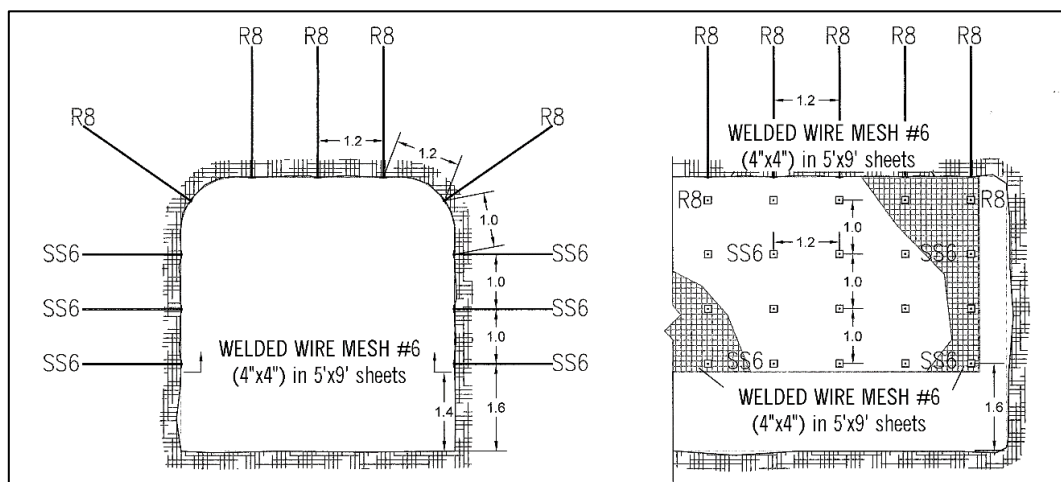
#### 16.5.3.1 Ground Support

The main ramp, drifts (haulage, accesses to raises and stope) and the ventilation air raises (intake and exhaust) will be supported to prevent rock falls. A provision of rock bolting and meshing has been made for the rooms (safety/lunch, sumps, explosives and detonator storages, maintenance, fueling and MCC) once they are excavated and accessed for adequate supporting. The ground supporting methods presented below have been selected to comply with the geotechnical assessment of both the ore and the adjacent sterile rock mass and on proven technology used in similar rock characteristics and underground mine operations.

##### a. Main Ramp and Drifts Support:

The wall is supported by rings of rock bolts spaced at 1.2 m with an applied galvanized steel mesh #6 along the length of the gallery. Each bolt ring is characterized by spacing between the bolts of 1.0 m on the walls and at 1.2 m on the roof. Figure 16.22 illustrates a cross section of the supporting system.

**Figure 16.22 - Ramp and Drifts Wall Support System**



##### b. Main Ventilation Raise Intake:

The main ventilation intake raise will be supported with five (5) ft long resin grouted rebars installed on a 1.2 m x 1.2 m pattern and galvanized welded wire mesh gauge-9 secured by three (3) ft split sets installed on a 1.2 m x 1.2 m pattern, as presented in Figure 16.23.

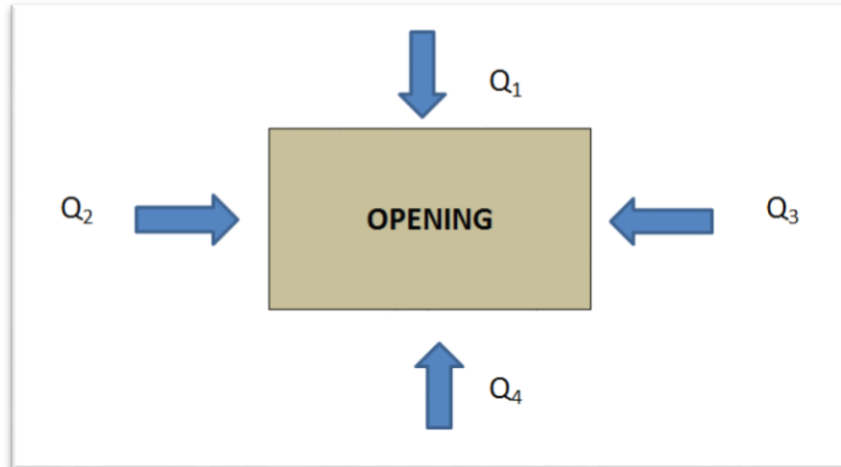
### 16.5.4 HYDROGEOLOGICAL PARAMETERS AND MINE DEWATERING

#### 16.5.4.1 Hydrogeological Parameters

The estimation of the total water inflow is based on the Darcy Law which was applied to all openings (mine ramps, mine galleries, mine stopes, etc.) occurring underground. Based on the level of the

water table in the project area, which is above the first level underground mine, it was established that each underground opening will be an outlet for underground flow.

**Figure 16.23 – Conceptual Inflow into Underground Opening**



The total inflow is the sum of  $Q_1$  to  $Q_4$  with  $Q_1$  being the more prominent part and  $Q_4$  the less prominent. The Darcy Law describes the flow rate of a fluid through a porous medium as a mathematical combination between the coefficient of permeability, the hydraulic gradient and the surface of flow. The cumulative underground flow that was calculated for the underground infrastructure openings is  $25.5 \text{ m}^3/\text{d}$  at the end of the development phase. Table 16.10 shows the water inflow estimation calculation.

#### 16.5.5 DRILLING AND BLASTING

##### 16.5.5.1 Transverse Longhole Stopes

Production drilling is done using a longhole hydraulic drill. The primary and secondary stopes are drilled on a fanned pattern. For all stopes, the blast hole diameter is 115 mm by 25 m long. The average spacing and burden is 1.83 m and average steaming is 13 m. A 76 cm diameter open cut is drilled using a small raisebore machine. The powder factor used for blasting in the underground confined conditions is 0.52 kg/tonne with emulsion explosive products. The explosive product selected is bulk emulsions with electronic detonators. Finally, the shot rock ore will be reclaimed by a LHD wheel loader that will travel back and forth in the access drift in between the muckpile draw point and the haulers.

##### 16.5.5.2 Crown Pillar

The mining method selected for blasting the crown pillar is the drilling and blasting of the 30 m high pillar from the floor of the pit bottom with surface mining equipment and techniques. The crown pillar will be shot in sequence of a large blast of 200,000 to 300,000 tonnes with a progression starting from one end of the pit towards the other end. The drilling and blasting equipment and technique



used will be the same as the open pit mining apart from a higher powder factor due to the more confined condition inherent to a single free face blast.

The powder factor used is 0.39 kg/tonne using a 114 mm hole diameter resulting in a drill pattern dimension of 3 m (burden) x 3 m (spacing) with a 5 m steaming in the collar zone. The selected explosives products are bulk emulsion with electronic detonator initiation. Pre-Shear drilling and blasting is planned along the mineralization contacts on each side of the ore dyke as a mean to reduce the grade dilution of the ore. The same production drill will be used to drill 75 mm diameter holes spaced at every 1.8 m. The main explosive products used are detonator sensitive cartridges and detonating cords.

**Table 16.10 – Mine Water Inflow / Development Phase**

Mine Area	Infrastructure	Distance (m)	Area (m <sup>2</sup> ) (s1+s2+s3)	Darcy Flow (1/d) (Q1+Q2+Q3)	Area (m <sup>2</sup> ) (S4)	Darcy Flow (1/d) (Q4)	Total Flow (1/d)
Level 157	Haulage Drift & Level Access	1,060	15,950	2,329	5,300	387	<b>2,716</b>
	Stope Access (Waste)	800	12,050	1,759	4,000	292	<b>2,052</b>
	Stope Access (Ore)	550	8,300	1,212	2,750	201	<b>1,413</b>
	Raise Vent Intake Access	35	575	84	175	13	<b>97</b>
	Raise Vent Exhaust Access	12	230	34	60	4	<b>38</b>
	Electrical Sub Station	12	230	34	60	4	<b>38</b>
Level 127	Haulage Drift & Level Access	700	10,550	1,540	3,500	256	<b>1,796</b>
	Stope Access (Waste)	470	7,100	1,037	2,350	172	<b>1,208</b>
	Stope Access (Ore)	480	7,250	1,059	2,400	175	<b>1,234</b>
	Raise Vent Intake Access	30	500	73	150	11	<b>84</b>
	Raise Vent Exhaust Access	25	425	62	125	9	<b>71</b>
Level 97	Haulage Drift & Level Access	570	8,600	1,256	2,850	208	<b>1,464</b>
	Stope Access (Waste)	470	7,100	1,037	2,350	172	<b>1,208</b>
	Stope Access (Ore)	780	11,750	1,716	3,900	285	<b>2,000</b>
	Raise Vent Intake Access	30	500	73	150	11	<b>84</b>
	Raise Vent Exhaust Access	38	620	91	190	14	<b>104</b>
Level 67	Haulage Drift & Level Access	440	6,650	971	2,200	161	<b>1,132</b>
	Stope Access (Waste)	460	6,950	1,015	2,300	168	<b>1,183</b>
	Stope Access (Ore)	551	8,315	1,214	2,755	201	<b>1,415</b>
	Raise Vent Intake Access	30	500	73	150	11	<b>84</b>

Mine Area	Infrastructure	Distance (m)	Area (m <sup>2</sup> ) (s1+s2+s3)	Darcy Flow (1/d) (Q1+Q2+Q3)	Area (m <sup>2</sup> ) (S4)	Darcy Flow (1/d) (Q4)	Total Flow (1/d)
Level 35	Haulage Drift & Level Access	190	2,900	423	950	69	<b>493</b>
	Stope Access (Waste)	120	1,850	270	600	44	<b>314</b>
	Stope Access (Ore)	32	530	77	160	12	<b>89</b>
	Raise Vent Intake Access	25	425	62	125	9	<b>71</b>
Ramp	Surface @ Level 37	1,274	19,160	2,798	6,370	465	<b>3,263</b>
	Remucks: 160m	160	2,450	358	800	58	<b>416</b>
	Safety Bays	100	1,550	226	500	37	<b>263</b>
Raises	Inter Level	180	2,750	402	900	66	<b>467</b>
	157 @ 215 (exhaust)	57.5	912.5	133	287.5	21	<b>154</b>
	Level 215 (exhaust pit drift)	36	590	86	180	13	<b>99</b>
	Intake (157 @ Surface)	176	2,690	393	880	64	<b>457</b>
						<b>TOTAL</b>	<b>25,507</b>

## 16.5.6 UNDERGROUND MINE PLANNING

A mining contractor will be selected to perform the underground mine development and production phases. The owner's administration staff and engineering teams pertaining to the underground mine will manage the mining contractor during these phases.

### 16.5.6.1 Development Phase

The proposed work schedule for the development of the underground mine 24 hours per day and seven (7) days per week. The schedule of the underground mine development was developed such that there is a 4-month period overlap between the end life of the open pit and the full production regime of the underground operation. Approximately 300,000 tonnes of ore are planned to be excavated from the underground mine and temporarily piled at the bottom of the mine as a mean to mitigate the possible lower production rate associated with the start-up of the underground mine. The ore stockpile is planned to be processed during 2046 of the life of mine.

The first nine (9) months of the development will focus on the ramp development. At the ramp bottom, the following month will focus on ramp access to the lowest level excavating at the same time the main infrastructure excavations. The development crew will then focus on ore development to open stopes in the central zone at the Level 2. Prior to the first stope blast, the excavation of the two (2) first vent raises will take place.

The permanent pumping system, the first main fan and the electrical installations will all be installed as well. Additional equipment like jumbo drills, alimak, raise borers, etc. will be brought into the mine

as needed for the development of the underground infrastructure such as the haulage drifts and ventilation raises once they become available for their construction. The following production rates have been used to calculate the underground mine development schedule:

- Ramp and haulage drift = 5 m/d;
- Ventilation intake & exhaust excavation = 3 m/d;
- Ventilation intake & exhaust construction = 3 m/d;
- Ventilation intake access excavation = 3 m/d.

Table 16.11 presents the breakdown of the underground infrastructure linear metres, number of units, unit costs and the cross-sectional dimensions.

**Table 16.11 – Underground Infrastructure Linear Meters and Unit Costs**

Item	Unit Cost (\$/lm)	Dimensions
Main Ramp	5,755.64	5m x 5m
Main Ramp Remucks	5,384.23	5m x 6m
Main Ramp Access (waste)	5,390.28	5m x 6m
Main Ramp Access (ore)	5,155.06	5m x 6m
Remucks (haulage drift)	5,384.23	5m x 6m
Haulage Drift & level access	5,390.28	5m x 5m
Drift access (waste)	5,390.28	5m x 5m
Drift access (ore)	5,155.06	5m x 5m
Drift access (ventilation & misc.)	5,155.06	5m x 5m
Air Intake Main	7,845.66	diameter 3.35m
Air Intake Intermediate	7,845.66	3m x 3m
Air Exhaust Main	7,904.07	diameter 3.35m
Air Exhaust Intermediate	5,750.46	3m x 3m
Maintenance Room	12,413.74	6m x 7.5m
Fueling Room	9,165.06	6m x 7.5m
MCC Room	4,437.72	4m x 4m
Explosive Storage Room	11,264.40	5m x 6m
Detonator Storage Room	11,264.40	5m x 6m
Sump (water pump)	6,112.80	5m x 6m
Safety Room	6,789.53	4m x 4m
Safety Bay	1,675.08	2.4 x 2.4 x 2

#### 16.5.6.2 Production Phase

The stope production will begin at the lower level of the mine followed by the stopes from the level above. The production of 3,500 tonnes per day is assumed by having six (6) stopes in production at all times. During the three (3) last years of the underground mine, the production will come only from the crown pillar stopes. At each level, the primary stope will be mined prior to secondary.

For the underground mine, the total proven reserve is estimated to be 8,666,344 tonnes at an average grade of 1.21% Li<sub>2</sub>O that will be produced over a period of over seven (7) years as per the schedule Table 16.12, using the scheduling parameters discussed previously. The mine plan presented in Table 16.13 does not show the blending taking place at the concentrator stockpiles and does not represent the actual ore going through the plant. The concentrator schedule is discussed in Section 17 of this Technical Report.

**Table 16.12 – Underground Mine Development**

Items	Year								Total
	2045	2046	2047	2048	2049	2050	2051	2052	
Portal metre	15	0	0	0	0	0	0	0	15
Ramp metre	1,574	827	348	0	0	0	0	0	2,749
Cubby metre	88	70	32	0	0	0	0	0	190
Passing bay metre	24	0	0	0	0	0	0	0	24
Drift metre	561	1,987	1,389	41	184	180	18	0	4,360
Vent drive metre	208	84	134	0	0	0	0	0	426
Vent hole metre	321	84	213	0	0	0	0	0	618
Ore drive metre	252	528	527	521	529	522	522	154	3,555
Ore drive Crosscut metre	232	441	620	657	543	506	274	346	3,620
Backfill hole metre	0	272	0	0	0	0	0	0	272
Backfill Drive metre	0	27	0	0	0	0	0	0	27
Sump (water pump)	60	0	0	0	0	0	0	0	60
Safety Room	15	0	0	0	0	0	0	0	15
<i>Sub-Total (m/l)</i>	<i>3,350</i>	<i>4,321</i>	<i>3,263</i>	<i>1,218</i>	<i>1,256</i>	<i>1,208</i>	<i>815</i>	<i>500</i>	<i>15,932</i>
The totals may not add up due to rounding errors.									

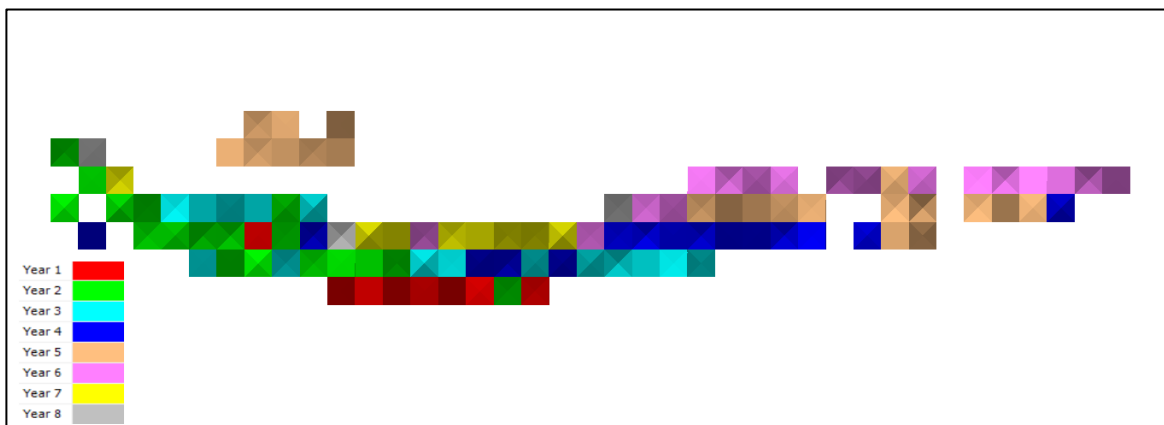
**Table 16.13 – Underground Mine Schedule**

Description	Units	Year								Total
		2045	2046	2047	2048	2049	2050	2051	2052	
Ore from Stopes		600,560	1,260,430	1,257,976	1,242,575	1,232,384	0	0	0	<b>5,593,925</b>
Ore from Pillar		0	0	0	0	29,562	1,244,725	1,245,789	367,461	<b>2,887,537</b>
Ore from Development		13,091	27,475	27,422	27,086	27,508	27,133	27,156	8,010	<b>184,882</b>
ROM to Plant	Tonnes	613,651	1,287,905	1,285,397	1,269,661	1,289,455	1,271,858	1,272,945	375,471	<b>8,666,344</b>
Li <sub>2</sub> O	%	1.25%	1.22%	1.20%	1.23%	1.13%	1.20%	1.26%	1.28%	<b>1.21%</b>
Black Rock %	%	0.57%	3.33%	2.09%	4.96%	9.27%	7.27%	0.53%	0.00%	<b>5.41%</b>
Total Waste	Tonnes	189,117	219,684	160,434	36,746	40,031	37,849	15,440	17,990	<b>717,290</b>

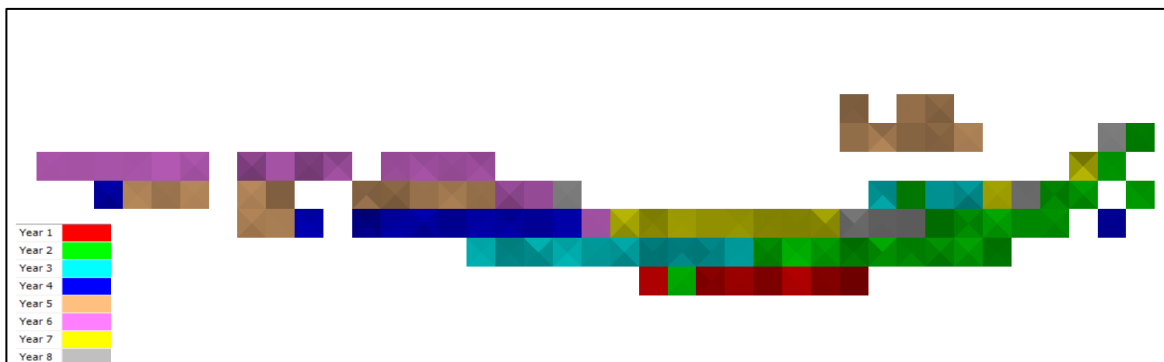
The totals may not add up due to rounding errors.

Mining sequence of the stopes and development for the different levels of the mine, based on calendar years, are presented from Figures 16.24 and 16.25.

**Figure 16.24 – Stope Extracting Sequence (longitudinal view looking North)**



**Figure 16.25 – Stope Extracting Sequence (longitudinal view looking North)**



## 16.5.7 UNDERGROUND MINING EQUIPMENT

The Owner will supply the larger equipment that requires engineered installation and that can't be mobilised and demobilized by the mining contractor.

### 16.5.7.1 *Equipment Furnished by the Owner*

The list of the equipment supplied by the Owner is presented in Table 16.14.

**Table 16.14 – Owner's Equipment List**

Description	Quantity
Main Ramp Entry Portal	1
Electrical Sub Station Vent (6.5 MVA)	1
Push-Type Air Ventilator & Heather Station	1
Mine Rescue Equipment	1
Fueling Station (20,000 gallons) with dispensers (SatStat)	1
Oil containers with dispenser (SatStat)	1
Greasing station with dispenser (SatStat)	1
CS3 cassette carrier (MacLean Mining)	1
Maxi Loader 5344 (ORICA)	1
EL3 Emulsion charger with basket (MacLean Mining)	1
Ventilation Door Control	5

### 16.5.7.2 *Contractor*

The major mobile equipment required by the contractor to complete the work is presented in Table 16.15.

**Table 16.15 – Mining Contractor Equipment List**

Description	Total
Cable Bolter	1
Hydraulic Production Drill	5
Raise Drill	2
Jumbo Drill 2 Boom	2
LHD 17 Tonnes	7
Mine Truck 40t	7
Roof Bolter	2
Scissor Lift	1
Shotcrete Sprayer	1



Description	Total
Shotcrete Mixer	1
Loader Cat 988	1

## 16.5.8 UNDERGROUND MINE SERVICES

### 16.5.8.1 Mine Ventilation / Heating

#### a. Ventilation and Heating Requirements

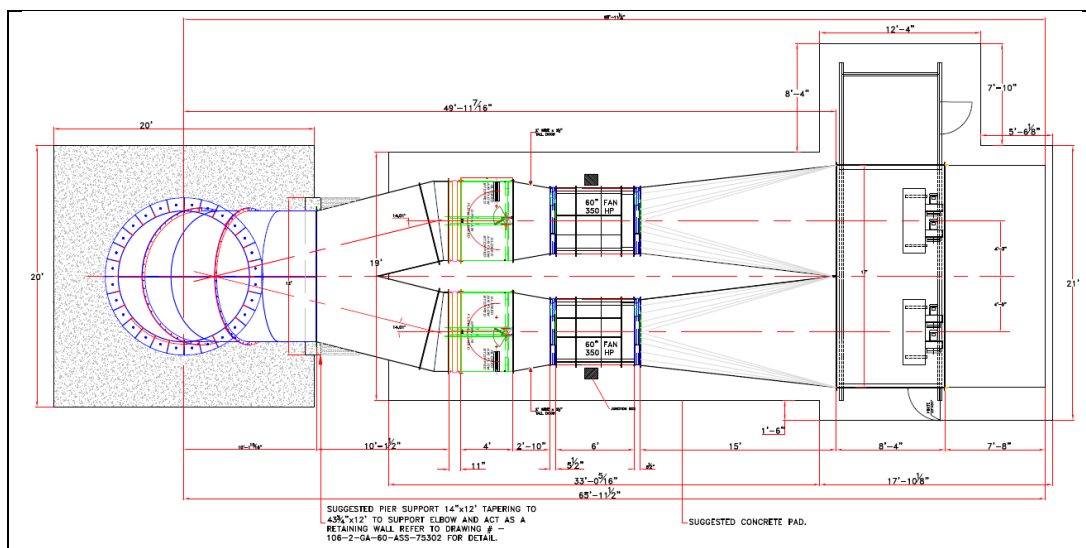
The estimated quantity of air to be injected into the main intake raise is 250,000 CFM at a pressure of ten (10) inches of water. The estimation is based on a ratio of 125 CFM / HP of diesel-powered equipment planned to be in usage in the underground mine (maximum 2,000 HP). The fresh and cold air of the winter months will need to be heated up to 3°C before being injected into the underground mine.

#### b. Ventilation and Heating System Installation

The ventilation system is equipped with an air heater installed on the surface above the air intake raise entry to push and heat the air into the underground mine galleries and stopes. The channeling and control of the air flows through the various haulages drifts is done with five (5) portable ventilation control doors.

The ventilation and heating system selected is a two parallel fan design to deliver a maximum amount of 280,000 CFM at 10.3 inches of water of static pressure. The two (2) ventilators will run simultaneously. Each ventilator is characterized by one 350 HP motor driving a full bladed fan at a speed of 18,000 RPM. Figure 16.26 illustrates the ventilation system.

**Figure 16.26 – Plan View of the Ventilation and Heating System**



#### 16.5.8.2 *Electrical Power Distribution*

The electrical power distribution to the underground mine is characterized by an interconnection point between Nemaska Lithium and Hydro-Québec 25 kV line. From there on, an aerial electrical power line brings the 6.5 MVA / 1200A power to the main ventilator and into the air intake ventilator shaft to the MCC room located on the 157 m level haulage drift where the 2.66 MVA electrical substation is located.

From this point on, the mining contractor will connect the required cable network and other electrical sub-stations to supply the power to its equipment. The planned power requirements are 866 kW (1161 HP) during the development phase and 1416 kW (1898 HP) during the production phase.

#### 16.5.8.3 *Compressed Air*

Compressed air will be required underground for various services (fans, cylinders, pumps, jacklegs and stopes, etc.). The compressed air will be supplied underground via pipes in the intake raise and connected to each level. The mining contractor will supply two electric air compressors to generate the estimated 3,000 CFM air mine requirements. The compressors will be located in a shelter near the main ventilator installation at the entry point of the air intake raise on ground level.

#### 16.5.8.4 *Maintenance*

A 6 m x 7.5 m x 30 m maintenance room will be constructed, set up and tooled-up for the light maintenance purposes such as the regular servicing programs and small and quick repairs. The maintenance bay will be equipped with fully portable oil containers and dispenser, a greasing station and a 20-litre oil container, all equipped with fire suppression, reel and hoses.

#### 16.5.8.5 *Fueling Facility*

One 6 m x 7.5 m x 30 m fueling room will be excavated and set-up on the Level 157 m haulage drift to supply the diesel for the underground mine equipment. The fueling station is characterized by a dual portable 20,000-gallon container with a dispenser with reels, hoses and fire suppressors.

#### 16.5.8.6 *Lunchroom and Refuge Station*

The lunchroom / refuge room will be located at the beginning of the Level 157m haulage drift. The dimension is 4 m x 4 m x 25 m.

#### 16.5.8.7 *Explosives & Underground Explosive Magazines*

The emulsion explosive product will be used for the underground development work, stopes and crown pillar blasting. The emulsion will be stored in a trailer type tank, adapted and heated to remain on the ground surface and serving as a transfer point to smaller transportable totes to the underground sites.

A small flatbed carrier vehicle will be used to transport two (2) bulk emulsion totes and a loader unit (Orica Maxiloader 5344) to service the blasting crew of the stopes and the crown pillar. The same

flatbed carrier will transport an emulsion charger with basket unit, an emulsion tote along with the Orica mini loader unit to service the blasting crew of the development work. The mining contractor will supply the equipment and manpower for all blasting activities.

Two (2) explosive storage rooms are planned to be constructed underground:

- The explosive product storage is located in a dedicated excavated area on the main ramp near the Level 127 m haulage drift. The room dimension is 3.6 m x 5 m x 9 m located at the end of a 24 m long drift. A concrete wall with a 2 m wide steel door will seal and protect the entry of the explosive storage area designed to store 24,000 kg of explosives cartridges, packaged emulsions, etc.
- The detonator room is located in a dedicated excavated area in the main ramp near the Level 67 m haulage drift. The room dimension is 3.6 m x 5 m x 4.5 m and located at the end of a 24 m long drift. A concrete wall with a 2 m wide steel door will seal and protect the entry point of the explosive storage to store 20,000 detonator units.

#### 16.5.8.8 Mine Dewatering

The installed water pumping capacity is 91 m<sup>3</sup>/h and was purposely selected to be larger than the estimated maximum mine water inflow of 85 m<sup>3</sup>/d that is expected to come, due to the fact that additional hydrogeology studies in the deeper part of the orebody will be required for a more precise estimation of the underground water inflows. DRA/Met-Chem and *Don Bourgeois & Fils Entrepreneur Minier* selected the pumping capacity from their respective databases of similar rock mass characteristics and similar size operations. The mining contractor will supply and install the permanent and temporary pumping stations in the mine in the following locations:

- Permanent pumping station on Level 155 with a room dimension of 20 m x 6 m near the ventilation raise equipped with two stationary pumps of 100 HP each expulsing the clear water toward the surface through piping installed in the intake ventilation raise.
- Permanent pumping station on Level 65 with a room dimension of 20 m x 6 m near the ventilation raise equipped with one stationary pump of 100 HP expulsing the clear water toward the Level 155 pumping station.
- Permanent pumping station on Level 35 for the dirty water located at a slightly extended end of the ramp with one submersible pump of 30 HP expulsing the clear water upward to the water reservoir of Level 65. The mud will be cleaned, reclaimed and disposed at regular intervals.

There will be one (1) 100 HP pump and two (2) 30 HP submersible pumps for back-up in case of failure or additional pumping needs on a temporary basis.

#### 16.5.9 UNDERGROUND MANPOWER

The underground mine manpower is broken down into the owner's and mining contractor personnel.

#### 16.5.9.1 Owner Personnel:

The Owner will manage the underground mine along with the mine tailings operations. This will be done by the following three departments:

- Mine operations;
- Mine engineering;
- Mine tailings.

A total of 52 to 56 employees including the number of shifts and rotation requirements is planned during the underground mine development and the production phase.

#### 16.5.9.2 Mining Contractor Personnel:

The mining contractor will supply the manpower to operate the underground mine. This includes the maintenance functions for the various equipment supplied by the contractor and the owner. The mining contractor's superintendent and supervisors will liaise with the owner's chief and mine engineers to ensure the adequate quality, production rate, safety and development of the underground mining operation.

Eighty-six (86) employees will be required for the development phase while 70 will be required during the production phase. This includes the number of shifts and rotations. Table 16.16 displays the underground mine manpower requirement.

**Table 16.16 – Manpower Requirement**

Description	2045	2046	2047	2048	2049	2050	2051	2052
<b>Mine Operations (U/G)</b>								
Mine Manager	1	1	1	1	1	1	1	1
Mine Captain	1	1	1	1	1	1	1	1
Supervisor U/G	4	4	4	4	4	4	4	4
<b>Engineering (U/G)</b>								
Operations Lead	1	1	1	1	1	1	1	1
Assistant Operations Lead	1	1	1	1	1	1	1	1
Mining Engineer	2	2	2	2	2	2	2	2
Mining Technician	2	2	2	2	2	2	2	2
Geologist	2	2	2	2	2	2	2	2
Geology Technician	2	2	2	2	2	2	2	2
Surveyors	2	2	2	2	2	2	2	2
<i>Total Owners Overheads Staff</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>	<i>18</i>

Description	2045	2046	2047	2048	2049	2050	2051	2052
<b>Contractor Personnel (U/G)</b>								
Superintendent	1	1	1	1	1	1	1	1
Supervisors	4	4	4	4	4	4	4	4
Contract Clerk	2	2	2	2	2	2	2	2
Chief Maintenance	1	1	1	1	1	1	1	1
Mechanics	12	12	8	8	8	8	8	8
Electrician	2	2	2	2	2	2	2	2
Service Man	2	2	4	4	4	4	4	4
Long Hole Driller	0	4	8	8	8	8	8	8
Blaster Long Hole	0	2	4	4	4	4	4	4
LHD Operator	8	8	8	8	8	8	8	8
Truck Operator	8	8	12	12	12	12	12	12
Jumbo Operator	8	8	4	4	4	4	4	4
Bolter Operator	16	12	4	4	4	4	4	4
Backfill	0	4	8	8	8	8	8	8
Raise Miner Operator	8	8	0	0	0	0	0	0
Construction Miner	8	8	0	0	0	0	0	0
<i>Mine Workforce (Contractor)</i>	<i>80</i>	<i>86</i>	<i>70</i>	<i>70</i>	<i>70</i>	<i>70</i>	<i>70</i>	<i>70</i>
<b>Total Mine Workforce</b>	<b>98</b>	<b>104</b>	<b>88</b>	<b>88</b>	<b>88</b>	<b>88</b>	<b>88</b>	<b>88</b>

## 17 RECOVERY METHODS

Section 13 of this Report described the metallurgical test work and how the results were used to derive the Process Flow Diagrams (“PFD”) and mass balance. The process design has been split in two (2) locations. The concentrator will be located 675 m north east of the Whabouchi mine open pit while the Electrochemical Plant will be located in Shawinigan.

The descriptions of the various areas encompassing the processing plants are provided herein. This information serves as the basis for the development of the capital and operating cost estimates presented in Section 21.

### 17.1 Whabouchi Concentrator

The data have been applied to the period from 2021 to 2025. The data are average of the annual throughput rate, Li grade, and all the other items that come from the new mine plan. The Spodumene concentrate will be produced by two (2) distinct processes: DMS circuit and flotation circuits. The DMS will recover 7.9% by weight, while the flotation circuit will recover 11.3% by weight for a total of 19.2% weight recovery.

The concentrator is designed to produce a spodumene concentrate containing 6.25% lithium or 77.8% spodumene ( $\text{LiAlSi}_2\text{O}_6$ ), from an ore containing an average 1.53%  $\text{Li}_2\text{O}$ . To achieve this concentration, the beneficiation processes include crushing, ore sorting, hydraulic separation, dense media separation, magnetic separation, grinding, attrition scrubbing, desliming, and flotation. Before leaving the concentrator, the concentrate will undergo further steps of thickening, filtration, crushing, drying and material handling, including storage and loading of spodumene concentrate on road trucks. The concentrator production average for first five years is 205,364 dry tonnes of spodumene concentrate per year. Tailings will be transported to the co-disposal area by trucks.

#### 17.1.1 PROCESS DESIGN CRITERIA

The original concentrator design was based on the production of 215,000 dry tonnes per year of 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate from a feed grade of 1.53%  $\text{Li}_2\text{O}$ , resulting in an annual throughput rate of 1,030,831 tonnes of ore.

For the Years 2021 to 2025, the expected average throughput rate is 1,086,990 tonnes per year. This is based on the adjusted mine plan which coincides with an average production of 205,364 dry tonnes of 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate from a feed grade of 1.38%  $\text{Li}_2\text{O}$ .

The Whabouchi concentrator will operate 24 hours per day, seven (7) days per week, 52 weeks per year. The general concentrator operating availability will be 92%, the DMS section will operate at 80%. The crusher will be operated based on 66.7% availability. The concentrator capacity has been established at an average rate of 2,824 dry tonnes per day or an average throughput rate of 117.7 dry tonnes of ore per hour.

The crusher and concentrator have been sized to meet the parameters in Table 17.1.



**Table 17.1 – Process Design Basis**

<b>Concentrator Capacity</b>				
<b>Parameter</b>	<b>Units</b>	<b>Design</b>	<b>Average 2021 to 2025</b>	<b>Remaining Open Pit to 2044</b>
Annual Ore Processing Rate	dry t/y	1,030,831	1,086,990	1,129,087
Average Ore Processing Rate	dry t/d	2,824	2,978	3,093
Spodumene Ore Grade	% (Li <sub>2</sub> O)	1.53	1.38	1.32
Ore Sorter Circuit Recovery	%	98.8	99.0	99.9
Concentrator Recovery	%	86.2	86.25	86.25
Overall Lithium Recovery (Sorting + Concentrator)	%	85.2	85.4	86.2
Spodumene Concentrate Grade	%	6.25	6.25	6.25
Annual Spodumene Concentrate Production	dry t/y	215,000	205,364	204,963
Daily Spodumene Concentrate Production	dry t/d	589	563	562
ROM Ore Moisture	%	2.0	2.0	2.0
Crusher Operating Time	%	67	67	67
DMS Circuit Operating Time	%	80	80	80
Rest of Concentrator Operating Time	%	92	92	92
DMS Circuit Feed (F <sub>80</sub> )	mm	6.2	6.2	6.2
HydroFloat Separation Feed (F <sub>80</sub> )	mm	0.63	0.63	0.63
Column Flotation Circuit Feed (F <sub>80</sub> )	mm	0.17	0.17	0.17

#### 17.1.2 MASS AND WATER BALANCES

Table 17.2 shows a summary of the in and out flows from the concentrator for 2021 to 2025. The daily ore throughput is 2,978 tonnes requiring 320 m<sup>3</sup>/d of makeup water. Most of this water is lost in tailings which are about 12% moisture for dry stacking in a co-disposal facility with waste rock from the open pit.

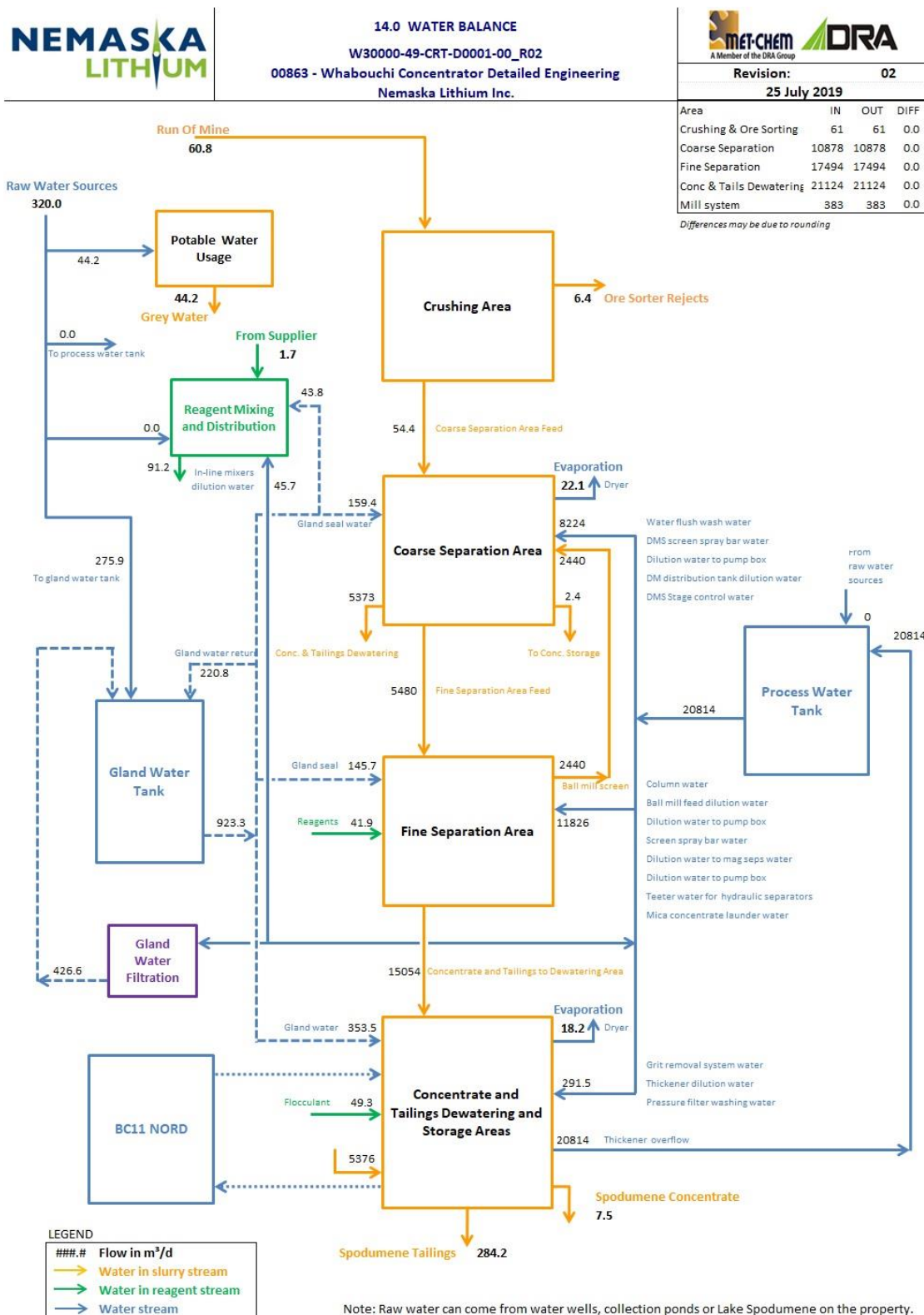
**Table 17.2 – Whabouchi Concentrator Summarized Process Mass Balance**

Mass Entering System				Mass Exiting System			
Streams	Dry Solids (t/d)	Water (m <sup>3</sup> /d)	Total Mass (t/d)	Streams	Dry Solids (t/d)	Water (m <sup>3</sup> /d)	Total Mass (t/d)
Fresh Water from several sources	—	320.0	320.0	Grey Water	—	44.2	44.2
Spodumene Ore to Concentrator	2,978.1	60.8	3,038.9	Water Evaporation from Dryer	—	40.3	40.3
Dense Media	0.9	—	0.8	Ore Sorter Rejects	325.1	6.4	331.5
Reagents	0.8	1.7	2.5	Final Concentrate	570.7	7.5	578.3
				Final Tailings	2,084.0	284.2	2,368.2
<b>Total Entering</b>	<b>2,979.8</b>	<b>382.5</b>	<b>3,362.3</b>	<b>Total Exiting</b>	<b>2,979.8</b>	<b>382.5</b>	<b>3,362.3</b>

Differences may be due to rounding.

Figure 17.1 illustrates a summary of the water flows around the different circuits of the concentrator.

Figure 17.1 – Water Balance



### 17.1.3 FLOW SHEETS AND PROCESS DESCRIPTION

Simplified flow sheets are presented in Figures 17.2 and 17.3. These flow sheets are indicative of the process. The crushing facility can operate independently from the concentrator, to the extent that the fine ore can be stockpiled. The concentrator has three (3) distinct process areas: dense media separation, flotation, and dewatering. Figure 17.2 shows the crusher area with ore sorting. Figure 17.3 shows the concentrator simplified flow sheet.

#### 17.1.3.1 *Crushing and Ore Sorting*

There is an accommodation for an 80,000 t mine ore stockpile at the crusher. The crushing is split in three (3) areas, primary crushing, ore sorting, and fine crushing, see Figure 17.2.

The ROM ore, containing 17.5% spodumene with a moisture content of 2%, will be dumped into a hopper by front end loaders. The ore is transported via an apron feeder, underneath the hopper, into the jaw crusher. The primary crusher discharge will have a particle size of 80% less than ( $P_{80}$ ) 95 mm. The broken rock will be transported via conveyors to the double deck coarse ore crusher screen. The top deck has 80 mm screen openings and the bottom deck has ten (10) mm screen openings. The top deck oversize of this screen is returned to a smaller second jaw crusher. The discharge of the second jaw crusher, with a  $P_{80}$  of 72 mm, returns via the same conveyors to the same coarse ore screen in closed circuit. The bottom deck screen oversize will be transported to the ore sorters. The coarse ore crusher screen undersize is transported to fine crushing area.

Ore sorters operate by identifying ore from waste and removing the waste preferentially using air jets through small nozzles. The method of identification is X-Ray Transmission ("XRT"). Once a particle is identified as waste the ore sorter targets this particle for removal. The ore sorting area starts with screening the feed using the coarse ore sorter feed screen with 35 mm openings. The coarse ore sorter feed is – 80 mm + 35 mm, while the fine ore sorter feed is – 35 mm + 10 mm. The waste is rejected and stockpiled for removal with mine trucks to the co-disposal area, while the accepted material is transported to the fine crusher ore facility via belt conveyors.

The fine crushing facility is composed of screening and 2-stage crushing. The coarse ore screen fines and the sorter accepted material are combined and then screened on a double deck vibrating screen. The screen top deck opening is 20 mm, while the bottom deck opening is 9 mm. Both screen oversize discharges are transported to a coarse ore bin. This bin has two (2) compartments, -80 mm + 20 mm and -20 mm + 9 mm. The secondary cone crusher feed is deposited in the coarser section. There are two (2) secondary crushers and one tertiary crusher. The crushers operate in closed circuit with the double deck screen to produce a crushed product  $P_{80}$  of 5.8 mm will be conveyed to the fine ore stockpile near the concentrator building.

The secondary crushers will be standard cone crushers that crush the top deck oversize to a  $P_{80}$  of 21 mm. The tertiary crusher will be a short head cone crusher that crushes the bottom deck oversize to a  $P_{80}$  of 12.7 mm. All crusher discharges will be re-directed to the double deck vibrating screen via two (2) conveyors.

**Figure 17.2 – Simplified Flow Sheet of Crusher and Ore Sorting**

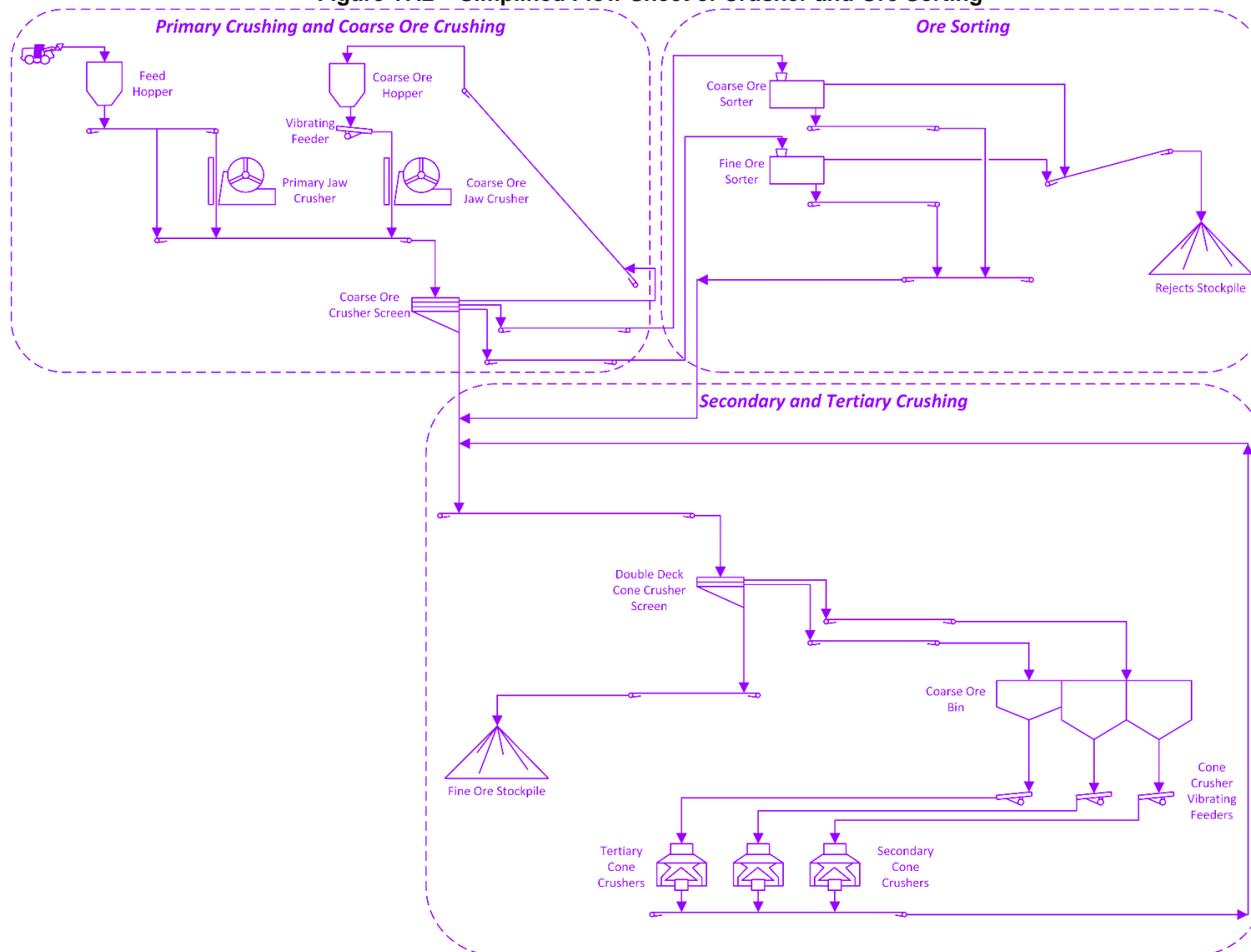
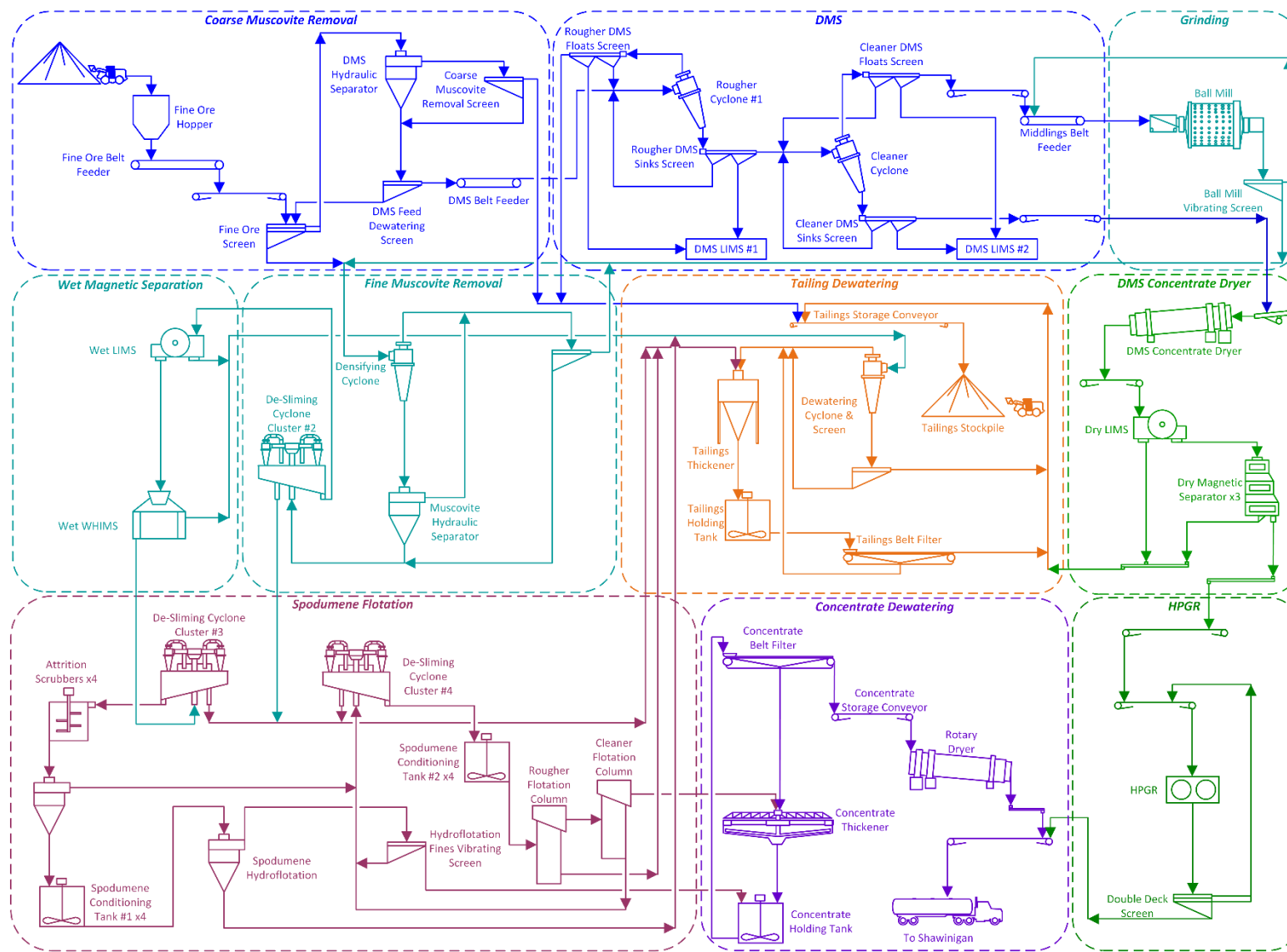


Figure 17.3 – Simplified Flow Sheet of Concentrator





#### 17.1.3.2 Concentrator

The fine ore stockpile is located in a dome. It has a capacity of 2,600 tonnes. The concentrator includes multiple stage of separation and concentration as well as products dewatering circuits. A simplified flow sheet is presented in in Figure 17.3.

##### a. Preparation to Dense Media Separation

Ore will be added by front end loader to a fine ore hopper with one (1) belt feeder. The belt feeder transfers the crushed ore to a conveyor and to a double deck vibrating screen, the fine ore screen. This double deck vibrating screen has a top deck with 2.0 mm openings and a bottom deck with 0.85 mm openings. The top deck is a protection deck to improve screening performance and prevent bottom deck damage from coarse gravel. The screen undersize goes to the fine muscovite removal circuit. Both top deck and bottom oversize report to the coarse muscovite removal circuit.

##### b. Coarse Muscovite Removal

The coarse muscovite removal hydraulic separator uses water as the separating medium. Water is injected into the lower part of the separator and flows upwards. The hydraulic separator removes coarse muscovite flakes and some finer ore particles. The hydraulic separator overflow is screened over a single deck screen with 2 mm openings. The screen oversize goes to final tails, while the screen undersize is mixed with the hydraulic separator underflow and pumped to a dewatering screen prior to the DMS circuit. The screen oversize is stored in the DMS feed bin.

##### c. Dense Media Separation

The DMS is a gravity concentrator that uses fine ferrosilicon as dense medium to enhance the separation of the ore by specific gravity. The fine ferrosilicon, when combined with water, behaves like a heavy liquid. The apparent specific gravity of this “heavy liquid” is controlled by water addition to the ferrosilicon slurry. The material with the higher specific gravity is referred to as sinks (concentrate), while the less dense material is floats (tailings).

The Whabouchi concentrator design is based on a 2-stage dense media separation unit. The first stage consists of two (2) DMS cyclones, the rougher stage, and produces a Rougher Sinks and a Rougher Floats stream. The floats become the DMS tailings. The Rougher Sinks is re-processed in the second stage which consists of a single DMS cyclone, the cleaner stage, to produce a Cleaner Sinks and a Cleaner Floats. The Cleaner Floats are considered middlings and are transported by conveyor to the ball mill. The Cleaner Sinks form the DMS concentrate. The DMS concentrate is sent to the dryer.

The sinks and floats of each stage are separated from the dense medium using wash screens. The ferrosilicon recovered is densified using low intensity magnetic separators and reused in the DMS process.

d. Drying and Magnetic Separation

The DMS concentrate is dried in a rotary dryer to a moisture content of less than 1% as dry magnetic separation requires free flowing material to perform efficiently.

The first stage of magnetic separation is affected by low intensity magnetic separation; the second stage uses rare earth high intensity magnetic separation. The final DMS concentrate will have at least 6.3%  $\text{Li}_2\text{O}$ . The magnetic material is transported to tailings via conveyors.

e. Concentrate Drying and DMS Concentrate Crushing

In Phase 2, the DMS concentrate will be crushed using an HPGR to facilitate the lithium refining at the electrochemical facility. This crushing circuit will include a buffer feed bin, several conveying systems, and HPGR and a dry screen. The material will be crushed to an  $F_{100} = 1.0 \text{ mm}$ .

f. Grinding

The DMS middlings need to be ground to liberate the finer spodumene particles. They enter the ball mill via the ball mill feeder conveyor from the Middlings storage bin. The ball mill discharge is pumped to the ball mill fine screen with apertures of  $850 \mu\text{m}$ . The screen oversize reports back to the ball mill. The screen undersize, at a  $P_{80}$  of  $640 \mu\text{m}$ , is pumped to the fine ore screen undersize to join the natural fines for fine muscovite removal stage.

g. Fine Muscovite Removal

The fine ore screen undersize and the ball mill product are pumped to cyclones to densify the slurry. The cyclone underflow is introduced into the fine muscovite removal hydraulic separator. The muscovite and fine particles of less than  $200 \mu\text{m}$  are pushed to the overflow. The overflow is screened at 212 microns to recover fine ore particles that would be lost with the muscovite flakes. The screen oversize is tailings with mostly muscovite.

The hydraulic separator underflow is mixed with the screen undersize and pumped to a second cyclone cluster for de-sliming. The slimes are rejected to tailings, while the de-slimed material is transferred to wet magnetic separation.

h. Wet Magnetic Separation

Magnetic separation is performed in two (2) stages. The first step is the removal of residual dense media and steel from the ball mill with a Low Intensity Magnetic Separator. The second stage is a Wet High Intensity Magnetic Separation to remove paramagnetic material from the flotation feed. The magnetic products are tailings, while the non-magnetic products are the feed to the third cyclone cluster for further de-sliming. These cyclones have a dual duty to remove more slimes and to densify the attrition scrubber feed.

i. Attrition and De-sliming

This circuit is mainly for the removal of more deleterious tailings prior to spodumene flotation. The attrition step is used to loosen tenacious fine particles. It must be performed at a high pulp density to be effective. A dispersant is added to enhance loosening of the fines and caustic soda is used to increase pH to 12 and make the dispersant more potent.

The attrition scrubber discharges into a hydraulic separator. This hydraulic separator is a classifier to ensure that the quantity of fines in the underflow are kept to a minimum before going to Hydroflotation. The separator has a cut size of 250  $\mu\text{m}$ . The underflow goes to the conditioning stage for coarse flotation particles, using Hydrofloat, while the overflow goes to a fourth (4<sup>th</sup>) set of cyclones, which constitutes the final de-sliming phase and provides the high slurry density required for spodumene conditioning before column flotation.

j. Spodumene Hydroflotation

The spodumene Hydroflotation circuit consists of conditioning, flotation and screening of the recovered concentrate. The circuit starts with four (4) stages of high-density conditioning using a spodumene collector. Sulfuric acid is introduced to lower the alkalinity of the flotation feed and achieve a conditioning pH of 8. High density conditioning is a process requirement to obtain the proper particles preparation.

Hydroflotation is blend of a hydraulic separator and column flotation, and the unit is called a HydroFloat separator. This system is used to float coarse material as the collector will attach itself to coarse minerals particles and these will have an increased buoyancy due to air sticking to them. The water up-flow entrains some finer particles non-selectively. The HydroFloat concentrate is screened at 250  $\mu\text{m}$ . The fine screen undersize is recycled to the column flotation circuit. The screen oversize, with a grade of approximately 5.5%  $\text{Li}_2\text{O}$ , is stored into the concentrate holding tank in the concentrate dewatering circuit.

k. Spodumene Column Flotation

The conditioning step of the column flotation circuit is adjusted for the fine particles, which requires a different collector dosage than the HydroFloat conditioning stage.

The spodumene column flotation circuit consists of two (2) flotation columns. The rougher column tailings are pumped to the tailings thickener. The rougher concentrate is pumped to the cleaner column. The cleaner column concentrate is a final concentrate with a grade of approximately 6.4%  $\text{Li}_2\text{O}$ . The cleaner tail is recycled back to the pump box of the 4<sup>th</sup> set of cyclones to be reintroduced in the column flotation circuit.

l. Spodumene Concentrate Dewatering and Storage

The coarse HydroFloat concentrate is screened and the oversize sent to the concentrate holding tank. The screen undersize is sent to the fine column flotation concentrate and is thickened to 62% solids in a high capacity thickener. The combined flotation concentrate is

then filtered to <8% moisture using a belt filter. The filtered concentrate is then dried to 1.5% moisture content using a rotary dryer. The dried flotation concentrate is sent to the same conveyor as the dried DMS concentrate. The blend of filtered and DMS concentrate is conveyed into a 3-day concentrate storage bin.

The combined DMS and flotation concentrate is expected to have < 1.5% moisture.

m. Tailings Dewatering and Storage

The coarse tailings will be screened, while the fine tailings from several locations in the concentrator will be thickened to 61% solids in an inclined plate settler. The thickened tailings will then be filtered to 15% moisture using a belt filter. The filtered tailings will be sent to the same conveyor as the rest of the tailings from screens. The combined tailings are transported by conveyor into a 1-day tailings storage stockpile.

Mine haul trucks will transport the tailings to an onsite tailings co-disposal area.

#### 17.1.4 WHABOUCHI PROCESSING CONCENTRATOR - EQUIPMENT SIZING AND SELECTION

The equipment selection was based on the fulfillment of the design criteria. The equipment list was prepared, and the equipment was sized according to the developed design criteria, the flow sheet drawings and the mass balance. The design factor for crushing equipment was set at 30%. The concentrator mostly uses a 15% design factor but is depended on the type of equipment and 5% was used for slurry pumps.

##### 17.1.4.1 Primary Crushing

Primary crushing takes place in two (2) separate crushers. This circuit main equipment consists of two (2) jaw crushers and a double deck screen. Jaw crushers are the most appropriate crushers for this facility based on throughput rate and cost.

The static grizzly, with bars spaced at 610 mm, is on top of a surge hopper with 42 m<sup>3</sup> capacity. Underneath the hopper is an apron feeder with a length of 4,300 mm and a width of 1,524 mm. The feeder controls the ore fed in one 1000 mm × 1300 mm – 160 kW jaw crusher at a rate of 190 t/h.

The crushed ore is transported on two (2) 1220 mm wide conveyors to a triple deck vibrating screen. The screen has a top deck with 80 mm openings, a middle deck with 35 mm and a bottom deck with 10 mm openings. The top deck oversize is transported via a 1220 mm conveyor into a conveyor going to an 8 m<sup>3</sup> surge hopper. The hopper discharges via a vibrating feeder 0.6 m wide × 3.6-m long into an 800 mm × 1150 mm – 132 kW jaw crusher.

The secondary jaw crusher operates at a rate of 73 t/h and discharges back onto the conveyor feeding the surge hopper of the triple deck screen. The middle and bottom deck oversize are transported to the ore sorting circuit. The screen bottom deck undersize goes to the fine crushing circuit.

The crusher sizing was based on crushing work index test work results and performed by in-house DRA experts. Screen sizing and crusher selection were based on producing a minus 80 mm product for ore sorting limitations.

The crushing area is now partially erected. The crushing area electrical room is installed and powered. The jaw crusher structural steel is erected, with mechanical equipment installation in progress. The secondary and tertiary crushing building is erected, with mechanical equipment installation in progress.

#### 17.1.4.2 *Ore Sorting*

The middle and bottom deck screen oversize consist of 83% of the original feed and goes to a single deck ore sorter screen. The middle deck screen oversize is – 80 mm + 35 mm in size and is transported to the coarse ore sorter at a rate of 106 t/h. The bottom deck screen oversize is – 35 mm + 10 mm and goes to the fine ore sorter at a rate of 52 t/h. 915 mm wide conveyors are used from this point for all material finer than 80 mm.

The ore sorting average rejection rate was estimated at 13% or 21 t/h. The accepted material is transported to the fine crushing circuit at a rate 137 t/h. The ore sorter sizing is based on the bench scale test work at suppliers' facilities.

It is expected that Nemaska will install a future scavenger ore sorter which will increase the ore sorting efficiency. This new ore sorter facility is expected to be in operation within a four-year period after Project start-up.

The ore sorting building has been erected, and the ore sorters are in place on secondary steel, with additional mechanical equipment installation in progress. Conveyor assembly has begun, erection will begin once conveyor segments are complete and lifting operations in the area have been done.

#### 17.1.4.3 *Secondary and Tertiary Crushing*

A double deck screen combined with three (3) cone crushers have been selected for this section based on tonnage and the final ore crushed size required.

The crushed ore from the primary crushers and the ore sorting circuit is transported via conveyors to the secondary crushing circuit. The crushed ore will be classified on the crusher vibrating screen consisting of one (1) 2.4 m wide × 7.3 long double deck vibrating screen with top deck screen apertures of 20 mm and the bottom deck screen apertures of 9.0 mm.

The top deck oversize will be crushed in two (2) standard secondary cone crushers which have 132 kW drives producing crushed ore, at a  $P_{80}$  of 21 mm. The discharge from these crushers is recycled back to the crusher vibrating screen.

The bottom deck oversize will be crushed in the tertiary short head cone crusher which has a 132 kW drive and produces crushed ore at a  $P_{80}$  of 12.7 mm. The discharge from this crusher is also recycled back to the crusher vibrating screen.

The crusher vibrating screen undersize will have a  $P_{80}$  of 5.8 mm and will be transported by conveyor to the fine ore storage stockpile located in a dome at a rate of 169 t/h.

The crusher sizing was based on crusher work index test work results and performed by in-house DRA/Met-Chem's experts and the supplier. Screen sizing and crusher selection were based on producing a final crushed material at 100% passing 9 mm.

#### 17.1.4.4 Fine Ore Screening

The fine ore is loaded with a front-end loader into a surge hopper with 42 m<sup>3</sup> capacity located outside the concentrator. A belt feeder, underneath the hopper and equipped with a VFD, controls the ore tonnage to the double deck fine ore screen with one (1) 2.4 m wide × 6.1 m via a transfer conveyor at a rate of 120 dry t/h. The fine ore screen undersize (– 0.85 mm) bypasses the DMS system and is pumped to the fine muscovite removal circuit. The fine ore screen oversize (– 9.0 mm + 0.85 mm) is pumped to the coarse muscovite removal circuit at a rate of 100 dry t/h.

The surge hopper sizing allows half (½) hour retention capacity to provide flexibility for the front-end loader operator which is also required to load the tailings, located in the same dome, into the mine trucks for transportation to the co-disposal facility.

#### 17.1.4.5 Coarse Muscovite Removal

The screen oversize is fed into a 1.83 m × 1.83 m hydraulic separator. The hydraulic separator overflow flows over a sieve bend with 0.8 mm openings to remove the excess water and is then screened by a single deck screen (1.22 m × 3.05 m) with 2.0 mm square openings in the panels.

The screen oversize is directed to tailings, while the undersize is mixed with the separator underflow and pumped to the DMS hydraulic separator underflow dewatering screen. The dewatering screen (1.83 m × 3.66 m) has 0.85 mm openings in the panels. The dewatering screen undersize is mainly water and flows back by gravity to the fine ore screen, while the screen oversize is stored into the DMS feed bin with a capacity of 220 tonnes. Underneath the DMS feed bin is a belt feeder with scale to accurately deliver DMS feed to the separators at a rate of 114 dry t/h.

The hydraulic separator sizing was based on the bench scale test work at the supplier.

#### 17.1.4.6 Dense Media Separation

This system is modular with turnkey design and supply. It includes two (2) separation stages, the rougher stage and the cleaner stage. Each stage operation is described below. The design is based on DRA/Met-Chem's experts for similar application.

##### a. Rougher DMS

The first step is a feed preparation screen to ensure only loose material enters the feed. After mixing with dense media, the material is pumped into one (1) 660 mm diameter cyclone, which make up the first stage of DMS. This cyclone includes two (2) dense medium single deck drain and wash screens. The rougher stage also includes a dense media recovery system.



This rougher stage will be operated at low-density with a cut point at a specific gravity of 2.7. The cyclone overflows are rougher floats (DMS tailings) and is conveyed to tailings after washing and screening. The cyclone underflows are the rougher concentrate and, after washing and screening, are dropped into the DMS cleaner feed pump box.

b. Cleaner DMS

After mixing the rougher concentrate with dense media, the material is pumped into one (1) 510 mm diameter cyclone, which is the second stage of DMS. This cyclone includes its own separate two (2) dense medium single deck drain and wash screens and a dense media recovery system.

This cleaner stage will be operated at a higher density with a cut point at a specific gravity of 2.96. The cyclone overflow is cleaner floats (DMS middlings) and is conveyed to the DMS middlings storage bin after washing and screening. The cyclone underflow is the cleaner concentrate and, after washing and screening, is conveyed to the DMS concentrate dryer.

It is estimated that the DMS plant will require 0.9 tonne of ferrosilicon per day to maintain the proper dense media operating levels in the circuit.

17.1.4.7 *Fine Muscovite Removal*

The fine ore screen undersize, including the ground DMS middlings, is pumped into a densifying cyclone. This cyclone will thicken the fine muscovite hydraulic separator feed.

The cyclone underflow, at 60% solids, goes into a 1.83 m × 1.83 m hydraulic separator. The hydraulic separator overflow combines with the cyclone overflow and flows over a sieve bend with 0.25 mm openings to remove the excess water and is then screened by a single deck screen with 0.2 mm openings. The screen oversize is tailings, while the undersize is mixed with the hydraulic separator underflow and the combined mixture is pumped to a de-sliming cyclone cluster.

This second cyclone cluster consists of 30 - 4-in. cyclones with 19 in operation and 11 as standby. The de-sliming cyclone overflow is tailings, while the underflow is pumped to wet magnetic separation.

The hydraulic separator sizing was based on the bench scale test work at the supplier. Cyclone clusters sizing was based on producing the proper density for the hydraulic separator and optimal slimes removal.

17.1.4.8 *Grinding*

The DMS middlings are transported by belt feeder at a rate of 38.4 dry t/h into a 2.4 m diameter by 3.2 m effective grinding length ("EGL") 285 kW grate discharge ball mill. The ball mill discharge is pumped to the ball mill screen.

The ball mill screen is a single deck high frequency vibrating fine screen with panels at 0.85 mm apertures. These panels will be used to produce a product of 80% passing 0.64 mm. The oversize

goes back into the ball mill, while the screen undersize is pumped to fine ore screen undersize pump box.

The ball mill sizing is based on the bond ball mill work index tests and simulations. A variable speed drive was specified to avoid overgrinding and to be flexible with grinding capacity.

#### 17.1.4.9 *Wet Magnetic Separation*

The second cyclone cluster underflow will be pumped to a wet magnetic separation circuit to remove iron oxides bearing minerals. This will be carried out in two (2) steps. In the first step, a 1.2 m diameter x 1.5 m wide counter rotation single drum magnetic separator will be used as LIMS at 950 Gauss. The second step will use a vertical Wet High Intensity Magnetic Separator (“WHIMS”) at 12,000 Gauss to remove paramagnetic material.

The magnetics rejects from both LIMS and WHIMS are combined and sent to the tailings dewatering cyclones. The WHIMS non-magnetic product is further de-slimed in a third cyclone cluster prior to attrition scrubbing.

This third cyclone cluster is required to ensure thickening before attrition scrubbing and removes more slimes. It consists of twelve (12) 4-in. cyclones with eight (8) in operation and four (4) as standby. The cyclone overflow will contain 3% w/w solids and the cyclone underflow will have 60% w/w solids.

The magnetic separators power was sized using bench scale and pilot plant test work results. The cyclones sizing was recommended by manufacturers using simulations.

#### 17.1.4.10 *Attrition and De-sliming*

Attrition scrubbing is used to clean the mineral surfaces from slimes that adhere to the larger particle surfaces. The third cyclone cluster underflow discharges into the attrition scrubber circuit with four (4) attrition cells of 3.5 m<sup>3</sup> each, where dispersant and caustic soda is added to assist with the loosening of persistent sticky fines. The scrubber discharge feeds the attrition scrubber hydraulic separator which is used for size classification to minimize fines that enter the hydroflotation step. The separator underflow (at 68% solids) flows to the hydroflotation conditioning, while the separator overflow is pumped to a fourth cyclone cluster ahead of the column flotation circuit.

This fourth cyclone cluster removes loosened fines from the attrition scrubber stage and ensures thickening before high density conditioning for column flotation. The cyclone cluster consists of nineteen (19), 4-in. diameter, cyclones, twelve (12) operating and seven (7) as standby. The cyclone overflow will contain 0.1% w/w solids and will go to the tailings thickener. The cyclone underflow will have 56% w/w solids.

The attrition scrubber cells residence time was derived from pilot plant test work and the hydraulic separator sizing was recommended by suppliers based on throughput and cut point. The cyclones sizing was derived from manufacturers simulations.

#### 17.1.4.11 Spodumene Hydroflotation

The operation uses coarse and fine spodumene flotation. The coarse flotation will be done using a hydroflotation unit.

High-density conditioning is a requirement for spodumene flotation to succeed. The slurry from the hydraulic separator underflow feeds the high density spodumene conditioning tank #1 by gravity, where sulfuric acid and spodumene collector are added. The sulfuric acid is required to bring the pH down to 8, for proper conditioning to be achieved. There is one conditioning tank of 13 m<sup>3</sup> with four (4) agitators for each section to provide a narrow residence time for conditioning of the flotation feed. Each conditioning tank section is equipped with a 22 kW agitator.

The conditioned slurry is pumped from the last conditioning tank to the feed of the spodumene hydroflotation separator. The hydroflotation separator is 1.8 m diameter × 3.7 m high. Air, water and frother are injected near the bottom of the separator and this causes the spodumene to adhere to air bubbles and float to the surface of the cell. The separator underflow are final tailings, while the separator overflow is screened

The hydroflotation screen is a multiple stack high frequency vibrating screen with panels having 0.25 mm apertures. The oversize goes to the spodumene concentrate filter holding tank, while the screen undersize joins the fourth cyclone cluster feed pump box. This way the material is introduced to column flotation.

The conditioning cells residence time was derived from pilot plant test work. The hydraulic flotation separator sizing was provided by the supplier based on pilot scale test work.

#### 17.1.4.12 Spodumene Column Flotation

The fourth cyclone cluster underflow slurry feeds the high density spodumene conditioning tank #2 by gravity. Again, sulfuric acid and spodumene collector are added as spodumene flotation reagent. The sulfuric acid brings the pH down to a pH=8, for proper conditioning to be achieved. Frother is added to the last tank. This is a four (4) section conditioning tanks of 13 m<sup>3</sup> to provide a residence time for conditioning of the flotation feed. Each conditioning tank is equipped with a 15 kW agitator.

The slurry is pumped from the last conditioning tank into the rougher flotation column. This flotation column is 2.5 m diameter × 8.0 m high. Air is injected near the bottom of the column and this causes the spodumene to float. The column underflow is final tailings, while the column overflow is rougher concentrate.

The rougher concentrate feeds the cleaner flotation column. This cleaner flotation column is 2.5 m diameter × 8.0 m high. Air is injected near the bottom of the column and this causes the spodumene to float. The column underflow is cleaner tailings, while the column overflow is final concentrate. The cleaner tail is recycled back to the dewatering cyclones cluster #4 to be reintroduced to the rougher flotation column. The concentrate from the cleaner column flows by gravity to the concentrate thickener.

The conditioning cells residence time was derived from pilot plant test work. The flotation column sizing was based on the pilot scale test work at the supplier's laboratory.

#### 17.1.4.13 DMS Concentrate Drying

Based on test work results, dry magnetic separation was found to be efficient in upgrading the coarse DMS concentrate.

The DMS concentrate will be conveyed to a 1.65 m diameter × 15.5 m long rotary dryer indirect electric dryer with a 2.5 MW heating capacity.

The dried concentrate is then transported to the dry magnetic separation circuit.

The dryer sizing was based on the bench scale test work at the supplier and calculations for the concentrate moisture and feed tonnage.

#### 17.1.4.14 Dry Magnetic Separation

Based on test work results, dry magnetic separation was found to be efficient on coarse material separation.

The magnetic separation of dried DMS concentrate will be carried out in three (3) stages in a single enclosed unit. The unit has a 120 °C temperature maximum rating. The first stage is designed with a lower field intensity and is used as Low Intensity Magnetic Separator (“LIMS”). The second and third stages use rare earth magnetic separator drums as High Intensity Magnetic Separator (“HIMS”). The peak magnetic field intensity on the HIMS drum goes up to 8,000 gauss and is effective in removing fine ferrous iron and many coarse paramagnetic constituents.

The dry magnetic separator sizing was based on the full-scale test work at the suppliers' facilities.

#### 17.1.4.15 Dry DMS Concentrate Crushing using HPGR

The dry DMS concentrate is conveyed to a holding bin. This bin will buffer the feed to the HPGR. The bin capacity will be 32 tonnes. The HPGR with rolls of 800 mm in diameter × 500 mm width, with two (2) drives of 75 kW. The crushed material will be screened by a single deck screen (1.52 m × 3.66 m) with 2.0 mm square openings in the panels. The screen oversize is redirected to the HPGR feed bin, while the undersize is mixed with the filtered concentrate dry material.

The HPGR and screen sizing was based on simulation using supplier software.

#### 17.1.4.16 Concentrate Dewatering and Storage

The final column concentrate goes to the concentrate thickener, which is a 6.0 m diameter high rate thickener. The thickener overflow is pumped to the process water tank for recirculation of process water, while the concentrate thickener underflow at 62% solids will be pumped to spodumene the concentrate holding tank (5.5 m diameter × 8.4 m high). The solids will be kept in suspension with a 90 kW agitator.

From the holding tank, the concentrate is pumped to the concentrate filter. The belt filter was sized based on filtration tests. The filter has a filter area of 6 m<sup>2</sup>. The filtrate will be re-circulated to the spodumene concentrate thickener via a filtrate pump.

The filter cake at about 6.5% moisture will be dried to 1.5% using a diesel fuel rotary dryer. The dryer will be 1.8 m diameter x 12.2 m long with a capacity of 1.1 MW.

The dried crushed DMS concentrate and the dried filtered concentrate will be combined and stored in one silo. The one silo will be 11 m diameter x 23 m high and hold 2,200 tonnes.

The high rate concentrate thickener was sized based on sedimentation test work conducted at SGS. The filter was sized by filtration test work performed on concentrate made from the pilot plant testing. The dryer dimensions have been estimated by DRA/Met-Chem. Diesel was selected as the electrical power consumption as the f was nearing the maximum load of grid connexion.

#### 17.1.4.17 *Tailings Dewatering and Storage*

Various streams from the concentrator, including overflow from de-sliming and dewatering cyclone clusters, magnetics from LIMS and WHIMS and tailings from column flotation circuit and hydroflotation circuit are pumped through a single (1) 420 mm dewatering cyclone. The cyclone underflow is screened on the tailings dewatering screen. The screen undersize is pumped with the cyclone overflow to the 10.5 m diameter x 12.6 m high inclined plate settler or thickener.

The tailings screen is a standard dewatering where screen oversize is discharged on the tailings storage conveyor.

The thickener overflows into the process water tank, while the tailings thickener underflow at 61% solids is pumped to the tailings holding tank.

The tailings holding tank has dimensions of 5.6 m diameter x 7.2 m high.

From the holding tank, the tailings are pumped to the tailings vacuum filter. The belt filter, with 12 m<sup>2</sup> of filtering surface, will produce a filter cake with a moisture content of 15%. The filtrate will be re-circulated to the tailings thickener by a filtrate pump. The filter cake is combined with the other tailings and stored in a dome before trucking to the co-disposal area.

The inclined plate settler was sized based on bench scale sedimentation test work and hydraulic loading capacity with recommendation from the manufacturer.

Trucks will be used to transport the tailings to the onsite co-disposal area.

### 17.1.5 WHABOUCHI PROCESSING CONCENTRATOR – UTILITIES

#### 17.1.5.1 *Concentrator Water Services*

The water consumption is based on the concentrator nominal water consumption per hour.

a. Fire Water

Water wells will be the main water source of fresh water near the concentrator. The fresh water will be pumped to an 8 m diameter × 11 m high combined fresh water / fire water tank.

b. Process Water

Process Water will be recycled back, at a nominal rate of about 943 m<sup>3</sup>/h, from the tailings and concentrate thickeners. The process water tank is 10 m diameter × 12.8 m high.

c. Gland Water

The gland water system has a separate 5.5 m<sup>3</sup> gland seal water tank. A water filtration system produces 20.9 m<sup>3</sup>/h of gland water. This filtration system cleans process water. The remaining 11.7 m<sup>3</sup>/h water comes from the fresh water system, and 10.0 m<sup>3</sup>/h is recirculated back into the gland water tank.

d. Potable Water

Potable water will be used at a rate of 2.0 m<sup>3</sup>/h. This water is treated in the site potable water treatment system located near the camp prior to entering the concentrator. The potable water system will supply water to safety shower, concentrator offices and dry, mine dry and laboratory.

The fresh / fire water tank and process water tank have both been erected. The fresh / fire water tank is in service, currently providing the site with fresh water.

17.1.5.2 *Concentrator Compressed Air (High Pressure)*

The ore sorters will have their own air compressor and dryer which is slightly oversized to provide compressed air in other areas of the crushing circuit. This will be used for dust collection pulsation and other small requirements.

In addition, flotation equipment (flotation columns and hydroflotation unit) will have a separate compressed air network to maintain a constant pressure. The main air compressors will have variable speed drives. The variable speed drive air compressors, while more expensive, will be substantially lower in energy consumption. An air dryer and accumulator tank will be used for instrument air only.



## 17.2 Electrochemical Processing Plant

Based on the testing results described in Section 13.2, the electrochemical plant process design criteria, mass balance, process flow sheets, equipment list as well as plant layouts were prepared for a plant design feed rate of 215,000 t/y (dry) of 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate and a lithium sulfate solution feed rate of 2,000 tonnes per year  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$  eq. (dry). The Electrochemical plant is designed to produce 37,000 t/y lithium hydroxide monohydrate crystals (**LHM**) (approximately 33,000 t/y of Lithium Carbonate Equivalent ("**LCE**")). The following Section summarizes the process for the Project.

The Electrochemical plant processing activities include concentrate reception, calcination, acid bake (sulphation), leaching, purification, electromembrane process, acid concentration, LHM crystallization, LHM drying and packaging, and purge treatment. Services include river water treatment, boilers, cooling towers, reagent storage, compressed air, process gases, natural gas and electricity.

### 17.2.1 PLANT DESIGN CRITERIA

The process plant is scheduled to operate seven (7) days per week and 24 hours per day. The plant availability has been estimated at 85% based on benchmarks with comparable industries and dynamic simulation availability analysis. The overall lithium recovery is based on laboratory results and extensive mass balance modeling.

A summary of the key design criteria is presented in Table 17.3.

**Table 17.3 – Electrochemical Plant Design Criteria - Summary**

Parameters	Unit	Value
Concentrate Design Processing Rate	tonne per year (dry)	215,000
Concentrate Composition	% DMS /% Flotation	42 / 58
Concentrate Grade (Total)	% Li / $\text{Li}_2\text{O}$	2.9 / 6.25
Concentrate% Moisture	% $\text{H}_2\text{O}$	0.5%
Concentrate Size Distribution F95	microns	1,000
Lithium Sulfate Solution Feed Rate	tonne per year $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$ eq. (dry)	2,000
Plant Operating Time	hours per day	24
Overall Plant Availability	%	85
Lithium Hydroxide Monohydrate Design Production	tonne per year	37,000
Lithium Hydroxide Monohydrate Product Moisture	%	$\leq 0.1$
Lithium Hydroxide Monohydrate Product Grade	% $\text{LiOH}$	$\geq 57.5$ ( $< 20$ ppm Na)
Overall Lithium Recovery	%	94.9

## 17.2.2 SIMPLIFIED FLOW SHEETS

A simplified flow sheet is presented in Figure 17.4 and summarizes the process. The equipment list has been based on the process flow diagrams and the equipment has been sized based on the design criteria and mass balance.

## 17.2.3 PROCESS DESCRIPTION

The section provides a high-level overview of the process. Multiple process details have not been included in order to maintain Nemaska's Intellectual Property (IP).

Risks related to the process are discussed in Section 25.3.2.1.

### 17.2.3.1 Concentrate Reception and Thermal Conversion

The plant feed consists primarily of a blend of Dense Media Separation ("DMS") concentrate and flotation concentrate which has been dried and crushed at Whabouchi to the appropriate size for calcination.

The spodumene concentrate is transported from the mine and concentrator site to the Shawinigan process plant in railcars. Deliveries are expected approximately two to three times per week.

The current Whabouchi mine plan allows for a production of, on average, 205,000 tonnes per year of high-grade concentrate. Should additional concentrate be purchased to make full use of the 215,000 tonnes per year plant capacity, it will be shipped to site also by rail.

The concentrate is discharged from one (1) railcar at a time, into a receiving hopper. A series of conveyors feed the concentrate silo.

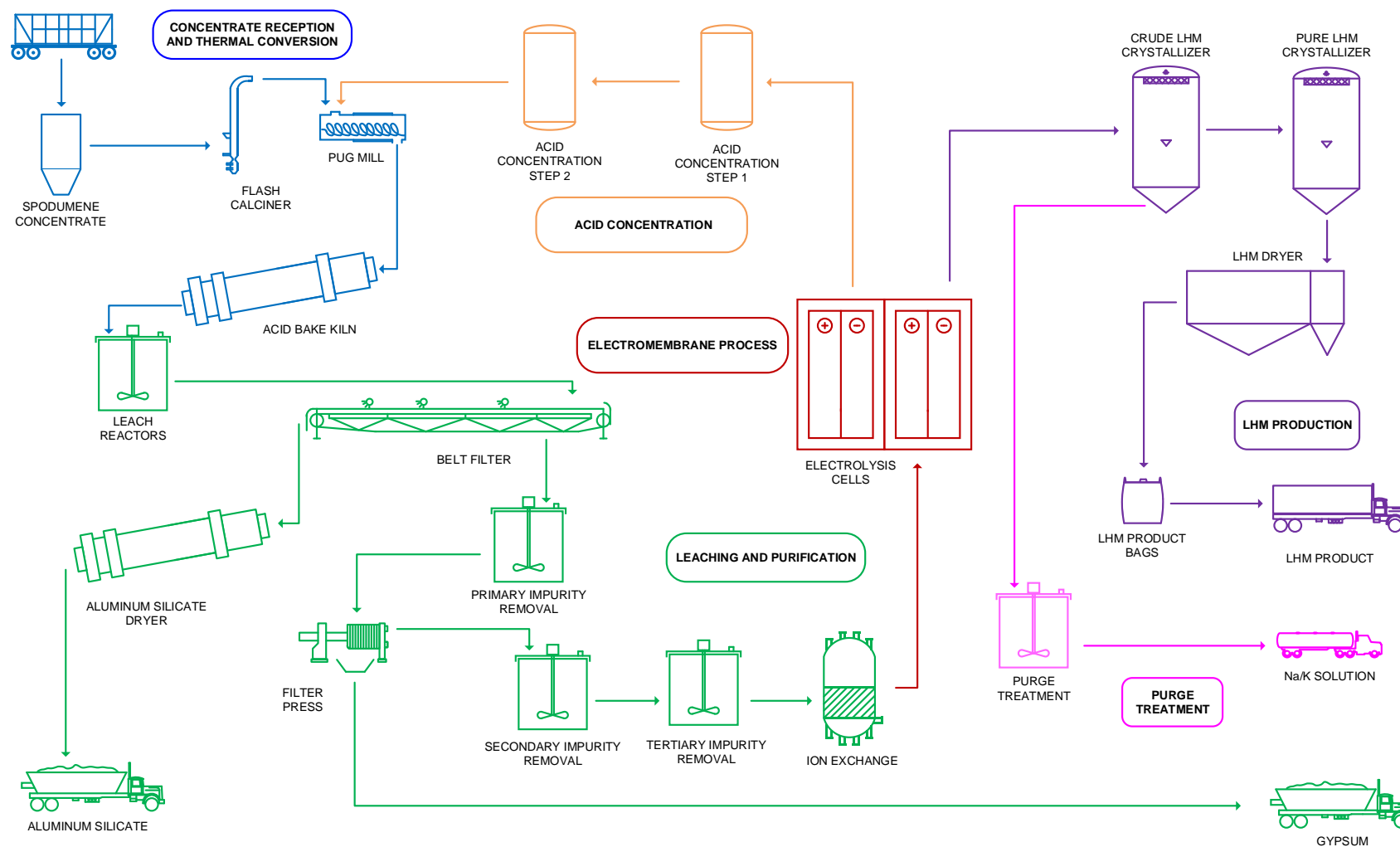
The Concentrate Silo live capacity will provide seven days of feed buffer for the calciner system and acts to buffer different production and transport schedules between the mine and the electrochemical plant.

Conveyors extract the concentrate from the silo and feed the calciner system. In the first step, the concentrate is preheated in three pre-heating cyclones. The concentrate is then calcined at 1,000 to 1,100°C in the natural gas fired Flash Calciner. At this temperature the spodumene concentrate is converted from the alpha crystalline structure to the beta crystalline structure.

Unlike alpha-spodumene, beta-spodumene is amenable to sulphation (acid bake) and water leaching. The hot concentrate is separated from the hot off gases and is cooled in a series of Cooling Cyclones. Air used in the process flows counter current to the solids and acts as the pre-heating, transport and cooling medium.

Hot flue gases from the calciner system are sent to a dedicated baghouse to remove any dust. The dust is recycled within the calcination system. The cleaned flue gas is exhausted to atmosphere.

Figure 17.4 – Lithium Electrochemical Plant Simplified Flow Sheet



Final cooling of the roasted concentrate is performed in a water cooled indirect Roasted Concentrate Cooler and stored in a Roasted Concentrate Silo. The silo has 26 hours of buffer capacity for the downstream acid bake sector.

#### 17.2.3.2 *Acid Bake*

The roasted concentrate silo feeds the acid bake sector via a series of pneumatic conveyors.

A mixture of fresh and recycled sulfuric acid is sprayed onto the beta-spodumene in a continuous Pug Mill with a stoichiometric ratio based on lithium grade and a slight predetermined excess. The homogeneous mixture is then fed to an indirect fired Acid Bake Kiln and heated up to between 200 and 300°C. The resulting reaction produces solid lithium sulfate and aluminum silicates. A wet vent scrubber draws the acidic vapors out of the Acid Bake Kiln, cools and cleans them before they are exhausted into the atmosphere. The Acid Bake Kiln is natural gas fired and the flue gases are vented to atmosphere.

Product of the acid bake kiln is cooled with water in an indirect Acid Bake Cooler to between 100 and 150°C before being sent to leach.

#### 17.2.3.3 *Leaching*

The sulfated concentrate, consisting of solid lithium sulfate and aluminum-silicate gangue material, is fed from the Acid Bake Cooler into the first of three Concentrate Leach Tanks. Wash water from a downstream belt filter, which will contain lithium sulfate in solution, and various miscellaneous recycle water streams, are also fed to the tank. Lithium sulfate and other sulfate salts, being soluble in water under these conditions, dissolve in the aqueous acidic phase.

The resulting slurry is pumped to the aluminum-silicate belt filter. Lithium sulfate solution is separated from the solid gangue material. Wash water is used in three (3) counter-current wash stages to recover the lithium sulfate solution trapped with the solid waste material. This filter cake, containing primarily aluminum-silicates, is then dried and shipped by truck offsite partly to disposal (first years of operation) and partly to clients. Multiple end-uses for the aluminum-silicate are being actively investigated by Nemaska and it is assumed that 100% of the aluminum silicate will be sold as by-product by the fifth year of operation.

#### 17.2.3.4 *Primary Impurity Removal (PIR)*

The filtered lithium sulfate solution collected at the belt filter is pumped to three PIR tanks arranged in series.

Hydrated lime slurry is fed to the PIR tanks to neutralise excess free acid and to increase the pH to precipitate out impurities such as iron and aluminum in the form of insoluble hydroxides.

To separate the precipitated metal hydroxides and gypsum from the lithium sulfate leach solution, the slurry is pumped to the PIR residue thickener. The overflow of this thickener can be fed directly

to the next purification step. The thickener underflow is pumped from the PIR residue thickener to a set of two filter presses. Filtrate will then be directed to the next purification step (SIR) along with the thickener overflow. The wet filter cake containing gypsum and metal hydroxides is shipped to disposal by truck.

The plant is also designed to accept up to about 3.5% of its lithium feed as lithium sulfate from external suppliers. The lithium sulfate is assumed to be received by tanker truck and added to the first PIR tank, but it is possible that a solid feed also be received (to be clarified during contract negotiations).

#### 17.2.3.5 Secondary Impurity Removal (SIR)

In the SIR tanks, the pH is further increased to precipitate even more dissolved metals such as silica, manganese and magnesium.

Out of the SIR tanks, the solid liquid mixture is pumped to a set of two (2) candle filters to remove the solid impurities from the lithium sulfate solution. The wet solid residue is combined with the PIR residue. The filtrate is pumped to the TIR.

#### 17.2.3.6 Tertiary Impurity Removal (TIR)

In the TIR, the leachate is processed with chemical additives to further precipitate impurities such as calcium and magnesium.

Out of the TIR reactors, the solid liquid mixture is pumped to a set of two (2) candle filters to remove the solid impurities from the lithium sulfate solution. The wet solid residue is recycled upstream to recover the lithium sulfate.

The filtrate is then pumped to the last purification step, the ion exchange process.

#### 17.2.3.7 Ion Exchange

The final lithium sulfate solution purification step is performed by four (4) ion exchange columns. The solution is fed to three (3) columns in series while the fourth is being cleaned/stripped/regenerated.

Purified lithium sulfate solution discharging from the columns is stored in the electrolysis feed tank. Waste solutions from the column stripping step are collected in the ion exchange residue tank and recycled upstream. Waste solutions from the column regeneration step are collected in the regeneration solution tank and recycled back to the process to capture any lithium salts.

The ion exchange is a polishing process aiming to reduce the impurities content to final specifications before the electrolytic conversion of the lithium sulfate solution into lithium hydroxide solution.

#### 17.2.3.8 Lithium Hydroxide (LiOH) Electromembrane Process

Nemaska's proprietary patented electromembrane process is used to convert lithium sulfate to lithium hydroxide.

Multiple feed tanks will provide up to 24 hours of feed to the electromembrane process.

An electric current is applied across the cell causing the positive lithium ions to cross the cation exchange membrane and water to split at the electrodes. In the cathode compartment, the lithium ions combine with the free hydroxide ions producing lithium hydroxide. In the anodic compartment, sulfuric acid is electrolytically generated.

The lithium hydroxide solution produced at the catholyte is fed to the lithium hydroxide crystallization circuit.

The dilute sulfuric acid electrolytically generated is sent to the acid concentration circuit to recover and reuse the sulfuric acid.

The hydrogen generated at the cathode is presently flared but, in the future, could be recycled to boilers or compressed and sold.

#### 17.2.3.9 Acid Concentration

The electromembrane process produces dilute sulfuric acid.

A two-step acid concentration circuit is used to enable the acid to be recycled within the process. In the first step, the dilute sulfuric acid is concentrated up to an intermediate concentration. In the second step, the acid is further concentrated in the Spent Acid Concentrator (“SAC”). The concentrated sulfuric acid is recycled back to acid bake.

This process provides multiple benefits namely reduced acid consumption, reduced lime consumption, and reduced gypsum disposal costs.

#### 17.2.3.10 Lithium Hydroxide Monohydrate Crystallization

The crystallization circuit produces LHM crystals from the lithium hydroxide solution generated in the electromembrane process. The crystallization circuit consists of a falling film evaporator, a forced circulation crude crystallizer and a forced circulation pure crystallizer. This double crystallization step improves the purity of the crystals produced.

Two (2) crystallization feed tanks will provide up to 28 hours of feed to the crystallization circuit. The LiOH feed solution is pre-heated in a plate and frame type heat exchanger and subsequently fed to a falling film evaporator for concentration. Evaporated water is recovered as distilled water and recycled in the plant.

The concentrated LiOH solution feeds the LHM crude crystallizer. LiOH solution is brought to its saturation limit causing the precipitation of LiOH.H<sub>2</sub>O crystals. The crude crystals are removed and washed in a pusher-type centrifuge. Evaporated water is recovered as distilled water and recycled to the plant.

A purge is taken off the crude crystallizer to control the impurity level in the crystals. This purge solution is sent to the Purge Treatment System.



The crude crystals are dissolved in water and pumped to the LHM pure crystallizer. This second forced circulation crystallizer will operate along the same principles as the LHM crude crystallizer.

The crystallizer is expected to produce pure wet crystals, which are to contain a maximum of 20 ppm Na and 10 ppm K.

#### 17.2.3.11 LHM Drying and Packaging

The LHM crystals discharging from the LHM pure crystal centrifuge are dried before the final packaging step. A fluid bed drying system using an electric heater will dry the lithium hydroxide monohydrate final product.

The final product will then be automatically packaged in 500 kg bags and shipped offsite by truck.

#### 17.2.3.12 Purge Treatment

The crude lithium hydroxide crystallization circuit is purged to control the buildup of impurities, mainly sodium and potassium.

Purge solution containing a mixture of lithium hydroxide, sodium hydroxide and potassium hydroxide is sent to the purge circuit.

The purge solution will be carbonated to remove and recycle most of the lithium. The remaining solution which is concentrated in sodium, potassium and trace lithium will be shipped offsite for disposal or sold as a by-product. Multiple end uses are being actively investigated by Nemaska.

#### 17.2.3.13 Reagents

Hydrated lime is received by truck and stored in a silo. It is mixed with water and used to control pH, produce gypsum and precipitate iron and other metals in the PIR tanks.

Sulfuric acid ( $\text{H}_2\text{SO}_4$ ) is delivered by truck and unloaded into outdoor storage tanks. The primary user of sulfuric acid is in the acid bake step as make-up to the recycled acid.

Small volume chemical additives are delivered by bags, drums or totes for localized users throughout the plant.

#### 17.2.3.14 Services

##### a. Cooling Water

Cooling water is required throughout the plant. A dedicated cooling water circuit will be supplied by multiple crossflow cooling towers.

##### b. Steam

Steam is required throughout the facility.

The plant is equipped with three (3) natural gas boilers. Two (2) boilers will operate at any one time. High pressure steam will be reduced to low pressure steam through a pressure reducing valve train.

One (1) boiler will have the ability to be modified in the future to use hydrogen gas (produced in electrolysis) as a fuel.

c. Compressed Air

Three (3) high pressure air compressors (two in operation and one stand-by) will provide instrument and plant air for all users throughout the plant. The main instrument air users are the filter presses, the various dust collection systems and instruments. Plant air is required in some reactors and for the utility stations.

d. Nitrogen

Nitrogen ( $N_2$ ) is used as a blanketing gas by multiple users throughout the facility.

Nitrogen is shipped to site by truck and stored in a pressurized storage tank.

e. Carbon Dioxide

Carbon dioxide gas ( $CO_2$ ) is used primarily in Purge Treatment, but also by multiple other minor users.

Carbon dioxide is shipped to site by truck and stored in a pressurized storage tank.

f. Natural Gas

Natural gas is used as a fuel throughout the facility, with the large users being the flash calciner, the acid bake kiln, the aluminum silicate dryer and the boilers.

Natural gas is supplied via the pipeline network available at the site location.

#### 17.2.3.15 Water Management

a. Reverse Osmosis Water

River water will be filtered, cleaned and then sent to reverse osmosis units to produce clean reverse osmosis water. This water is the only makeup water that is introduced into the process, which is a net consumer of water. Reverse osmosis water is used throughout the plant in leach, purification, electrolysis, washing of filters, pump seal water and boiler feed water.

b. Process Water

Almost all lithium containing process water will be recycled back internally to capture lithium salts. The exception are minor purge streams which will be sent to waste water treatment.

c. Condensates

Condensate from the LHM crystallization circuit and Acid Concentration circuit are used internally where pure hot water is required.

d. Waste Water Treatment

River water treatment, reverse osmosis concentrate, cooling tower blow down, boiler blow down and miscellaneous minor process purge streams will undergo treatment before discharge to the river. The treatment train will be designed to meet the applicable regulations for waste water discharge.

## 18 PROJECT INFRASTRUCTURE

The mine and the concentrator infrastructure are located at Whabouchi and are described in Section 18.1. The electrochemical infrastructure is located in Shawinigan and is described in Section 18.2.

### 18.1 Whabouchi General Site Plan

Two (2) different scale plans were produced for the Project: Drawing No. W00000-40-0D0-0101 presents the overall area where the mining project is and Drawing No. W00000-40-0D0-02 shows the concentrator and related infrastructure more precisely. Both drawings are presented in Figures 18.2 and 18.3.

The drawings contain the topographic information from LiDAR laser mapping technology provided for the Project by Nemaska.

The site is accessible via the *Route du Nord* through a fully manned guard house which leads to the Project areas, the administration facilities and the construction camp which will be re-used as the permanent camp.

All mining activities will be concentrated in a 75 ha. area; delimited by the UTM 5,728,000 mN, NAD83 Zone 18 to the north, the UTM 5,724,500 mN, NAD83 Zone 18 to the south, the Mountain Lake to the west and the Spodumene Lake to the east.

#### 18.1.1 GENERAL PLAN

##### 18.1.1.1 *Route du Nord*

The *Route du Nord* is located north of the open pit and most project infrastructure, except for the tailings and waste rock co-disposal facilities which are located on the north side of the *Route du Nord*. The Project is located at km 276. The portion of the road on which the Project is located is administrated by *Société de développement Baie-James* (« **SDBJ** ») as part of its strategic assets in the area. The Route du Nord provides site access from the west, via the Route de la Baie James and the town of Matagami, and from the south-east via the town of Chibougamau.

##### 18.1.1.2 *Gate House*

The gate house is located near the *Route du Nord* and will be used to control all access to the site. A gate will be operated by a security guard.

##### 18.1.1.3 *Main Access Road to Concentrator*

The main access road to the concentrator was designed using the general concentrator site topography and attention was given to grades and turning radius for long concentrate hauling trucks to be able to traverse the concentrator building and the concentrate loadout system for loading the concentrate transport trucks.

The road is constructed with cut and fill material completed with a base of 300 mm natural granular fill MG112 (pit run 0-4 in) topped with 150 mm of MG20b crushed stone (0-3/4 in).

The road width is 8.5 m and a two (2) m additional rolling width is allowed on the inside of each road bend for the concentrate trucks. The road is one-way, counter-clockwise, to assure safety of users especially in winter.

In addition, the main access road and mining hauling roads are kept separate to avoid having large mining vehicles on the same road as the concentrate, delivery, and services vehicles.

An overpass over the Route du Nord will be added to allow the mining trucks unimpeded access to the co-disposal area.

#### 18.1.1.4 *Mine Service and Hauling Roads*

The site hauling roads were designed for 65t class haul trucks with an 111,811-kg target operating weight. The quantities required for building those roads, were established based on draft profiles for each section of mining road. Those profiles were determined based on the roads with a maximum slope of eight percent (8%). To suit the truck dimensions, those mining roads were designed to be 20 metres wide.

The quantities of fill required to construct the service roads were established using a standard AASHO-H20 highway live load. All service roads were designed to be ten (10) metres wide.

#### 18.1.1.5 *Administrative Offices*

A modular administrative offices complex is located near the guard house and north of the concentrator site. This complex houses the construction management team, mine management and administrative employees, conference rooms and training rooms.

#### 18.1.1.6 *Storage Areas*

The storage areas for process equipment and spares, dangerous residual wastes, reagents and hazardous material will be located on the main site access road and between the administrative office complex and the concentrator.

#### 18.1.1.7 *Truck Scale*

A truck scale will be used to track loads entering and leaving the site, particularly fuel and concentrate shipments. The truck scale will be located close to the guard house.

#### 18.1.1.8 *Maintenance Garage*

The maintenance garage building is located south of the concentrator. The garage will be used for servicing the mine equipment in addition to other mobile equipment. The garage will be equipped with an overhead crane, tools, air compressors, and houses three (3) maintenance bays for the mine trucks and other large mobile equipment and one (1) light-vehicle maintenance bay.

The maintenance garage has been erected, and interior finishing remains to be completed and is shown in Figure 18.1.

**Figure 18.1 – Maintenance Garage**



#### **18.1.1.9 Wash Bay**

A wash bay will be constructed adjacent to the maintenance garage for the cleaning of the equipment prior to servicing. The wash bay will be equipped with a high-pressure wash system with water recycling and an oil and water separator.

#### **18.1.1.10 Warehouse**

The warehouse will be located east of the camp and will have racking arranged to optimize storage space. There will be a large exterior laydown space around the Warehouse.

#### **18.1.1.11 Laboratories**

A trade-off study is currently being conducted to reconsider the configuration of the process maintenance workshop, laboratory, and electrical rooms to improve operability, which has not yet been concluded. The laboratory has been modularly constructed, is on site, and the final location will be just south or west of the concentrator.

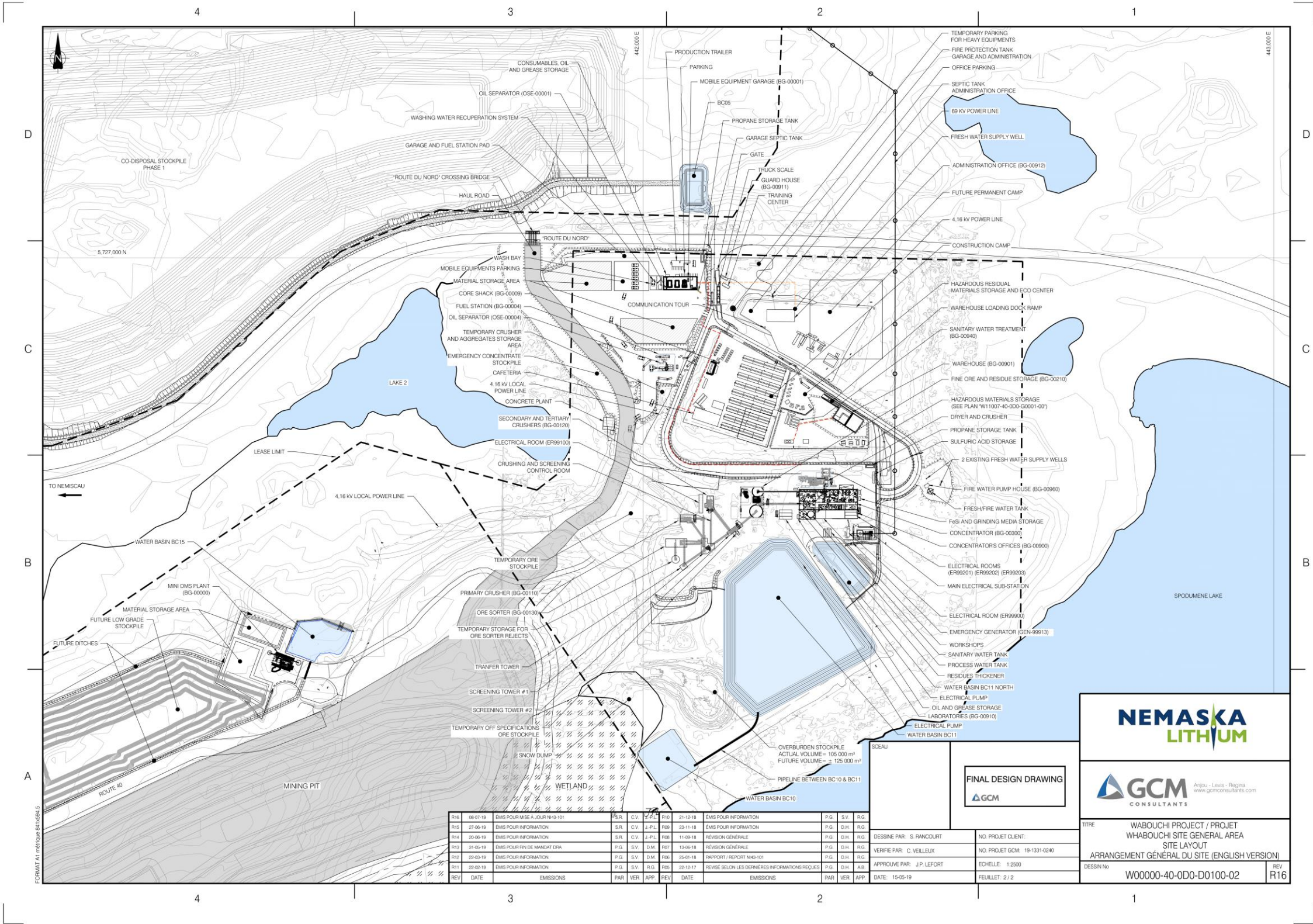


**Site Layout Drawing Details:**

- Infrastructure:** 69 kV POWER LINE, EXISTING HYDRO-QUEBEC TRANSMISSION POWER LINE 735 kV, ROUTE DU NORD, ROUTE 20, ROUTE DU NORD CROSSING BRIDGE, HAUL ROAD, TRUCK SCALE, GATE, PRODUCTION TRAILER, TRAINING CENTER, MOBILE EQUIPMENT GARAGE (BG-0001), GARAGE AND FUEL STATION PAD, MINING EQUIPMENTS PARKING, PARKING, FUTURE CO-DISPOSAL STOCKPILE PHASE 2, CO-DISPOSAL STOCKPILE PHASE 1, WASH BAY, FUEL STATION (BG-0004), TEMPORARY CRUSHER AND AGGREGATES STORAGE AREA, EMERGENCY CONCENTRATE STOCKPILE, CAFETERIA, 4.16 kV LOCAL POWER LINE, CONCRETE PLANT, SECONDARY AND TERTIARY CRUSHERS (BG-0012), ELECTRICAL ROOM (ER0010), CRUSHING AND SCREENING CONTROL ROOM, TEMPORARY ORE STOCKPILE, PRIMARY CRUSHER (BG-0010), ORE SORTER (BG0013), TEMPORARY STORAGE FOR ORE SORTER REJECTS, TRANSFER TOWER, SCREENING TOWER #1, SCREENING TOWER #2, TEMPORARY OFF SPECIFICATIONS ORE STOCKPILE, SNOW DUMP, OVERBURN STOCKPILE, ACTUAL VOLUME = 105 000 m³, FUTURE VOLUME = 125 000 m³, WETLAND, MINING PIT, FUTURE LOW GRADE STOCKPILE, EQUIPMENT STORAGE AREA, MINI DMS PLANT (BG-0003), VENTILATION BUILDING AND MINE SUB-STATION UNDERGROUND, FUTURE DITCHES, LEASE LIMIT, EMULSION PREPARATION BUILDING (BG-0003), EXPLOSIVES, BLASTING, CAPS AND DETONATORS STORAGE, WEATHER STATION, BORROW PIT BB07, BORROW PIT BB08, QA-2 SAMPLING STATION, EMISSARY, EMISSARY PIPELINE, WATER TREATMENT PLANT TO BE CONFIRMED BY SNC LAVALIN, LAC DES MONTAGNES, SPODUMENE LAKE, LAKES 1, 2, 23, 24, 25, 26, 27, 28.
- Facilities:** TEMPORARY PARKING FOR HEAVY EQUIPMENTS, FIRE PROTECTION TANK, GARAGE AND ADMINISTRATION, OFFICE PARKING, SEPTIC TANK ADMINISTRATION OFFICE, 69 kV POWER LINE, FRESH WATER SUPPLY WELL, ADMINISTRATION OFFICE (BG-00912), FUTURE PERMANENT CAMP, CONSTRUCTION CAMP, HAZARDOUS RESIDUAL MATERIALS STORAGE AND ECO CENTER, WAREHOUSE (BG-00901), FINE ORE AND RESIDUE STORAGE (BG-00210), HAZARDOUS MATERIALS STORAGE, DRYER AND CRUSHER, PROPANE STORAGE TANK, 2 EXISTING FRESH WATER SUPPLY WELLS, FIRE WATER PUMP HOUSE (BG-00900), FRESH FIRE WATER TANK, CONCENTRATOR OFFICES (BG-00900), ELECTRICAL ROOMS (ER00201) (ER00202) (ER00203), MAIN ELECTRICAL SUB-STATION, ELECTRICAL ROOM (ER00900), EMERGENCY GENERATOR (GEN-00913), SANITARY WATER TANK, WORKSHOPS, PROCESS WATER TANK, BC11 NORTH, RESIDUES THICKENER, LABORATORIES (BG-00910), BC11.
- Other Features:** NEMISCAU RIVER, NEMISCAU, TO NEMISCAU, 5.726.000 N, 440.000 E, 441.000 E, 442.000 E, 443.000 E, 444.000 E, 445.000 E, 446.000 E, 447.000 E, 448.000 E, 449.000 E, 450.000 E, 451.000 E, 452.000 E, 453.000 E, 454.000 E, 455.000 E, 456.000 E, 457.000 E, 458.000 E, 459.000 E, 460.000 E, 461.000 E, 462.000 E, 463.000 E, 464.000 E, 465.000 E, 466.000 E, 467.000 E, 468.000 E, 469.000 E, 470.000 E, 471.000 E, 472.000 E, 473.000 E, 474.000 E, 475.000 E, 476.000 E, 477.000 E, 478.000 E, 479.000 E, 480.000 E, 481.000 E, 482.000 E, 483.000 E, 484.000 E, 485.000 E, 486.000 E, 487.000 E, 488.000 E, 489.000 E, 490.000 E, 491.000 E, 492.000 E, 493.000 E, 494.000 E, 495.000 E, 496.000 E, 497.000 E, 498.000 E, 499.000 E, 500.000 E, 501.000 E, 502.000 E, 503.000 E, 504.000 E, 505.000 E, 506.000 E, 507.000 E, 508.000 E, 509.000 E, 510.000 E, 511.000 E, 512.000 E, 513.000 E, 514.000 E, 515.000 E, 516.000 E, 517.000 E, 518.000 E, 519.000 E, 520.000 E, 521.000 E, 522.000 E, 523.000 E, 524.000 E, 525.000 E, 526.000 E, 527.000 E, 528.000 E, 529.000 E, 530.000 E, 531.000 E, 532.000 E, 533.000 E, 534.000 E, 535.000 E, 536.000 E, 537.000 E, 538.000 E, 539.000 E, 540.000 E, 541.000 E, 542.000 E, 543.000 E, 544.000 E, 545.000 E, 546.000 E, 547.000 E, 548.000 E, 549.000 E, 550.000 E, 551.000 E, 552.000 E, 553.000 E, 554.000 E, 555.000 E, 556.000 E, 557.000 E, 558.000 E, 559.000 E, 560.000 E, 561.000 E, 562.000 E, 563.000 E, 564.000 E, 565.000 E, 566.000 E, 567.000 E, 568.000 E, 569.000 E, 570.000 E, 571.000 E, 572.000 E, 573.000 E, 574.000 E, 575.000 E, 576.000 E, 577.000 E, 578.000 E, 579.000 E, 580.000 E, 581.000 E, 582.000 E, 583.000 E, 584.000 E, 585.000 E, 586.000 E, 587.000 E, 588.000 E, 589.000 E, 590.000 E, 591.000 E, 592.000 E, 593.000 E, 594.000 E, 595.000 E, 596.000 E, 597.000 E, 598.000 E, 599.000 E, 600.000 E, 601.000 E, 602.000 E, 603.000 E, 604.000 E, 605.000 E, 606.000 E, 607.000 E, 608.000 E, 609.000 E, 610.000 E, 611.000 E, 612.000 E, 613.000 E, 614.000 E, 615.000 E, 616.000 E, 617.000 E, 618.000 E, 619.000 E, 620.000 E, 621.000 E, 622.000 E, 623.000 E, 624.000 E, 625.000 E, 626.000 E, 627.000 E, 628.000 E, 629.000 E, 630.000 E, 631.000 E, 632.000 E, 633.000 E, 634.000 E, 635.000 E, 636.000 E, 637.000 E, 638.000 E, 639.000 E, 640.000 E, 641.000 E, 642.000 E, 643.000 E, 644.000 E, 645.000 E, 646.000 E, 647.000 E, 648.000 E, 649.000 E, 650.000 E, 651.000 E, 652.000 E, 653.000 E, 654.000 E, 655.000 E, 656.000 E, 657.000 E, 658.000 E, 659.000 E, 660.000 E, 661.000 E, 662.000 E, 663.000 E, 664.000 E, 665.000 E, 666.000 E, 667.000 E, 668.000 E, 669.000 E, 670.000 E, 671.000 E, 672.000 E, 673.000 E, 674.000 E, 675.000 E, 676.000 E, 677.000 E, 678.000 E, 679.000 E, 680.000 E, 681.000 E, 682.000 E, 683.000 E, 684.000 E, 685.000 E, 686.000 E, 687.000 E, 688.000 E, 689.000 E, 690.000 E, 691.000 E, 692.000 E, 693.000 E, 694.000 E, 695.000 E, 696.000 E, 697.000 E, 698.000 E, 699.000 E, 700.000 E, 701.000 E, 702.000 E, 703.000 E, 704.000 E, 705.000 E, 706.000 E, 707.000 E, 708.000 E, 709.000 E, 710.000 E, 711.000 E, 712.000 E, 713.000 E, 714.000 E, 715.000 E, 716.000 E, 717.000 E, 718.000 E, 719.000 E, 720.000 E, 721.000 E, 722.000 E, 723.000 E, 724.000 E, 725.000 E, 726.000 E, 727.000 E, 728.000 E, 729.000 E, 730.000 E, 731.000 E, 732.000 E, 733.000 E, 734.000 E, 735.000 E, 736.000 E, 737.000 E, 738.000 E, 739.000 E, 740.000 E, 741.000 E, 742.000 E, 743.000 E, 744.000 E, 745.000 E, 746.000 E, 747.000 E, 748.000 E, 749.000 E, 750.000 E, 751.000



Figure 18.3 – General Site Plan – Close-up View





#### 18.1.1.12 Fire Protection

Fire water will be supplied from the combined Fire / Fresh water tank described in Section 17.1.5.1a. A pumping station, with two (2) electric pumps, will draw water from the wells to the fresh / fire water tank, located south of the Concentrator. It will be used for temporary fire protection services and fresh water supplied to the concentrator, laboratories, mine dry and offices garage and warehouse.

The fire water pumping station includes, one (1) jockey pump and one (1) emergency diesel powered pump. The fire water pumping station has space for a future electric fire water pump. Design provides for a concentrator-wide fire protection system, including all electrical rooms and other high-risk areas. The fire water will be distributed through an independent underground and heat traced piping system.

The fire alarm system will consist of a panel located in the guard house, with detectors and manual stations installed to cover all areas of the facility. Alarm signals will be automatically transmitted to the security station. There will be designated emergency muster stations in the event of a fire alarm, along with evacuation routes and procedures. Fire extinguishers will be provided in fire cabinets as required in areas such as offices, laboratory, warehouse, lunch rooms, and fuel stations. Hot work permits will be required for maintenance.

The project team is studying the possibility of extending the fire protection system to other project infrastructures, such as the Mine Maintenance Garage, the Warehouse, the Kitchen and Dining Room, and the Administration Building.

**Figure 18.4 – Fire Water / Fresh Water Tank**



#### 18.1.1.13 Sewage Treatment

One (1) sanitary waste water treatment system will be provided for the concentrator/garage and administrative buildings areas. Provision has been made for septic tanks and tile field disposal systems in both areas. Sanitary and shower waste water will be collected from each building via underground piping and discharged into these waste water treatment units. Maintenance of these units will be made annually by a local contractor.

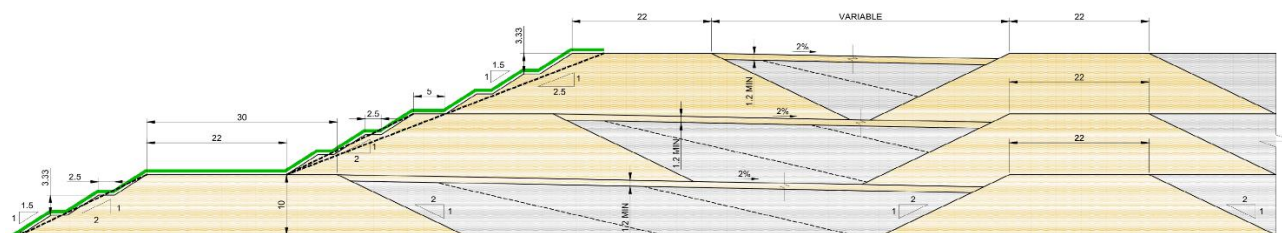
A maximum quantity of 18 m<sup>3</sup> per day is expected to be generated by the entire site.

#### 18.1.2 CO-DISPOSAL STORAGE FACILITY

Co-disposal methodology will be used for the storage of the tailings and ore sorter rejects produced at the concentrator and the waste rock from the mine. The adopted co-disposal methodology consists of confining filtered tailings into waste rock cells. This method has the advantage to increase stockpile global stability and water drainage efficiency with the main objective to ensure long-term physical and geochemical stability.

The co-disposal strategy is to use waste rock to construct peripheral berm and peripheral roads. The central access road is also needed to act as a filtering berm to ensure proper drainage of the co-disposal storage facility. A typical cross section of the co-disposal concept is presented in Figure 18.5. Berm construction will be managed to confine the tailings surrounded by waste rock (i.e. deposition is planned to have enough available space in cells to manage upcoming tailings).

**Figure 18.5 – General Cross Section of the Co-Disposal Methodology**



The tailings will be transported from the concentrator to the co-disposal storage facility with the same haul truck fleet as the open pit mine operations.

During the 26-year life of the open pit mine, a total of 32.4 Mm<sup>3</sup> of waste rock and 14.7 Mm<sup>3</sup> of tailings (1.5 Mm<sup>3</sup> of which are rejects from the concentrator that will be managed with tailings) will be generated for a total of 47.1 Mm<sup>3</sup>. From Years 26 to 33, an underground mine will be developed and operated, generating an additional 0.4 Mm<sup>3</sup> of waste rock and 4.9 Mm<sup>3</sup> of tailings. With both open-pit and underground mining, the lifespan of the Project will be 33 years and generate 52.4 Mm<sup>3</sup> of material.

Waste rock, tailings and rejects quantities and volumes were obtained from mine production schedules and mining plans, summarized in Section 16.0.

Four (4) co-disposal storage facilities located north of the Route du Nord (Figure 18.6) were designed. All the waste rocks and filtered tailings will be contained in these co-disposal storage facilities, except six (6) Mm<sup>3</sup> of waste rock that is expected to be disposed in the open pit mine that could be used as backfill material for the underground operation. The co-disposal storage facilities were designed with the following parameters:

- Overall Slope – 2.5H: 1V (21.8°);
- Bench Slope – 2H: 1V (26.6°);
- Bench Height – 10 m;
- Each bench will be constructed in three (3) lifts of approximately four (4) m, three (3) m and three (3) m (the height of each lift can change during the deposition);
- Lift Slope – 1.5H: 1V (33.7°);
- Maximum Height – Variable with local topography. The maximal elevation reaches 346 m for Phase 1, 350 m for Phase 2 and 321.5 m for Phase 3;
- The peripheral access of 22 m width will be constructed on the first bench of each co-disposal storage facility;
- Tailings Dry Density – 1.5 t/m<sup>3</sup>;
- Blasted Waste Rock Density – 2.32 t/m<sup>3</sup>.

The co-disposal storage facilities were designed to be at a minimum distance of 30 m from the *Route du Nord* centerline and 60 m from lakes and creeks. A right-of-way of 80 m was considered for the Hydro-Québec power lines (735-kV existing high voltage and 69-kV projected power lines).

The first co-disposal storage facility (Phase 1) has a capacity of 13.1 Mm<sup>3</sup>. This pile has a footprint of about 52 ha and a top elevation of 346 m. The first phase of construction (Phase 1A) will be contained in the eastern portion of Phase 1. The waste rock and tailings from the first two (2) years of operations (1.8 Mm<sup>3</sup>) will be co-disposed in Phase 1A. The co-disposal storage facility of Site 1 will then be expanded to the west in two (2) stages, namely Phases 1B and 1C, that will be constructed conjointly to prepare the waste rock cells within which tailings will be deposited.

The second co-disposal storage facility (Phase 2) has a capacity of 27.2 Mm<sup>3</sup> with a footprint of 95 ha, all within the limit of Nemaska mining Property. The first stage of the construction (Phase 2A) will be contained in the southern portion of Site 2, close to Hydro-Québec 735-kV high voltage power line. Phase 2A, will have a capacity of 13.3 Mm<sup>3</sup>. Phase 2A will then be extended north to Phase 2B. This extension will have a capacity of 13.9 Mm<sup>3</sup>.

A third co-disposal storage facility (Phase 3), with a footprint of 65 ha, is located north of Phase 2 and within the limit of Nemaska mining Property. It will have a capacity of 12.2 Mm<sup>3</sup>. This capacity accounts for waste rock and tailings volumes from the open pit as well as those from the underground operation.

The capacity of Phases 2B and 3 are at a preliminary stage of engineering (scoping study) and will have to be refined to confirm water management infrastructure, in a timely manner to secure the required environmental authorizations prior to their use, as outlined in Section 20.

The opportunity to carry-out in-pit disposal of the waste rock on the east side of the pit was evaluated. Approximately six (6) Mm<sup>3</sup> of waste rocks can be disposed in the pit, thus reducing the operational costs by decreasing haul distances for waste rocks and minimizing the environmental footprint of the co-disposal storage facility.

Table 18.1 summarizes the total volumes of waste rocks and filtered tailings to manage and the associated capacity of the co-disposal storage facilities for the 33-year life of mine.

**Table 18.1 – Summary of the Co-Disposition Sites Capacity**

Parameters	Value
Co-disposition piles capacity	52.4 Mm <sup>3</sup>
Tonnage to manage	106.3 Mt
Total volume to manage	52.4 Mm <sup>3</sup>
Waste rock volume	32.8 Mm <sup>3</sup>
Tailings volume	18.1 Mm <sup>3</sup>
Rejects volume	1.5 Mm <sup>3</sup>

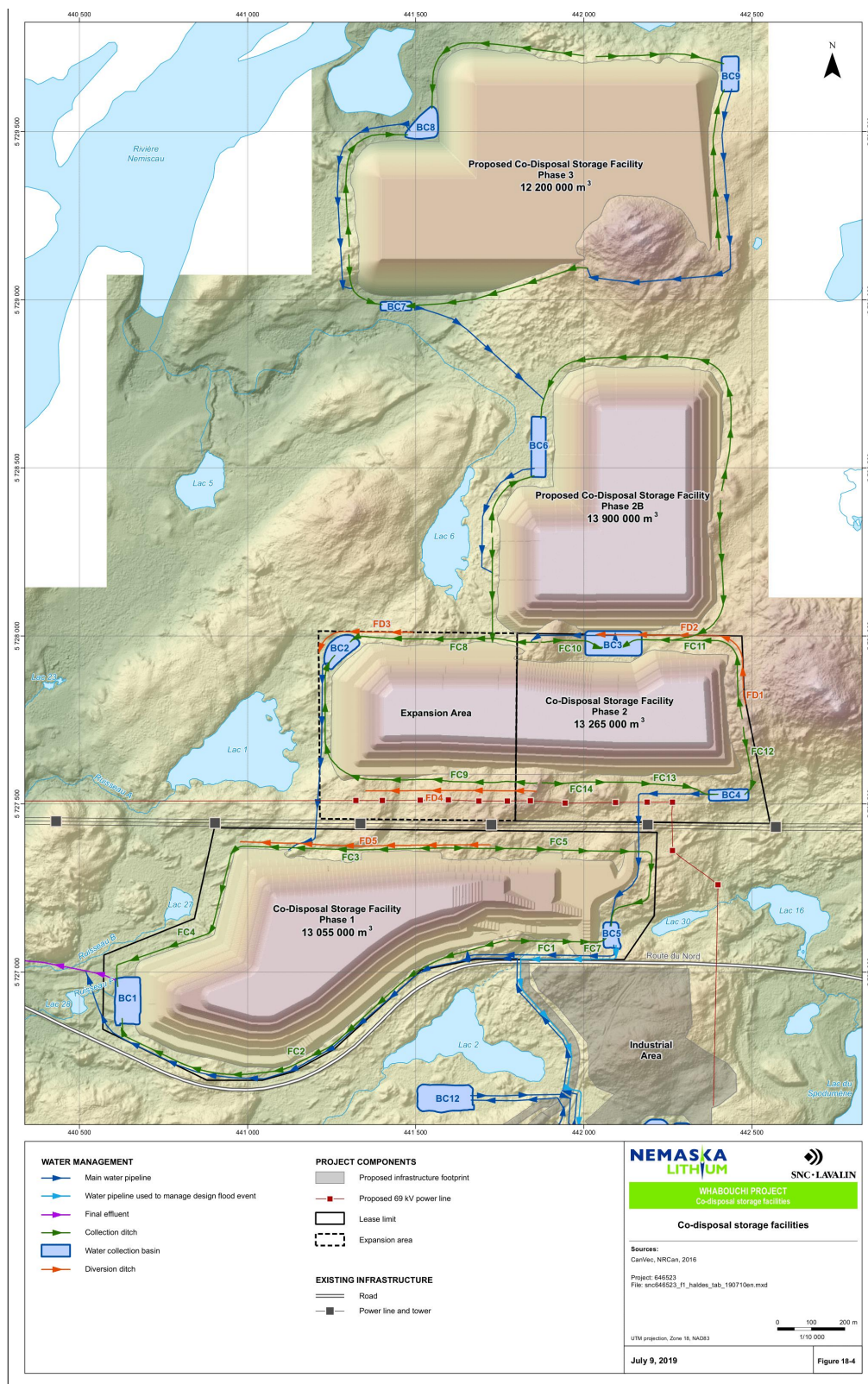
### 18.1.3 CONTROL SYSTEM

#### a. Automation Process Network

The topology of the Whabouchi Process Control System (“**PCS**”) has mix of redundant and non- redundant network. A redundant network is formed between the Central Control Room, office, lab, maintenance building and process areas. Between process areas’ electrical rooms, a ring topology is adopted to minimize the risks. Within Central Control Room or local process areas, a non-redundant topology is used to connect network components into the network. The network links all the main automation equipment, such as Supervisory Control and Data Acquisition (“**SCADA**”) system, Historian, Human Machine Interface (“**HMI**”) and Process Control System processor.



**Figure 18.6 – Proposed Co-Disposal Storage Facilities**



The proposed network includes fibre optic linking of the following main areas of the Whabouchi concentrator:

- Central Control Room;
- Electrical Room # ER-99100 (Crushing Area);
- Electrical Room # ER-99201 (Concentrator Area);
- Electrical Room # ER-99202 (Concentrator Area);
- Electrical Room # ER-99203 (Concentrator Area);
- Electrical Room # ER-99900 (Main Sub-Station);
- Electrical Room # ER-99970 (Pump Station);
- Concentrator Laboratory;
- Concentrator Office.

Network automation communication services are:

- SCADA stations located in the central control room and in the field;
- Process control system processors inter-communication;
- PCS/Remote Input/Output (“I/O”) communication;
- PCS direct interface to the Motor Control Centers (**MCCs**) and VFD lineups;
- Redundant IEC61850 interface to the power distribution equipment; Field device communication including communication with 3rd parties Programmable Logic Controller (“**PLC**”) supplied with mechanical equipment;
- A camera system will be installed in the concentrator for process control intermittent viewing purposes.

b. Process Control System

The process control system will be of Distributed Control System (“DCS”) type. A PCS system will be supplied to control each strategic areas of the concentrator with distributed remote I/O racks. The processors will be located inside electrical rooms.

Three (3) main processors will be included to control the following sectors: crushing, grinding, magnetic separation, main sub-station and fresh water pump house. Other PLCs may be supplied with mechanical equipment (crushers, water treatment, filters, etc.).

The central SCADA system has the capacity to control and supervise all the remote PCS equipment.

c. Wiring and Junction Boxes

All the field instruments and switches will be wired to the PCS through junction boxes up to remote I/O racks.

The wiring system will include field junction boxes for instrument power supply, for digital signals and for analog signals. The motor thermistor signals and RTD signals for motor protection will be wired directly to the related motor protection relays while equipment RTD signals for monitoring will be connected directly to the PCS remote I/Os.

The junction boxes will be located and installed in all process areas of the concentrator. The junction boxes will be wired to the PCS I/O racks via multi-conductor cable.

d. SCADA

The SCADA system will be based on client/server technology and will include two (2) SCADA servers for redundancy, two (2) historian servers, two (2) HMI operator stations and one (1) engineering station. The system will be located in the central control room.

There will be seven (7) local operation client stations throughout the concentrator. The four (4) field stations will be located in the grinding and the magnetic separation areas. The three (3) office stations will be located in the concentrator office, the laboratory and the main administration office.

e. SCADA and PLC Power Sources

In case of concentrator power outage, a diesel generator will supply emergency power to different electric loads throughout the concentrator. The PCS, switches, main servers, phone system, and security systems will be fed by Uninterruptible Power Supply ("UPS"). The UPS' will be powered from the emergency power. UPS status will be monitored.

f. Redundancy

Process Control System (Profinet) and IEC 68850 networks are redundant for increased safety and reliability.

g. Process Analog Instruments

Process analog instruments will support primarily the Profibus protocol and they will be wired to Profibus Spur field boxes to the process controller by Profibus PA fieldbus cables. Profibus PA instruments allow a better monitoring of the instrument themselves. Traditional 4-20 mA loop cabling with enabled HART protocol will be used as a backup solution when Profibus instrumentation is unavailable or impractical to use.

#### 18.1.4 WHABOUCHI COMMUNICATION SYSTEM (LOCAL AND EXTERNAL)

a. Telecommunication Guidelines

The telecommunication system will be based on Ethernet links throughout the concentrator buildings and administrative buildings.

Single-mode fiber optic backbone will be deployed through the site buildings to accommodate both automation and corporate services on the same fiber cable on different fiber.

For some remote buildings, an additional link will be supplied to communicate with corporate services. For short cable runs, a CAT6 cable will be used. The CAT6 cable will be armored when installed in an instrumentation cable tray or outside. For longer runs, microwave antennas will be used. Secure WIFI and wired connections will be deployed in every building where required

b. Telecommunication Services

The site is now connected to the Internet Service Provider (“ISP”), Telus via an optical fiber (partnership between Telus and Eeyou Communications Network) ending at the *Relais routier Nemiscau* (15 km west of the main facility) and a microwave link for the last 15 km. The connection has been established in January 2017 and provided an MPLS private network between the Quebec City office, the Shawinigan plant and the Whabouchi mine site. The microwave link is maintained by the local provider, *Communications Télésignal inc.* The bandwidth in place offer a 30 Mb/s on a 5-year contract basis with possibility of increase, as needed. Another distinct 100 Mb/s link is also in place via the same infrastructure to provide internet in the construction camp rooms via WIFI.

A backup system will use a cellular modem or satellite technology. The current cellular coverage (Telebec) allows the usage of the 4G technology.

The short-term plan is to extend the fiber optic link the final 15 km from the *Relais routier Nemiscau* to the site. The engineering required for this work has been completed.

c. Communication and Mobile Radio Systems

The communication and radio systems require a communication tower at the Whabouchi site hosting the microwave antennas and radio communication equipment.

The communication systems include:

- IP PBX and IP Phones;
- Mobile Radio System.

The IP PBX phone system is centralized in Shawinigan plant and use the private network in place to communicate with the other sites and include a bridge with the exterior. QoS is configured to manage priority for the voice and to assure good quality of communication.

The mobile radio system will be provided for the construction phase and the operation of the mine site, the concentrator and the unloading area. Various communication groups will be programmed to organize and optimize communications between all users, mobile equipment will also be equipped with permanent radio to allow communication anywhere on the site during mining operation.

d. Corporate Network

The Ethernet backbone network, 48 fibers, in a ring type topology described in the previous section will be used for the automation, the process and security camera video, the IP phone system and the corporate network applications.

All the major network equipment will be located in a dedicated server rooms located in the administrative office, the telecom shelter, the control room and electrical rooms.

Corporate services are:

- Wired/Wireless internet/network connection;
- Phones and System Server;
- Process and Security Camera System;
- Access Control System (gate, door);
- Fire Detection.

A camera system, with recorder and a viewer, will be installed in the main gate office. Aside from the gate cameras, various cameras will be installed in the concentrator for process control purposes. One (1) viewing station will be installed in each control room for process control purposes.

18.1.5 WHABOUCHI HEATING, VENTILATION AND AIR CONDITIONING

The heating, ventilation and air conditioning (“HVAC”) will be provided for all buildings based on the required working temperatures. The heating and air conditioning design conditions are based on data provided by Environment Canada for the site. Dust Control will comply with national and local laws and regulations.

18.1.6 FUEL STORAGE FACILITY

The fuel storage facility will be designed to have 220,000 litre of storage capacity and will be built on a lined pad. The system will include the following:

- Four (4) 50,000 litre capacity double wall diesel fuel tanks;
- One (1) 20,000 litre capacity double wall gasoline fuel tank;
- A complete command center for the transfer pump system and distribution station, will be installed in a container including area lighting.

18.1.7 POWER SUPPLY AND DISTRIBUTION

18.1.7.1 *Power Line, Main Sub-Station and Electrical Distribution*

The total power demand of the Whabouchi site was determined to be approximately 11.7 MW (in winter) based on the estimated connected load, running load and running power. Table 18.1 shows



the power demand breakdown by sector. Most loads have now been verified with vendor data from completed purchases.

**Table 18.1 – Estimated Total Project Power Demand**

Area	Power Demand (kW)
Process Utilities	631
Processing (Concentrator, Crusher, DMS)	6,588
DMS concentrate dryer	1,963
Power Demand Process	9,182
Infrastructure and Services	2,322
<b>Power Demand Subtotal</b>	<b>11,505</b>
Network Loss (2%)	230
<b>Total Power Demand</b>	<b>11,737</b>

Note: The power demand was calculated using an average efficiency factor, load factor and diversity factor. The power demand was provided by Nemaska.

The Whabouchi Project is supplied from the Hydro-Québec Nemiscau sub-station. From that point, a new 69 kV overhead power line of approximately 12 km was constructed by Hydro Québec terminating at the Project 69 kV to 4.16 kV main outdoor substation. One 15/20 MVA transformer is installed in the Main Substation. The transformer then feeds a 4.16-kV switchgear installed in a dedicated prefabricated electrical room ER-99900. The electrical room is installed in the vicinity of the main substation switch yard.

Currently, 10 MW is contracted from Hydro-Québec. An increase to 13 MW is currently being evaluated by Hydro-Québec. It is expected that modifications to the Nemiscau substation will be required to supply 13 MW, and an estimate for this work is included in the Capex.

The 4.16-kV main switchgear is located in a pre-fabricated electrical room (ER-99900) and provides power to:

- A capacitor bank through a feeder. The Power Factor Compensation Unit will improve the power factor to 95%. It will be located in the Main Substation switchyard
- The concentrator area through 3 feeders from the 5-kV main switchgear to three (3) dedicated electrical rooms;
- The primary, secondary and tertiary crushing area through a feeder from the 5-kV main switchgear to one dedicated electrical room;
- An overhead 4.16-kV line that supplies the administration/garage area and all other areas requiring electrical power.



**Figure 18.7 – Main Substation**



The primary, secondary and tertiary crusher electrical equipment is supplied from the electrical room ER-99100. The main equipment installed inside the electrical room comprises a dry step-down 3 MVA, 4.16 – 0.6 kV transformer and the 600 V equipment for distribution and control (MCC, VFD).

The concentrator electrical equipment is supplied from a modular electrical room, comprised of three modules: ER-99201, 99202 and 99203.

The main equipment installed inside modules 99201 and 99202 each comprise a dry step-down 4 MVA, 4.16 – 0.6 kV transformer and the 600 V equipment for distribution and control (LV Switchgears, MCC, VFD).

The main equipment installed inside module 99203 comprise a dry step-down 3 MVA, 4.16 – 0.6 kV transformer and the special control equipment (thyristor control units, total power 2,250 kW, 600 V) dedicated to the control of the HTR-51051 DMS concentrate dryer heater. In this electrical room, the VFDs are installation, including that which supplies the BAM-32000 Ball Mill motor (285 kW).

**Figure 18.8 – 4.16 kV Switchgear Building**



There are also two additional electrical rooms dedicated to the following:

- ER-99960 dedicated to supply the Administration building and the Garage;
- ER-99970 dedicated to supply the Pump Station.

A 4.16 kV pole line will supply power to the following areas:

- Water Basin BC-11N;
- Water Basin BC-11;
- Administration Building;
- Mine Garage;
- Water Basin BC-05;
- Fuel Service Station;
- Communication Tower;
- Explosives plant (Added in Year 2);
- Water Basin BC-01 (Added in Year 2).

There will be no electrical distribution to and within the open mine, as all mining equipment, including pumps, will be powered from diesel motors. At Year 25 of operation, a circuit will be added to feed the underground ventilation system and services.

#### 18.1.7.2 *Emergency Generators*

Emergency power will be provided by a 1500 kVA, 4.16 kV diesel powered generator. The generator is connected to the 4.16 kV main switchgear SWG-99901. The following process equipment will operate on emergency power:

- Auxiliary services of larger motors of the concentrator;
- Tank agitators;
- Thickener rakes;
- Sump pumps;
- Partial heating/lighting;
- Communication and control equipment; and
- Fresh and fire water pumps.

#### 18.1.8 CAMP ACCOMMODATIONS

A construction camp, housing construction workers and Nemaska site staff and visitors, is located near the main administration office and within walking distance of the Project facilities. This existing camp will form the basis of the permanent camp following the departure of the construction workers.

Currently, the camp is being operated and maintained by a local contractor, including all the required services.

The common areas of the permanent camp, such as the kitchen and the recreational areas are used by the residents of the construction and permanent camps. Thus, the kitchen capacity in the permanent camp will be sized to accommodate the additional load from the construction workforce.

##### 18.1.8.1 *Permanent Camp Accommodations*

The construction camp will be upgraded for use as the permanent mine camp, with the following features:

- Approximately 150 rooms with private bathrooms;
- Satellite television and internet access in all rooms;
- A laundry area;
- Addition of a dry/change room;
- Addition of a reception area;
- Addition of a waiting room and luggage storage area;
- Addition of a backup power generator.

## 18.2 Electrochemical Plant Infrastructure

This Section summarizes infrastructure such as power line, site roads, concentrate rail unloading facility, site buildings and site services that will be required to complement the processing of spodumene concentrate at the Electrochemical processing plant.

All topographic information for the location of infrastructure was gathered from readily available data from the City of Shawinigan.

An overall general site layout and access plan is shown on Figures 18.9 and 18.10. Due to space restrictions, the existing site does not allow for significant future expansion.

### 18.2.1 POWER LINE, MAIN SUB-STATION, AND ELECTRICAL DISTRIBUTION

The total power demand of the Electrochemical Plant site was determined to be approximately 50.5 MW (56MVA at 0.9 power factor), based on the estimated connected load, running load and running power. Table 18.2 shows the power demand breakdown calculated using an average efficiency factor, load factor and diversity factor.

**Table 18.2 – Estimated Total Project Power Demand**

Area	Power Demand (MVA)
<b>Power Demand Subtotal</b>	<b>56.0</b>
Power demand after PF compensation and loss estimation	51.1
Security Factor (20%)	10.2
<b>Total Power Demand</b>	<b>61.4</b>

The Electrochemical Plant will get its power from the Hydro-Québec *Grand-Mère* substation. From that point, power will be carried from an existing 69-kV overhead power line that will terminate at a new outdoor substation. At this sub-station, the incoming voltage will be stepped down to a distribution voltage of 25-kV through one (1) 75/100 MVA transformer. The layout can accommodate the installation of a second transformer. The transformer will feed two (2) 25-kV switchgears. All equipment is rated at 120-kV except transformers as Hydro-Québec plans to modify the power line to 120KV.

The two 25kV main switchgears will be located indoors in a new, prefabricated electrical room and provides power to:

- One (1) 25-kV switchgear for Building #67;
- One (1) 25-kV switchgear for Building #80;
- Two (2) transformer rectifiers and space for one (1) future;
- Two (2) capacitor banks to improve the power factor to 95%.



Figure 18.9 – Overall General Site Layout and Access Plan

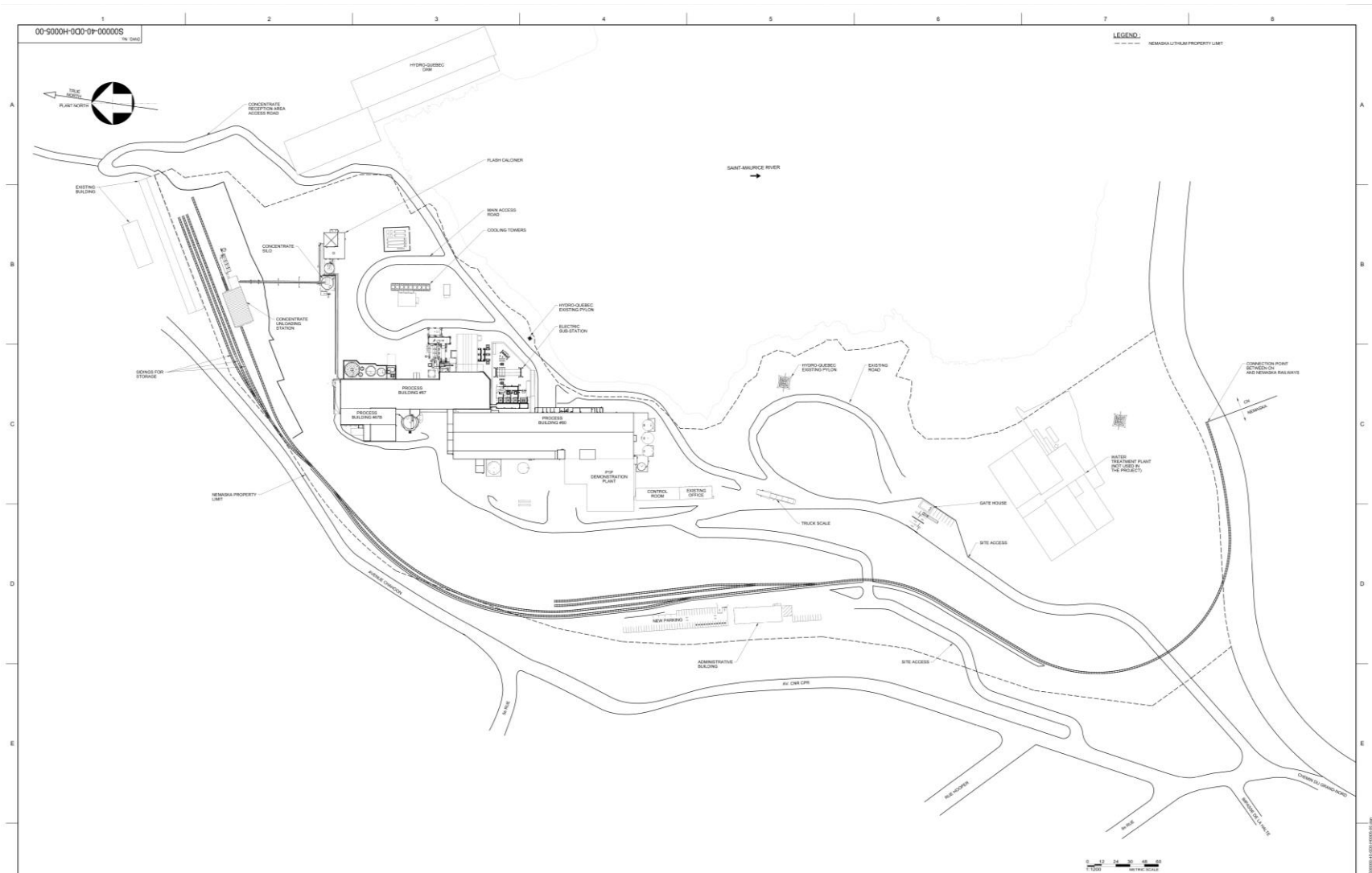
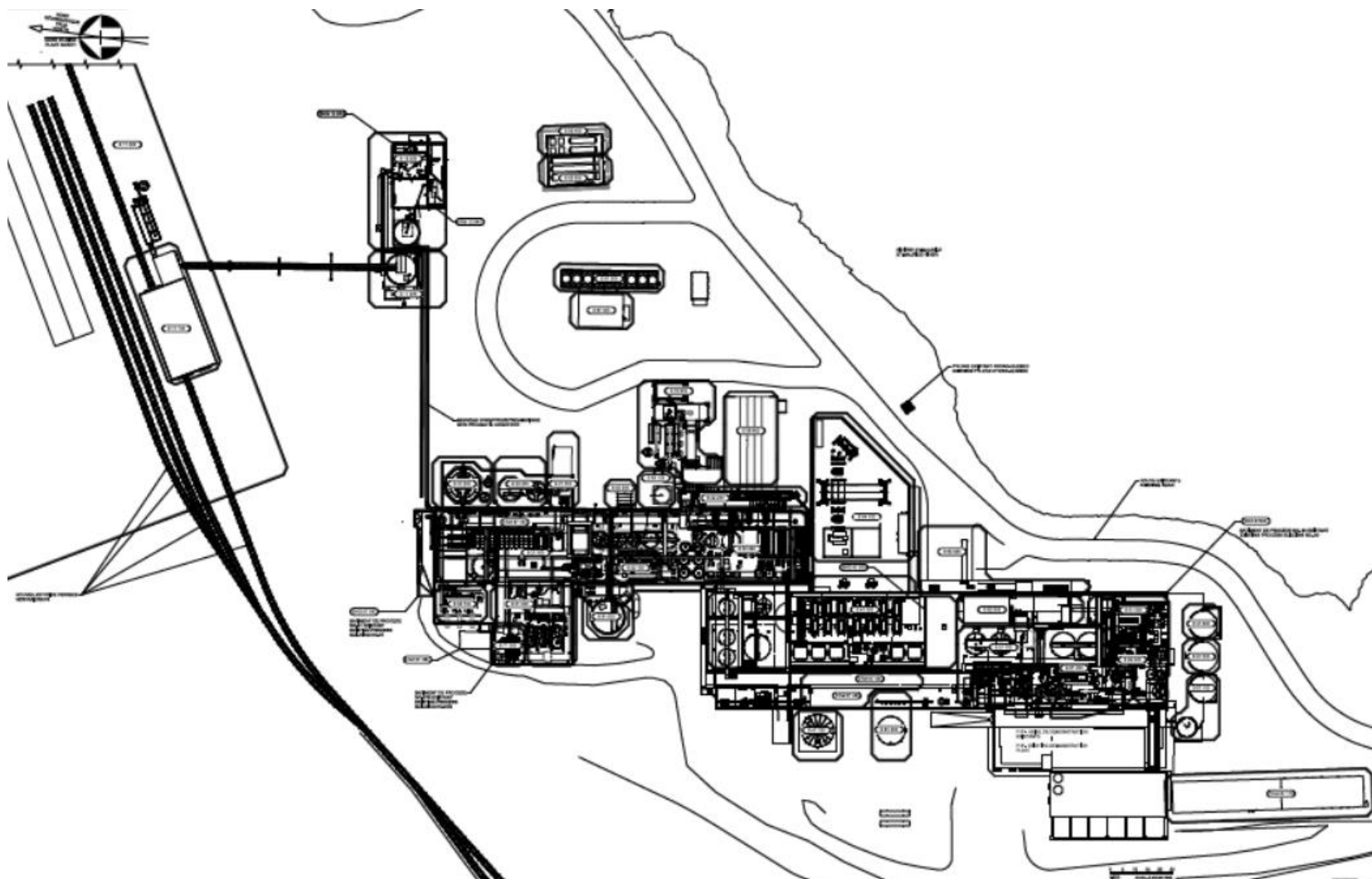


Figure 18.10 – Site Layout – Close-up View





The 25-kV switchgear will be located indoors in an existing, renovated, electrical room in Building #67 and provides power to seven (7) distribution transformers:

- Two (2) 2-MVA 25-kV/600 V transformer powering three (3) MCCs located in Calciner E-room for various calcination loads;
- Four (4) 2-MVA 25-kV/600 V transformer powering nine (9) MCCs for various Building 67's loads;
- One (1) 2-MVA 25-kV/600 V transformer powering two (2) MCCs located in building 67B E-house for various Building 67B's loads.

The 25-kV switchgear will be located indoors in an existing, renovated, electrical room in Building #80 and provides power to eleven (11) distribution transformers:

- Two (2) 2-MVA 25-kV/4160 V transformer powering two (2) 4160 switchgear for MVR;
- Nine (9) 2-MVA 25-kV/600 V transformer powering thirteen (13) MCCs for Building 80's various loads, 1 MCC located in P1P e-house for P1P building's various loads;
- The temporary Hydro-Québec line feeding PIP installation will be dismantled, and a new feed point from building 80 e-house will feed P1P.

#### 18.2.2 EMERGENCY GENERATORS

Emergency power will be provided at 4,160 V via two (2) 2,000 kW diesel-powered generator. The generators will feed power to the complete distribution network instead of one (1) emergency MCC. Generators will provide a standby source of power to feed essential services (lighting, fire protection equipment, process control network, etc.) as well as critical process loads (slurry pumps preventing settling down of material, thickener, lifting devices, etc.) in the event of power loss from the grid.

#### 18.2.3 SITE ROADS

The Electrochemical processing plant will be accessible year-round without any interruption by the city's road network. The access road for plant personnel will be located directly to the southwest of the Property, near Hopper Street. Visitors and truck traffic will access the site on avenue CNR and CPR. A single guard house will be used to monitor the access point.

Site and service roads will provide access to:

- Process facility from city road;
- Aluminum silicate and gypsum loading;
- Concentrate unloading facility;
- Shipping warehouse;
- Warehouse.

#### 18.2.4 CONCENTRATE TRANSPORTATION AND UNLOADING FACILITY

Concentrate will be shipped by railcars from Matagami to the Shawinigan processing plant. Existing CN and Genessee & Wyoming railway lines run along the northwestern side of the site. The railcars will enter the site from one or both of these lines onto the existing railway network. The existing railway run in parallel to the south-west limit of the site. Project CAPEX is based on the CN option.

Deliveries are expected approximately three times per week. The railcars will be emptied one (1) at a time. The unloaded concentrate will be directed toward the processing facility.

#### 18.2.5 RESIDUES / BY-PRODUCT FACILITIES

The facility produces four (4) residues and by-products:

a. Aluminum Silicate By-Product

Concentrate leach by-products (aluminum silicate) will be discarded from the Electrochemical processing plant as a cake from a belt filter. The aluminum silicate will be dried in a rotary dryer, transferred to a silo that will act as a truck loading station. The silo will have a 24-hour capacity to avoid trucking at night. It is anticipated that a total of 212,000 t/y (dry) aluminum silicate will be produced and sent to disposal (initially) or sold as a by-product.

b. Gypsum Disposal

Gypsum will be produced as a result of the purification process. It will be discarded from the Electrochemical processing plant as a cake from a filter press. The gypsum will be stockpiled on a small pad outside, then loaded by a front -end loader into a truck for shipment offsite for disposal. It is anticipated that a total of 42,700 t/y (wet) gypsum will be produced.

c. Purge (Na & K)

Na & K purge solution is produced as a means of controlling Na and K within the process. Initially the purge solution will be combined with the aluminum silicate and sent to disposal offsite. When the aluminum silicate is completely sold, the purge solution will need to be sent offsite for treatment and disposal, sent to the river or sold. It is anticipated that a total of 7,400 t/y will be produced.

d. Water Treatment and Disposal

The facility is a net zero water consumer and virtually no water in contact with the process is to be discharged. The clear majority of the process water will be reused within the plant.

River water feeding the Reverse Osmosis (“RO”) system and blow down from the cooling towers and boilers will generate a water product. This water will be treated and returned to the river once its full compliance with applicable laws, regulations and standards has been confirmed through continuous monitoring upstream of discharge point. Any impurity will be collected and sent to an approved disposal site.

#### 18.2.6 SITE BUILDINGS

The roasting will be done in a separate structure east of Building #67. The Electrochemical processing plant including the sulphation and leaching, purification, electrolysis, crystallization, precipitation, drying and packaging circuits will be housed inside existing decommissioned paper mill buildings (Buildings #67 and #80). It will also contain the acid storage tanks and the Spent Acid Concentrator (“**SAC**”) and associated boilers and services. The employee change room, locker room and lunch room will be in a new building south of building #80. The administration building was constructed end of 2018 and is located south west of building #80.

In addition, the site will include the following buildings:

- Concentrate receiving and storage light structures;
- New guardhouse.

#### 18.2.7 SITE SERVICES

The following site services are included in the scope:

- The plant will be connected to the City of Shawinigan’s existing potable water distribution network and sanitary waste water network;
- The plant will be connected to the existing *Énergir* natural gas distribution network to provide fuel to the flash calciner, acid bake kiln, dryers and boilers;

#### 18.2.8 ELECTROCHEMICAL PLANT CONTROL SYSTEM

##### a. Automation Process Network

The Electrochemical Plant PCS will be based on an Ethernet backbone network in a redundant star type topology. The network links all the main automation equipment, such as SCADA system, historian (PI), HMI and Process Control System processor.

The proposed network includes fiber optic ring linking of the following main areas of the Shawinigan plant:

- Central Control Room;
- Plant Offices;
- Main Sub-Station;
- Electrical Room # 67;
- Electrical Room # 67B;
- Concentrate Reception Area;
- Laboratory;
- Electrical Room # 81;
- Electrical Room # 80;

- Calciner area.

Network automation communication services are:

- SCADA stations located in the central control room and in the field;
- Process control system processors intercommunication;
- PCS/Remote I/O communication;
- PCS direct interface (Profinet) to the MCCs and VFDs;
- IEC61850 Interface to the power distribution equipment;
- Field device communication including communication with third-party PLC supplied with mechanical equipment.
- A camera system will be installed in the plant for process control intermittent viewing purposes.

b. Process Control System

The process control system will be DCS type. The system will be supplied to control each strategic area of the plant with remote I/O racks located in the electrical room to protect them from the potentially acidic environment.

Main processors will be included to control the following sectors: concentrate leach, impurity removal, tailing and main substation. Other PLCs may be supplied with mechanical equipment (ion exchange, electrolysis, etc.).

The central SCADA system has the capacity to control and supervise all the remote PCS equipment. In a communication outage situation, the critical equipment will be controlled locally.

c. Wiring and Junction Boxes

All the field instruments and switches will be wired to the PCS through junction boxes up to remote I/O racks situated in the various electrical rooms.

The wiring system will include field junction boxes for instrument power supply, for digital signals and for analog signals. The motor thermistor and RTD signals will be wired directly to the related motor protection relays.

d. SCADA

The SCADA system will be based on client/server technology and will include two (2) SCADA servers for redundancy, one (1) historian server, two (2) HMI operators station and one (1) engineering station. The system will be located in the central control room.

There will be seven (7) local operation client stations throughout the plant. The office stations will be located in the plant offices and the laboratory.

e. SCADA and PCS Power Sources

In case of plant power loss, a diesel generator will supply emergency power to different electric loads throughout the plant. PCS, switches, main servers, telephony system and security systems will be fed by UPS. The UPS's will be powered from the emergency power. UPS status will be monitored.

f. Redundancy

For the automation network, the redundant star topology design shall offer a second route in case of a communication outage on one (1) segment.

g. Process Analog Instruments

Process analog instruments will support primarily the Profibus protocol and they will be wired to Profibus Spur field boxes to the process controller by ProfibusPA fieldbus cables. Traditional 4-20 mA loop cabling with enabled HART protocol will be used as a backup solution when Profibus instrumentation would be unavailable or impractical to use.

#### 18.2.9 COMMUNICATION SYSTEM (LOCAL AND EXTERNAL)

a. Telecommunication Guidelines

The telecommunication system will be based on Ethernet links throughout the plant building.

Single-mode fiber optic backbone will be deployed through the plant to accommodate both automation and corporate services on the same fiber cable on different fibre.

For short cable runs, a CAT6 cable will be used. The CAT6 cable will be armored when installed in an instrumentation cable tray.

b. Telecommunication Systems

The telecom service will be connected to the Shawinigan shelter hosting the plant communication interface.

The telecommunication system will include the following items:

- IP PBX and 30 IP Phones;
- Process and Security Camera System;
- Fire Detection System;
- Mobile Radio System.

The mobile radio system will be provided for the construction and operation phase covering the processing plant, the construction site and the unloading area.

c. Telecommunication Services

The site will be connected to an internet and telephone service including wireless communication through the local telecom service provider.

d. Telecommunications Distribution

The telecommunication distribution will be through the plant fiber optic network covering all areas of the processing plant and wireless communication for the other auxiliary outside of the plant.

e. Corporate Network

The automation Ethernet backbone network, 24 fibers, in a redundant star topology described in the previous Section will be used for the camera and security video, the IP phone system and the corporate network application.

All the major network equipment will be located in dedicated server rooms located in the administrative office, the telecom shelter, the control room and electrical rooms.

Corporate services are:

- Wired/Wireless Phones and Phone System;
- Security Camera System;
- Fire Detection.

A camera system, with a recorder and a viewer will be installed in the central control room to supervise process control areas and security area.



## 19 MARKET STUDIES AND CONTRACTS

This Section summarizes the key information contained in the market study **Lithium: Outlook to 2028**, sixteenth Edition published on July 5, 2019 by Roskill Consulting Group Ltd. (“Roskill”), independent and experienced consultant. As it was decided to produce strictly lithium hydroxide at the Shawinigan electrochemical plant, this section only covers lithium hydroxide and spodumene concentrate markets.

The first part of the Report describes lithium current producers and newcomers. The objective of this Section is to forecast future production capacity of lithium hydroxide from current producers as well as from the new supply sources that may enter the market. The second part analyses lithium demand by applications, with a special focus on the use of lithium in batteries since this application is driving the demand growth and is expected to remain in the future. Assumptions have also been made regarding the use of lithium hydroxide for each of the applications.

The recent evolution of lithium hydroxide is analysed and according to the balance between demand and production capacity, lithium hydroxide prices for the period from 2018 and up to 2028 are forecasted.

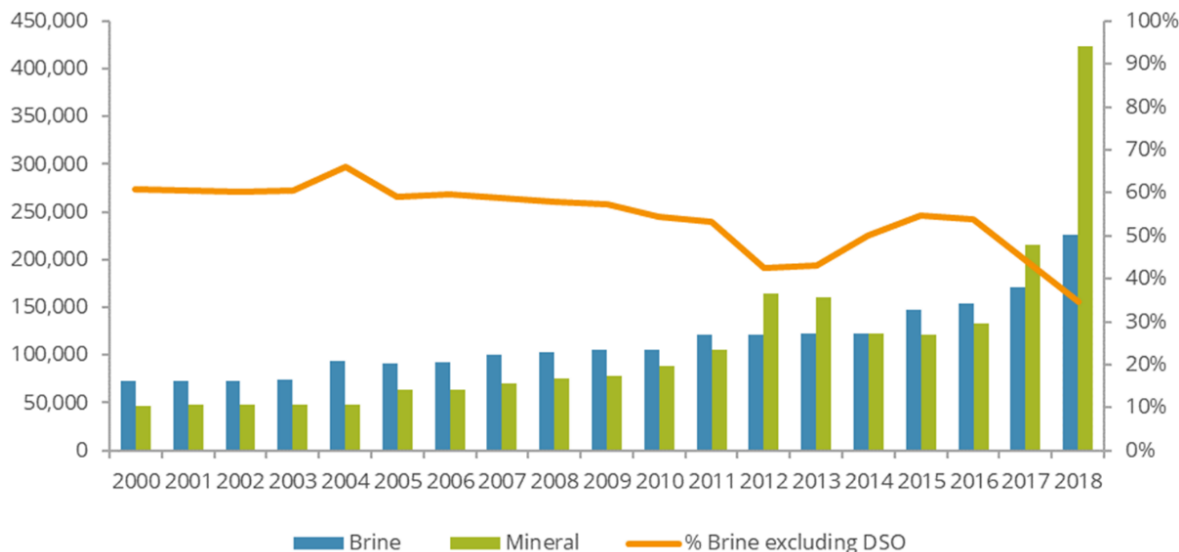
### 19.1 Lithium – Description

There are two (2) main sources of supply for lithium; continental brines and hard rock, mainly spodumene but also petalite and lepidolite.

Since 2000, the dominance of lithium capacity from brine operations has gradually fallen, as expanded and new capacity at lithium mineral operations increased more quickly in part due to moratorium imposed in Chile which was removed early 2018. In 2000, lithium compounds produced from brine production accounted for about 70% of the global total while about 30% was coming from minerals. Mine production of lithium totalled 397,821 t LCE excluding direct shipping ore (DSO), increasing by 27.7% compared to the previous year. Lithium mineral operations accounted for the majority of supply in 2018, with production of 252,448 t LCE forming 63% of global production. Output from lithium brine sources increased by 14.8% in 2018, totalling 145,373 t LCE.

Figure 19.1 shows the actual distribution of supply between these two (2) main sources evolution from 2000 to 2018.

**Figure 19.1 – World Mine Capacity of Lithium by Type, 2000-2018  
(tpy LCE and % Brine)**



Source: Roskill estimates

## 19.2 Lithium Hydroxide Demand – 2018-2028

Lithium hydroxide demand totalled 54,500 t LCE in 2018, with battery-grade now accounting for 65% and technical-grade 35% (Table 19.1). As shown in Table 19.1, Battery-grade hydroxide is expected to have the highest growth rate of all lithium products at 35.3% per year until 2028.

**Table 19.1 – World: Forecast Consumption of Lithium by Product, 2018-2028 (t LCE)**

Product Type	2018	2023	2028	CAGR '18-'28
Battery-grade carbonate	109,400	227,800	392,700	13.6%
Battery-grade hydroxide	35,600	341,100	730,500	35.3%
Technical-grade mineral conc.	37,500	42,200	47,600	2.4%
Technical-grade carbonate	32,300	36,200	40,600	2.3%
Technical-grade hydroxide	18,900	20,300	21,900	1.5%
Butyllithium	9,800	11,300	13,100	2.9%
Bromide	4,500	5,200	6,000	2.9%
Battery-grade metal	4,000	5,100	26,800	21.0%
Other <sup>1</sup>	9,100	10,100	10,900	1.8%
<b>Total</b>	<b>261,100</b>	<b>699,300</b>	<b>1,290,100</b>	<b>17.3%</b>
High	-	997,890	1,950,377	22.3%
Low	-	504,796	805,810	11.9%

Notes: 1 - Includes some of the products above that have not been differentiated from the total

Source: Roskill forecast

**Table 19.2 – World: Forecast Scenarios for Lithium Consumption by Product, 2018-2028  
(t LCE)**

	2018	2028 (t LCE)			CAGR		
		Low	Base	High	Low	Base	High
Battery-grade carbonate	109,400	347,911	392,700	740,757	12.3%	13.6%	21.1%
Battery-grade hydroxide	35,600	308,353	730,500	1,031,215	24.1%	35.3%	40.0%
Technical-grade mineral conc.	37,500	41,212	47,600	55,050	0.9%	2.4%	3.9%
Technical-grade carbonate	32,300	35,506	40,600	47,089	1.0%	2.3%	3.8%
Technical-grade hydroxide	18,900	20,074	21,900	24,456	0.6%	1.5%	2.6%
Butyllithium	9,800	11,918	13,100	15,926	2.0%	2.9%	5.0%
Bromide	4,500	4,931	6,000	7,271	0.9%	2.9%	4.9%
Battery-grade metal	4,000	25,494	26,800	15,750	20.3%	21.0%	14.7%
Other	9,100	10,410	10,900	12,863	1.4%	1.8%	3.5%
<b>Total</b>	<b>261,100</b>	<b>805,810</b>	<b>1,290,100</b>	<b>1,950,377</b>	<b>11.9%</b>	<b>17.3%</b>	<b>22.3%</b>

Notes: Rounded to nearest 100t LCE

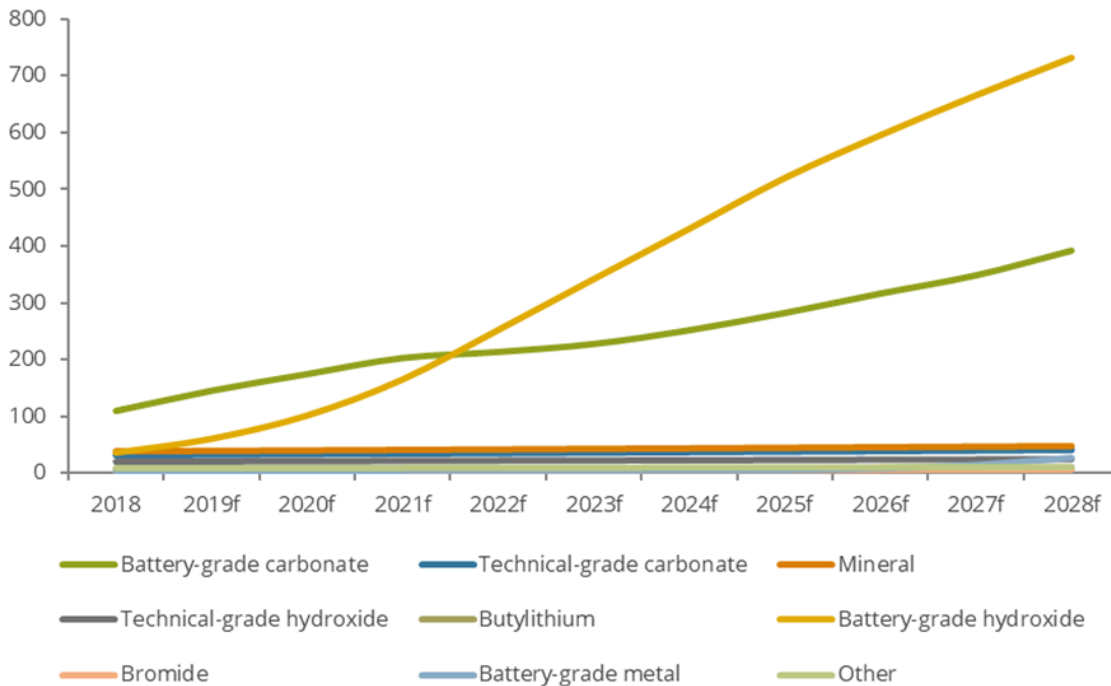
Source: Roskill forecast

Lithium hydroxide demand in particular is predicted to grow from the actual 73,100 t LCE in 2018 to over 730,500 LCE by 2028, the demand for battery grade hydroxide to grow at 35.3% Compound Annual Growth Rate (**CAGR**) per year between 2018 and 2028.

The consumption of battery-grade lithium hydroxide going forward depends on several factors, including:

- Cathode material type produced/consumed;
- Cathode manufacturer;
- Cost and availability.

**Figure 19.2 – World: Forecast Consumption of Lithium by Product, 2018-2028 (000t LCE)**



Source: Roskill estimates

The first two (2) factors are dependent on the performance of certain technologies, applications and companies. All high-nickel cathode materials (containing above 60% Ni) currently use lithium hydroxide, as the reaction between nickel hydroxide and lithium carbonate is detrimental to cathode quality resulting in a loss of performance (production of nickel carbonate which does not have ion shuttling capability). In addition, some lithium-iron phosphate (“LFP”) is produced by an alkali process which requires lithium hydroxide compared to lithium carbonate used in the acid method.

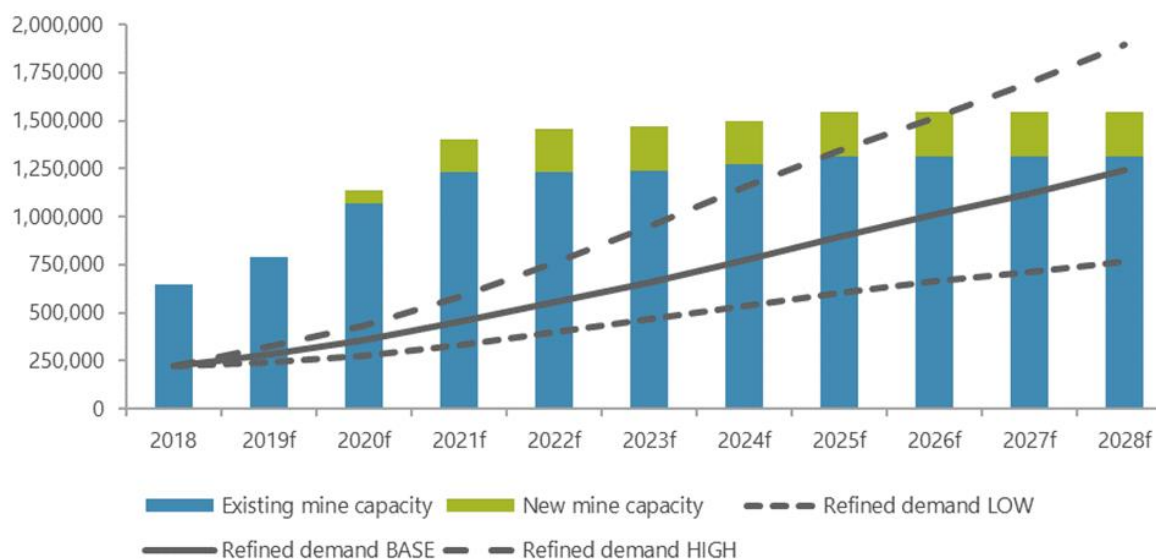
Only certain LFP manufacturers use the alkali method of production, these include Johnson Matthey Battery Materials (“JMBM”) in Canada and Alees in Taiwan. The largest consumer of lithium hydroxide for nickel-based cathode production is Sumitomo Metal Mining (“SMM”) in Japan, which supplies nickel-cobalt-aluminate (“NCA”) to cell-maker Panasonic. Panasonic also sources NCA from other cathode manufacturers. EcoPro of Korea is the second largest NCA producer behind SMM, it supplies Sony (now owned by Murata) as well as domestic cell makers.

The proportion of lithium hydroxide used in NMC is expected to grow over time, as higher nickel variants are used, and together with a greater volume of NCA [largely for Electric Vehicle (“EV”) batteries] and LFP [for Chinese EVs, e-buses and Energy Storage System (“ESS”)] means hydroxide demand growth will outpace carbonate to 2028, and hydroxide will become the main product consumed in the market from 2022

## 19.3 Lithium Supply

In 2018, mine production capacity totalled about 397,000 t/y LCE, excluding DSO, split between brines at 55% and minerals at 45%. In the period to 2028, it is expected that lithium mine production capacity by company from brine and minerals will reach approximately 1.5 M t/y LCE. Figure 19.3 shows the global forecast refined capacity for lithium in t/y LCE.

**Figure 19.3 – Forecast Mine Capacity for Lithium, 2018-2028 (LCE tpy)**



**Table 19.3 – Forecast Refined Lithium Capacity by Company, 2018-2028 (LCE t)**

	2018	2021	2024	2028
<b>Mineral Conversion</b>				
Albemarle	15,000	75,000	120,000	185,000
Tianqi Lithium	36,900	122,140	122,140	122,140
Ganfeng Lithium	68,140	90,140	90,140	90,140
General Lithium	10,000	51,280	81,280	81,280
Mineral Resources	-	-	-	50,000
Covalent Lithium <sup>1</sup>	-	-	39,776	39,776
Shangdong Ruifu	36,800	36,800	36,800	39,300
Zhiyuan Lithium <sup>2</sup>	12,400	38,200	38,200	38,200
CATL	-	18,800	37,600	37,600
POSCO	-	-	35,200	35,200
Yahua Group	15,360	33,440	33,440	33,440
Nemaska	100	500	31,240	31,240

	2018	2021	2024	2028
Dongpeng <sup>3</sup>	3,500	24,200	24,200	24,200
Youngy Co.	3,000	23,000	23,000	23,000
Nanshi Group	20,000	20,000	20,000	20,000
Yunli Company <sup>4</sup>	20,000	20,000	20,000	20,000
Tangshan Xinfeng Lithium	-	20,000	20,000	20,000
Guangxi Tianyuan	-	18,800	18,800	18,800
Yinli Company <sup>5</sup>	15,000	15,000	15,000	15,000
Baojang Company <sup>6</sup>	10,000	14,400	14,400	14,400
Others	39,400	77,800	77,800	77,800
<i>Mineral Conversion sub-total</i>	<i>305,600</i>	<i>699,500</i>	<i>899,016</i>	<i>1,016,516</i>
<b>Brine</b>				
SQM	63,000	120,000	150,000	180,000
Albemarle	50,000	96,000	96,000	106,000
Livent	26,000	40,000	56,000	60,000
Orocobre	17,500	42,500	42,500	42,500
POSCO	2,500	27,500	27,500	27,500
Minera Exar <sup>7</sup>	-	25,000	25,000	25,000
Eramet	-	-	24,000	24,000
Hengxinrong Lithium	20,000	20,000	20,000	20,000
Lanke Lithium <sup>8</sup>	10,000	20,000	20,000	20,000
Citic Guoan	10,000	10,000	10,000	10,000
Others	25,000	25,000	25,000	25,000
<i>Brine sub-total</i>	<i>224,000</i>	<i>426,000</i>	<i>496,000</i>	<i>540,000</i>
Recycling	8,131	18,786	36,528	115,981
<b>Total</b>	<b>537,731</b>	<b>1,144,286</b>	<b>1,431,544</b>	<b>1,672,497</b>

Notes:

- 1 – Kidman Resources and SQM JV
- 2 – Weihua Group
- 3 – Jiangxi Dongpeng New Materials Co.
- 4 – Jiangxi Yun Lithium
- 5 – Jiangxi Special Electric Motor Co.
- 6 – Jiangxi SE (JV with Burwill)
- 7 – Lithium Americas and Ganfeng JV
- 8 – QSL and Fozhao JV

Source: Company data; Roskill estimates



## 19.4 Prices

Lithium hydroxide prices respond to variations in supply, demand and the perceived supply/demand balance in a similar way to most raw materials. The most commonly referenced currency for lithium transactions is in \$USD, although most domestic transactions between Chinese domestic producers and consumers are conducted in the Chinese currency - Renminbi ("RMB"). The units of measure used in transactions vary from region to region and between product types.

The three (3) most commonly sold finished products are lithium carbonate, lithium hydroxide, and mineral concentrate; each is available in a range of grades designed to meet the diverse range of end-uses. Transactions are negotiated between the producer (or agent / trader) and the consumer to suit individual circumstances. Lithium compounds are not traded on any exchange.

Producers of lithium negotiate prices with individual consumers and price information is rarely reported, particularly for downstream lithium chemicals. Commercial payment terms are also negotiated between buyer and seller and can vary widely.

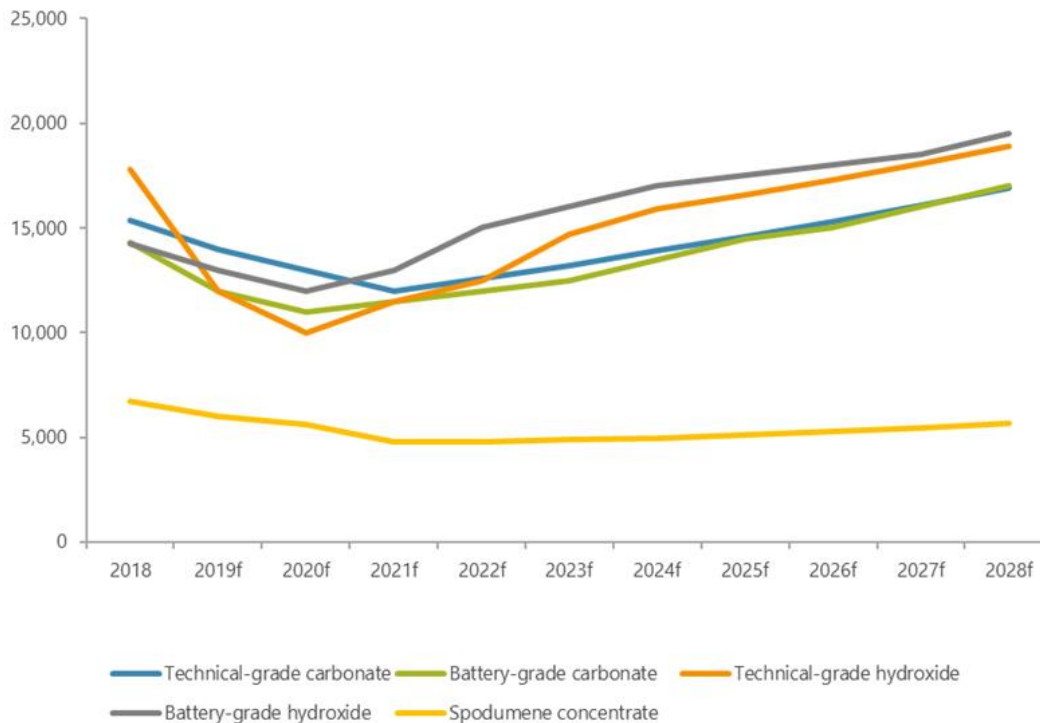
Spot prices for lithium have become more widely quoted, although they are not thought to influence contract pricing, rather they reflect material available off-contract in small volumes and are likely higher (when the market is good) or lower (when the market is poor) than contract prices. The price profiles quoted by different journals or websites are usually similar over an extended term although they might show a small, consistent offset.

These sources publish prices on a weekly, twice-weekly or month-end basis. They quote the low price and the high price that represents what has been the general consensus of industry correspondents who have reported spot transactions for the period. Spot transactions by definition use the spot price to settle. The spot price itself is open to negotiation between buyer and seller according to the perceived supply/demand conditions.

As Nemaska Project is to produce and sell lithium hydroxide, only this material for both technical and battery grades is described below; regardless of the fact that Nemaska will sell part of its spodumene concentrate from the Whabouchi Mine, until its electrochemical plant is fully commissioned and production ramped-up at the Whabouchi Mine.

Figure 19.4 and Tables 19.4 and 19.5 show the sales price forecast from 2018 up to 2028 for different lithium compounds, including technical grade and battery grade lithium hydroxide.

**Figure 19.4 – Lithium Product Contract Price Forecast, 2018-2028 (\$USD/t)**



**Table 19.4 – Average Annual Price Forecast Trend for Technical-Grade Lithium Hydroxide, 2017-2028 (\$USD/t CIF)**

	Contract		China Spot	
	Nominal	Real (inflation adjusted)	Nominal	Real (inflation adjusted)
2017	18,276	18,865	17,719	18,115
2018	17,817	17,817	16,338	16,338
2019	12,000	11,742	12,000	11,742
2020	10,000	9,592	11,000	10,551
2021	11,500	10,812	12,500	11,752
2022	12,500	11,512	13,500	12,433
2023	14,700	13,263	15,700	14,165
2024	15,900	14,053	16,900	14,937
2025	16,600	14,373	17,600	15,238
2026	17,300	14,673	18,300	15,522
2027	18,100	15,039	19,100	15,870
2028	18,900	15,384	19,900	16,198

Notes: Nominal forecast rounded to nearest US\$100/t. Real prices adjusted to constant 2018 US dollars using World GDP deflator data from the International Monetary Fund's World Economic Outlook Database

Source: Roskill

**Table 19.5 – Annual Average Price Forecast Trend for Battery-Grade Lithium Hydroxide, 2017-2028 (\$USD/t CIF)**

	Contract Asia		China Spot	
	Nominal	Real (inflation adjusted)	Nominal	Real (inflation adjusted)
2017	12,920	13,209	18,828	19,250
2018	14,258	14,258	17,780	17,780
2019	13,000	12,721	14,000	13,700
2020	12,000	11,510	13,000	12,470
2021	13,000	12,222	14,000	13,162
2022	15,000	13,815	15,000	13,815
2023	16,000	14,435	16,000	14,435
2024	17,000	15,025	16,400	14,495
2025	17,500	15,152	17,100	14,805
2026	18,000	15,267	17,800	15,097
2027	18,500	15,371	18,600	15,455
2028	19,500	15,872	19,400	15,791

Notes: Nominal forecast rounded to nearest US\$100/t. Real prices adjusted to constant 2018 US dollars using World GDP deflator data from the International Monetary Fund's World Economic Outlook Database  
Source: Roskill

Based on the information provided in this Section, combined with current off-take contracts in place and information gathered through discussions with potential customers and other sources; Nemaska has established its sale prices as follows (on a per tonne basis):

- Lithium Hydroxide (EXW Shawinigan): \$14,000 USD;
- Spodumene concentrate sales (FOB Port of Trois-Rivières): \$600 USD.

## 19.5 By-Product Market Study

In its process of producing lithium hydroxide, Nemaska will generate three (3) by-products, namely aluminum silicate, gypsum and Na/K purge solution. Aluminum silicate constitutes about 80% of the generated by-products.

Nemaska has initiated discussions with potential end users and also conducted first testing phase of its aluminum silicate with *Université du Québec (INRS)* and a Federal research center (Natural Resource Canada “**NRCan**”). The aluminum silicate has been found to be of high purity and initial tests confirm that it can be used in the making of cement or directly in concrete formulation. It can be used as a supplementary cementitious material when used in conjunction with Portland cement as it contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity, or both.

Discussion with cement industry representatives have led Nemaska to conclude that since this by-product is of high quality, non-toxic, very stable in composition and readily available, it can represent an advantage over existing supply chain providers. With the closing of many coal power plants, it is expected that the conventional fly ash cement additive will be less available for the construction industries and that Nemaska's aluminum silicate by-product is a very good substitute for fly ash.

Due to the time required to achieve qualification of the aluminum silicate with potential end users, it is assumed that some aluminum silicate will be landfilled for the first five years of production. After that, it is assumed that the aluminum silicate will always be sold to end users with a neutral impact on the operating costs. No disposal costs have been added and no additional revenues have been accounted for after the fifth year of production. Opportunities for rapid introduction of the aluminum silicate production exist and are being actively investigated by Nemaska. For the purposes of this Technical Report, it is assumed that the amount sent to landfill will decrease gradually over five (5) years until all the by product is sold.

It is assumed that the gypsum will be landfilled throughout the lifetime of the project. Studies will also be made to valorize this second by-product as it could also be potentially used in the cement or other industries.

Na/K purge solution can be disposed alongside the aluminum silicate with negligible cost impact. Once the aluminum silicate is no longer sent to disposal, it is assumed the purge will need to be disposed of as an effluent to the Saint-Maurice river. Multiple potential uses of the purge solution exist and are being investigated by Nemaska. Most promising is the ongoing negotiation with the regulator the allow effluent discharge.

## 19.6 Conclusions

The main conclusions of the reports received by Nemaska are:

- Demand for battery-grade lithium hydroxide is expected to grow at 35.3% CAGR between 2018 and 2028;
- Lithium hydroxide expected growth demand is mainly related to secondary batteries use over the next years.
- The prices for technical grade and battery grade lithium hydroxide are expected to range between \$14,000 USD to \$18,400 USD from 2022 to 2028.

## 19.7 Contracts

As at the date of this Technical Report, Nemaska has three (3) commercial off-take agreements in place totalling about 17,000/y LCE and valid between 60 and 120 months from the start of commercial production. There is one (1) contract for the sale of spodumene concentrate for the material available from the start of production of the Whabouchi mine until commercial production is reached at the Shawinigan electrochemical plant.

## **20 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT**

### **20.1 Whabouchi Mine Site**

#### **20.1.1 ENVIRONMENTAL BASELINE STUDIES**

Baseline environmental studies at the Whabouchi Mine Project site began in August 2010 with field surveys for water quality, sediment quality, benthic invertebrates, and fish. During 2011 and through 2012, additional data were collected, focusing on fish, surface water quality, bathymetry, hydrology, ground water quality, soil quality, air quality, noise, large mammals, small mammals, bats, birds, amphibians, and reptiles.

Two (2) study areas have been identified for the ESIA and the associated environmental and baseline studies (Figure 20.1). The “local study area” includes all of the areas likely to be directly physically impacted by the mine development (pit, buildings, and roads) or that is located in its immediate vicinity. Such area encompasses zones that are likely to be disturbed by the activities on-site (site preparation, noise, dust emissions, ore extraction, waste rock and tailings disposal, discharge of mine effluent, etc.). The “regional study area” is a larger area extending out of the Property and to which are potentially associated cumulative effects with other projects or infrastructure; such effects are typically associated with water quality, wildlife and socio-economic aspects.

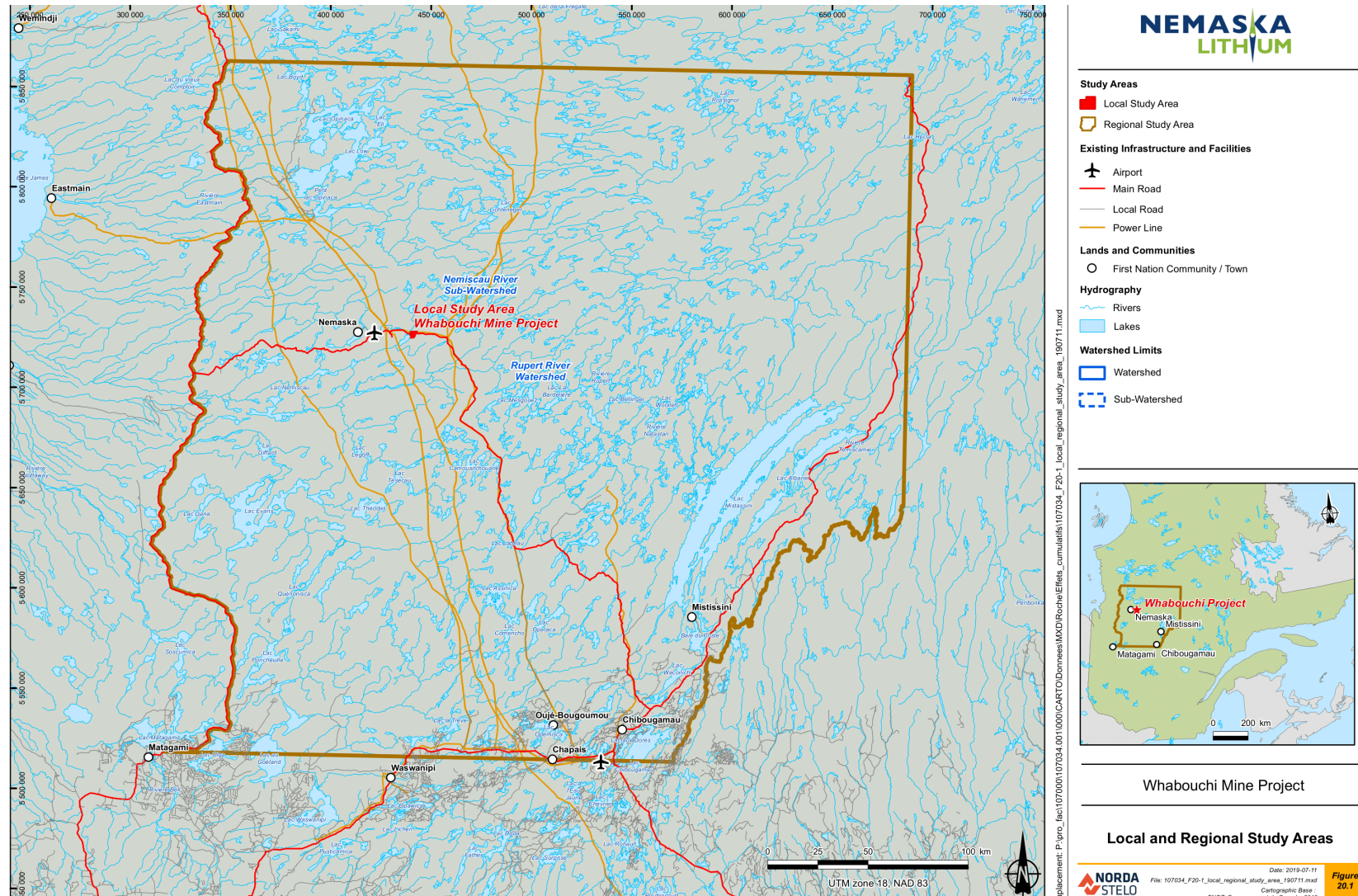
Physical and biological environments of the Whabouchi Mine Project area were described based on information collected from various sources:

- Field surveys;
- Aerial photographs and/or satellite images, maps, and geomatics tools;
- Information provided by various governmental agencies as well as by other project proponents active in the territory (municipality, other mine or hydropower projects, etc.);
- Studies from the scientific and technical literature.

Table 20.1 shows a list of completed, ongoing, and planned work for the environmental baseline studies.



Figure 20.1 – Local and Regional Study Areas





**Table 20.1 – Whabouchi Mine Project – Environmental Baseline Studies**

<b>Environmental Component</b>	<b>Works Undertaken to Date</b>	<b>Ongoing or Planned Works</b>
Cartography	Establishment of a GIS database for the Project and incorporation of existing databases (topographic base, LiDAR, etc.), desktop work, and field data. Database updated following multiple field and drone surveys completed as part of the construction phase.	Additional field and drone surveys in construction for detailed topography and evaluation of work progress.
Climate	Collection of data from existing weather stations: Chapais-2 (229 km), Nemiscau A (21 km) and <i>La Grande Rivière A</i> (241 km). Interpolated climatic design data obtained from Environment Canada and Weather Analytics. Climate data analysis (temperature, rainfall, snowfall, wind).	Installation of a weather station at mine site in 2019.
Geology and Soils	Extensive series of hard rock geology drilling and analyses by Nemaska Lithium described elsewhere in this Report. Particle size analysis of surficial deposit samples from trenching. Samples of soil and surficial deposits collected, in part during exploratory trenching (21 trenches dug) for chemical analyses. Geotechnical study completed in 2011. Photo interpretation. General description of the geology and soils from literature review. Geomorphology interpretation and field validation. Additional geochemical characterization works done in parallel with the 2016 and 2017 exploration drilling campaign.	-
Hydrogeology and Groundwater Quality	Twelve (12) drill holes converted into observation wells for groundwater quality. Drawdown tests. Eleven (11) permeability tests. Collection and chemical analyses of groundwater samples. Field works completed in 2011 and 2012. Hydrogeological modelling completed in 2012 and updated in 2014. Groundwater sampling in October 2011, November 2011, March and July 2012 (21 wells), and June 2014. Implementation in 2018 of the permanent network of groundwater monitoring wells as defined in the Environmental Monitoring Program approved by the authorities.	Additional groundwater sampling as part of the Environmental Monitoring Program.
Hydrology	Field check of non-mapped watercourses. Determination of watershed boundaries. Field flow measurements. Calculation of theoretical flows from CEHQ data. Collection of bathymetric data for three (3) areas and production of bathymetric maps. Cross- and longitudinal sections established for creeks B, C, E and F. High-water mark identified for lakes 2, 3, 27, 28, 30 and 16. Flow measurements. Stage gauging, water level measurements. Implementation in 2018 of the permanent water flow monitoring stations as defined in the Environmental Monitoring Program approved by the authorities.	Additional fieldworks as part of the Environmental Monitoring Program.
Water and Sediment quality	Surface water and sediment quality sampling completed in August 2010; February, July and December 2012; June, July and October 2014; and August 2016. Initial baseline sampling in 2018 for the Environmental Monitoring Program approved by the authorities.	Additional sampling as part of the Environmental Monitoring Program.

Environmental Component	Works Undertaken to Date	Ongoing or Planned Works
Air Quality	Permanent air quality monitoring stations installed in 2018. Air quality modelling completed in 2012 and 2013 and updated in 2014 and 2016 considering the most recent site arrangement plan. Initial baseline sampling ongoing since 2018 for the Environmental Monitoring Program approved by the authorities.	Additional sampling as part of the Environmental Monitoring Program.
Noise	Noise monitoring stations installed. Noise modelling completed in 2013 and updated in 2014 considering the most recent site arrangement plan. Initial baseline sampling in 2018 for the Environmental Monitoring Program approved by the authorities.	Additional sampling as part of the Environmental Monitoring Program.
Aquatic Habitats	Collection of data on habitats. Additional characterization of the final effluent discharge area in September 2017.	Additional fieldworks as part of the Environmental Monitoring Program.
Benthic Invertebrates	Analysis of benthic invertebrates at six (6) stations in 2010. Additional characterization of benthic invertebrates within the final effluent discharge area in September 2017.	Additional fieldworks as part of the Environmental Monitoring Program.
Fisheries	Experimental fishing at all local lakes and streams (by net, bait traps, hoop nets and electrofishing) in 2010, 2011, 2012 and 2014. Catches representing 13 fish species. Literature review. Metal content sampling in tissue of three (3) fish species. Walleye spawning areas validated in 2014. Initial baseline sampling in 2018 for the Environmental Monitoring Program approved by the authorities. Additional works completed in Lake 2 to potentially decrease the evaluation of potential indirect losses of fish habitats.	Additional fieldworks as part of the Environmental Monitoring Program.
Terrestrial Habitats and Vegetation	Detailed botanical work including vegetation mapping and identification of important plant communities and species. Field surveys completed in 2012.	-
Wetlands	Field works in 2012 to delineate and characterize wetlands. Additional characterization of nearby Spodumene Bog completed in 2014. Initial baseline sampling in 2018 in the Spodumene Bog for the Environmental Monitoring Program approved by the authorities.	Additional fieldworks as part of the Environmental Monitoring Program.
Amphibians and Reptiles	Amphibian and reptile surveys in 2012. Incidental observations while conducting other field works. Literature review. Initial baseline sampling in 2018 in the Spodumene Bog for the Environmental Monitoring Program approved by the authorities.	Additional fieldworks as part of the Environmental Monitoring Program.
Avifauna	Literature review. Incidental observations while conducting other field work. Literature review. Additional survey for special-status bird species completed in 2015. Initial baseline sampling in 2018 in the Spodumene Bog for the Environmental Monitoring Program approved by the authorities.	Additional fieldworks as part of the Environmental Monitoring Program.

Environmental Component	Works Undertaken to Date	Ongoing or Planned Works
Mammals	Aerial survey for large mammals in winter (2012). Track counts in snow for large and medium mammals in winter (2012). Trapping survey for small mammals (2012). Ultrasound recordings for bats (2012). Literature review. Initial baseline sampling in 2018 in the Spodumene Bog for the Environmental Monitoring Program approved by the authorities.	Incidental observations while conducting other field works and during mine construction works. Additional fieldworks as part of the Environmental Monitoring Program.
Special-Status Species	Information requests to agencies such as the CDPNQ and provincial departments; field surveys. Additional survey for special-status bird species completed in 2015.	Incidental observations while conducting other field works and during mine construction works.
Species of Traditional Use	Preliminary list of species established and presence confirmed during field work.	-

#### 20.1.1.1 Physical Environment

The characterization and validation of water courses and watersheds were done using topographical and thematic maps, Digital Elevation Models (“DEM”), aerial photos and field surveys. Watershed limits and stream alignments within the limits of the Property were established using LiDAR data and drone surveys. Calculations of stream flow rates derived from standard CEHQ models were made and supplemented with field checks.

The study area is characterized by the presence of numerous water bodies, streams and wetlands. The mine site is in the Rupert River watershed, which has a surface area of 43,400 km<sup>2</sup> and flows from east to west towards the Rupert Bay and ultimately into James and Hudson bays. The hydrographic network on the Property is constituted of five (5) creeks, named A, B, C, D, and E.

All of those small watersheds near the mine site drain into the Nemiscau River (2,000 km<sup>2</sup> watershed upstream from the site) itself, a tributary to the Rupert River that it joins 70 km downstream from the site. The Nemiscau River is on the western perimeter of the site and the on-site drainage trends west-southwest towards the Nemiscau River. The largest stream on-site is the one that drains Spodumene Lake (namely, creek D) with a watershed of over 100 km<sup>2</sup>. The other on-site watershed surface areas are well under 5 km<sup>2</sup>.

The largest lake in the vicinity of the site is Mountain Lake, with a surface area of 1,375 ha. It lies on the western side of the Whabouchi Property and is actually a widening of the Nemiscau River. Spodumene Lake, to the east of the site, is only 61 ha and is the second largest lake in the mine site vicinity.

The Mine Project study area is characterized by the presence of unconsolidated deposits, essentially of glacial and fluvio-glacial origin. Globally, their thickness is less than four (4) m, except in an area

northwest of Spodumene Lake, where their thickness can reach about 15 m. The landscape in the study area is dominated by rocky hills that are mostly oriented northeast/southwest. Most of these hills are low, with an elevation difference of less than 50 m.

The major part of the study area is characterized by the presence of undifferentiated till in thicknesses varying from one (1) m or two (2) m to more than ten (10) m. At the southwest of the study area, particularly on either side of the Nemiscau River, segments of the Sakami Moraine can be seen.

As part of the soil characterization program completed on the Whabouchi Property (during exploratory trenching), no results exceeded the applicable criteria C (for industrial areas such as mine sites). The results of the soils characterization completed for the Project indicate that there is no contamination in the unconsolidated deposits at the site.

Field hydrogeological data was used in order to perform groundwater flow modelling (Richelieu Hydrogéologie, 2012 and 2014). The results of that modelling enable portraying the hydrogeological conditions prevailing on the projected mine site and identifying the potential impacts of the Project on groundwater.

Groundwater was analysed at several well locations in 2011, 2012 and 2014 and results suggest that it is generally of good quality. Groundwater quality is characterized by acidic pH (mean of 6.25 in bedrock and 6.62 in surficial deposits). Natural background exceedances of resurgence in surface water criteria of the Soil Protection and Rehabilitation of Contaminated Sites Intervention Guide ("SPRCSIG") criteria, were measured for copper, zinc, mercury, aluminum, barium and nickel, all common metals in the Canadian Shield geological region.

According to surface water quality data collected in spring, summer and fall 2014, the waters on and near the site are typical of the Quebec boreal zone of the Canadian Shield. They are clear, very soft and of very low conductivity. The pH values range from 4.53 to 6.88. Acidic waters are common for Canadian Shield water bodies. They are poor in nitrogenous and phosphorous nutrients, what is typical of oligotrophic environments. Alkalinity levels are very low, indicating high sensitivity to acidification (low to very low buffering capacity). Results indicate that metal and metalloid contents in surface water of the Study area are low. Exceedances of applicable criteria were measured for aluminum, iron, mercury, arsenic, beryllium, copper and lead.

Sediment quality data collected in 2014 suggests that they are generally of good quality with some elevated arsenic, copper, mercury, lead and zinc concentrations.

#### 20.1.1.2 *Biological Environment*

The Whabouchi Mine Project is located at the northern limit of the spruce-moss forest domain, in the continuous boreal forest sub-zone. The site is not located in or nearby any protected areas, as designated by the Quebec or Canadian governments.

Black spruce is the dominant tree species, with other species being found, notably white birch, trembling aspen and balsam poplar. Forest fires have modeled the forest dynamic in the Nemiscau

area. The presence of many recent burns (less than 20 years old) near the Project site is an indication of this phenomenon. In fact, recent burns represent the most important class of vegetation in the study area (80% of the total impacted area).

Twenty-six (26) special-status plant species could potentially be present in the Project study area. Due to the features of the Project site, three (3) of these special-status species are susceptible of being found in bogs, namely dragon's mouth, linear-leaved sundew and twin-scaped bladderwort. Even though specific attention was paid to those species as part of all field works, none was observed. Moreover, no exotic invasive plant was observed on the Property.

Ten (10) species of amphibians and reptiles could be present in the study area. These include the yellow-spotted salamander, American toad, wood frog, mink frog and common garter snake. Field surveys confirmed the presence of some of these species, but of no special-status species of amphibian or reptile in the study area.

With regards to mammals, several species of large and small fauna are present in the study area. Moose and black bear are the two (2) main species of large mammals found in the study area. During the aerial surveys, five (5) moose yards with individuals present were observed, while no black bear was seen. Gray wolf, North American beaver, marten and red fox are among the other mammals observed in the Study area.

Six (6) bat species could be present in the study area. Field surveys carried out in 2012 have confirmed the presence of bat species of the *Myotis* and *Lasiurus* genders. The *Myotis* gender comprises two species (little brown bat and northern long-eared bat) that are listed as endangered under the Species at Risk Act while the *Lasiurus* gender comprises two species (hoary bat and eastern red bat) that are considered as likely to be designated threatened or vulnerable by the Quebec Government. A nursery roost of approximately 300 little brown bat individuals is present near the Mine Project site, more precisely at the northern end of the Spodumene Lake. This maternity located in an old cabin is monitored by the MFFP (Department of Forests, Wildlife and Parks). In addition, there is a prior record of one (1) sighting of a hoary bat near Spodumene Lake.

Otherwise, thirteen (13) species of micromammals (small mammals, mice and voles) might be present in the study area. These include the rock vole, southern bog lemming, deer mouse and arctic shrew. The deer mouse was the species captured most often during the inventories completed for the Whabouchi Mine Project.

A total of ten (10) special-status mammals (Quebec's Act Respecting the Conservation and Development of Wildlife and Canadian Species at Risk Act (SARA)) could be present in the study area: the least weasel, rock vole, southern bog lemming, wolverine, woodland caribou (forest ecotype), silver-haired bat, northern long-eared bat, hoary bat, eastern red bat and little brown bat. However, except for the hoary and little brown bats for which confirmed sightings exist, none was observed during the field surveys conducted on the Mine Study Area up to this date.

According to the documentation that was consulted, 131 bird species from the four (4) following groups could be present in the study area: waterfowl (geese, ducks and loons), other aquatic birds (gulls, herons, etc.), raptors (falcons, eagles, owls, etc.) and terrestrial birds (grouse, nighthawks, woodpeckers, etc.). Among the waterfowl, the Canada goose is the most abundant species during the spring migration, while during the fall migration, American black duck is the most numerous. Seven (7) species susceptible of being present in the study area have a special status at the provincial and/or federal level: golden eagle, common nighthawk, peregrine falcon, short-eared owl, olive-sided flycatcher, bald eagle and rusty blackbird. One (1) bird species, the common nighthawk, listed as “threatened” under the Federal Species at Risk Act, has been confirmed in the study area. In addition, some sightings of bald eagles have been reported around the Mountain Lake.

Fisheries and fish habitat assessment works were completed at various periods since 2010. Fish populations were inventoried using experimental fishing nets, bait traps, hoop nets and electrofishing. Thirteen (13) fish species have been identified in the lakes and streams near the site during fieldwork. The species caught most frequently is the lake whitefish. Other common species include white sucker, walleye, and brook trout.

Several of the fish species present are caught and eaten by local residents, notably brook trout, walleye, lake whitefish, and pike. In November 2011, over 100 fish tissue samples were collected and preserved for chemical analyses. Preliminary evaluation of the results from 40 of these fish suggests that levels of metals are generally low, even though mercury levels were above detection limits in all samples.

To date, no special-status aquatic species has been found on the site. Lake sturgeon is a species considered as likely to be designated threatened or vulnerable in Quebec and is present in some nearby lakes (i.e., Nemaska Lake) and in the Rupert River system. However, there are no indications of its presence on the Nemiscau River drainage area this far up. Local people have stated that they have not found it in this area.

Background benthic invertebrate studies were undertaken in 2010. Benthic invertebrates are important indicators of the quality of aquatic habitats. Results show high variability between sites. In addition, characterization of benthic invertebrates within the final effluent discharge area were carried out in September 2017.

#### 20.1.1.3 Waste Rock and Tailings Characterization

In order to determine the geochemical characteristics of mine materials to be produced as part of the Whabouchi Mine Project and to define the associated management requirements, an initial environmental geochemical characterization was carried out in 2011 and 2012 (Lamont, 2013), and a complementary characterization in 2014 (Roche, 2014). Also, large-scale *in-situ* leaching tests (experimental cells) were initiated in October 2017 as part of a research program in collaboration with the *Institut de recherche en mines et en environnement* of the *Université du Québec en Abitibi-Témiscamingue* in order to confirm that the observations and measurements



made during the previous tests are representative of the naturally-occurring conditions at the Mine Project site.

The number of samples and the type of tests performed during the initial and the complementary characterization are given in Table 20.2.

**Table 20.2 – Numbers of Samples Used in the Two (2) Geochemical Characterizations**

Material Type	Initial Characterization				Complementary Characterization
	ARD and Total Content (Major Elements)	Partial Content (Trace Elements) and TCLP	SPLP, SFE and Radioactivity	Kinetic Test (Humidity Cell)	Total Content and Partial Content (All Elements) TCLP, SPLP and CTEU-9
Spodumene Pegmatite (ore)	5	5	5	-	2
Basalt	41	41	23	-	7
Gabbro	26	26	16	-	5
Pegmatite	9	9	4	-	2
Volcanic Felsic Rock	2	2	2	-	2
Tailings	5	5	5	-	-
Waste Rock Composite	5	-	-	5	-
Tailings Composite	1	-	-	1	-

**Note:** Acid Rock Drainage (“ARD”); Shake Flask Extraction (“SFE”); TCLP (USEPA-1311), SPLP (USEPA-1312) and CTEU-9 (Environment Canada). Total contents of major elements obtained by X-ray fluorescence while total and partial contents tests by total digestion, aqua regia. The various lithologies in the deposit are: 50% basalt, 35% gabbro, 10% pegmatite and 5% volcanic felsic rock.

a. Applicable Management Requirements

In Quebec, *Directive 019* for the mining industry is the document used by the Department of Environment and the Fight to Climate Change (“**MELCC**”) to authorize and monitor mining projects. It should be noted that in that document waste rocks, tailings, treatment sludge and dusts are all defined as “mining residues” (or mining waste).

*Directive 019* outlines requirements with regards to the characteristics of the residues (low risk, leachable, acid-generating, radioactive or high risk) and defines leak proofing measures to be applied to mining waste management facilities, thereby ensuring groundwater protection. Figure 20.2 specifies criteria to be considered in determining the leak proofing measures as depicted in *Directive 019*.

Are defined as “low risk” any mining residues with metal concentrations that comply with criteria A of the SPRCSP for a specific geological province (in this case, Superior Geological Province) or with the natural local background levels of the area. However, residues that produce a leachate with concentrations lower than the groundwater protection criteria specific

to “leachable” mining residues are also considered “low risk”, even if total metal content is greater than criteria A of the SPRCSP.

A sample is considered “leachable” for a given element if its metal concentration is higher than Quebec's SPRCSP criteria A and its leachate concentration obtained with TCLP 1311 test is higher than the SPRCSP groundwater protection criteria for surface water seepage. Leachable residues require groundwater protection measures. It is important to note that there are no criteria A for some metals.

*Directive 019* specifies that “acid generating” mining wastes are characterized by a sulfur content of more than 0.3% and for which an acid generating potential has been confirmed by one (1) of the two (2) following conditions:

- The net acid neutralizing potential (NP-AP) is lower than 20 kg CaCO<sub>3</sub>/t of residues; or,
- The acid neutralizing potential ratio (NP/AP) is lower than 3. “Acid-generating” residues require groundwater protection measures.

In Quebec, materials are considered radioactive following the Regulation respecting hazardous materials definition: “radioactive material” means any material that spontaneously emits ionizing radiations and for which the result of the following equation, calculated for one (1) kg of material, is greater than one (1):

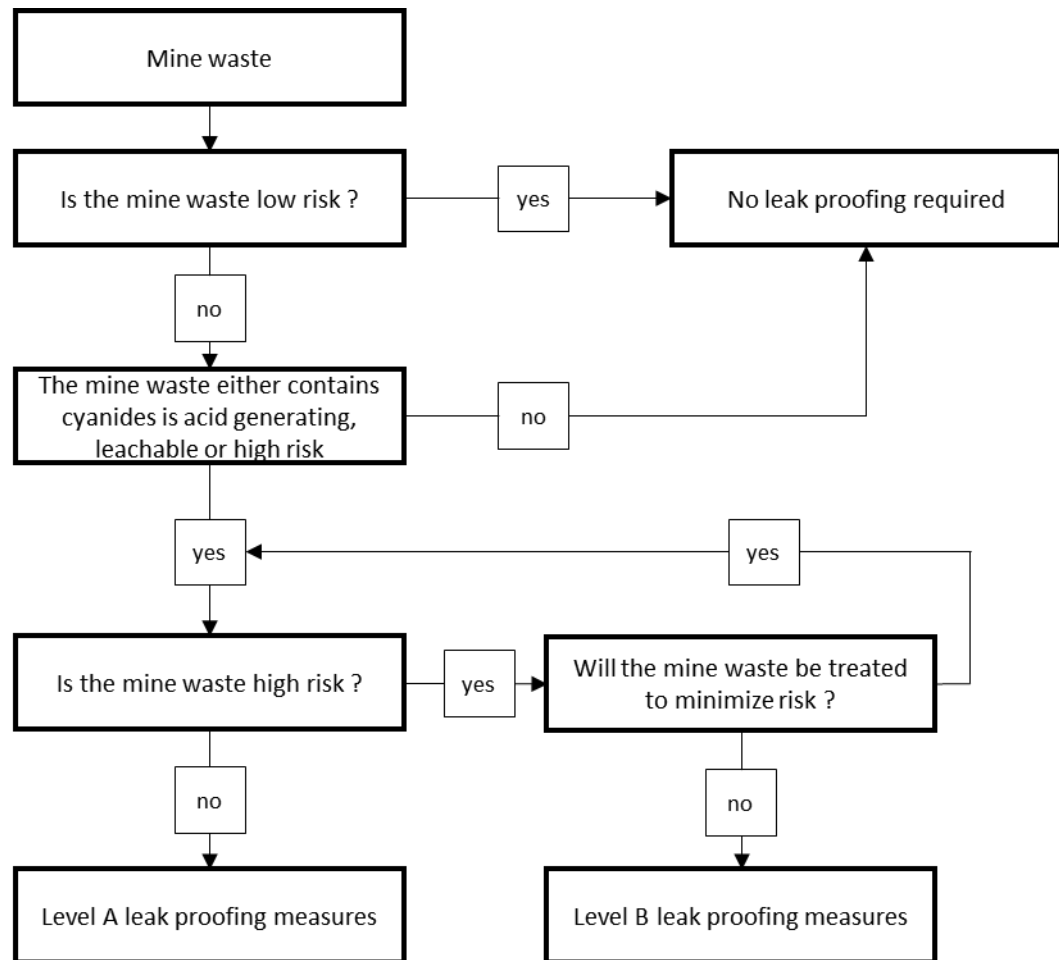
$$S\text{-factor} = C1/A1 + C2/A2 + C3/A3 + \dots + Cn/An$$

- Where “C1, C2, C3, ... Cn” represents the specific activity of the radioactive material for each radioelement it contains, expressed in kilobecquerels per kilogram (kBq/kg);
- and “A1, A2, A3, ... An” is expressed in kBq/kg and represents the maximum activity listed in Schedule 1 for one (1) kg of material for each corresponding radioelement.

This factor represents the specific activity of the radioactive material. When a mining waste is classified as “radioactive”, the Proponent must plan radioactive protection measures. In fact, it is considered more of a health and safety issue than an environmental issue.

Finally, “high risk” materials are defined as those that produce leachate with levels higher than those defined in Appendix II of *Directive 019* or as material that is considered radioactive according to *Directive 019*'s definition. “High risk” residues require the strictest groundwater protection measures.

**Figure 20.2 – Criteria for Determining Leak Proofing Measures to be Applied to Mine Residues Accumulation Areas**



Source: Directive 019 for the mining industry – March 2012

b. Radioactivity

Radioactivity characterization has shown that activities of all measured radioelements are low and well under applicable criteria. This is consistent with the very low content of uranium and thorium in waste and ore from the deposit.

c. Acid Rock Drainage Potential

Some waste samples from the initial characterization showed ARD potential according to short-term static tests. However, kinetic tests carried out on two (2) composite waste samples (made from potentially ARD samples) have shown that ARD is not an issue for the Whabouchi

Mine Project. These results have also been confirmed up to this date by the results of the ongoing in-situ experimental cells testing.

In fact, average sulphide content in the projected waste rock and tailings pile would be 0.14%. Moreover, the sulphide occurred as disseminated grains scatter randomly across the deposit (i.e. there has not up to this date been made any observations of localized concentration of sulphide mineralization within either strata or veins systems) and therefore, even if it is consequently impossible to do segregation of various types of wastes, there is no expectations to end up having to manage zones of potentially acid-generating material in the deposit as it is well distributed.

d. Leaching Potential

Concerning the leaching potential, or metal leaching ("ML"), conclusions from the Initial Characterization (Lamont, 2013) were:

- "Concentrations of selected metals were elevated in leachate from the individual TCLP, SPLP and SFE analyses compared to the SPRCSP Criteria for groundwater. However, results of the TCLP analyses in combination with the results of the trace metal analyses indicated that the waste rock, ore and tailings samples were classified as "Leachable" for only copper under the *Directive 019* criteria."
- "Results of the kinetic tests indicated that metal concentrations in leachate from the long-term tests were low:
  - / Metal concentrations in the leachate from all the different humidity cells, over the long-term, were below the SPRCSP Criteria for groundwater; and
  - / Only the humidity cell leachate from two (2) samples exceeded the SPRCSP for copper, for the pegmatite sample in week #1 and the tailings sample in week 1. These concentrations, however, immediately declined to levels roughly an order of magnitude below the SPRCSP criteria and remained below the criterion for copper for the remainder of the 46-week tests indicating that copper was mobile but release rates were very low."
- "Results of geochemical investigation to assess the ARD/ML potential of the waste rock, ore, and tailings from the Whabouchi Lithium deposit were similar to typical granitic pegmatites and mafic igneous rock, with generally low ARD and low ML potential."

Results from the Complementary Characterization and, up to this date, from the ongoing in-situ experimental cells testing confirmed most of the results from the Initial Characterization. However, results from TCLP leaching test showed that basalt and gabbro are not "leachable" for copper.

Results from TCLP leaching test showed that basalt, gabbro and volcanic felsic rock could be "leachable" for aluminum. However, aluminum concentrations in leachates from kinetic tests

were consistently lower ( $<0.10$  mg/L) than the groundwater protection criteria (0.75 mg/L) and thus this does not classify as “leachable”.

Pegmatite waste and ore could also be theoretically “leachable” for beryllium as it contains some small amounts of beryl mineral. However, beryllium contents in leachates from kinetic tests performed on a pegmatite composite sample were consistently lower (0.00002 mg/L) than the groundwater protection criteria (0.00006 mg/L). Moreover, beryllium contents in leachates from kinetic tests performed on a tailings composite sample were lower (0.00002 mg/L) than the groundwater protection criteria from Week 12 to the end of the testing (Week 28).

e. Rare Earth and Rare Metals Contents

Only total contents of Cs, Ta and Rb in pegmatite and ore samples and Cs content in waste rock samples were significantly higher than the average contents of the surficial terrestrial crust. There are no applicable criteria for the vast majority of those elements.

f. Conclusions

According to the results from the two (2) geochemical characterizations, and also, partly based on the results gathered up to this date from the ongoing in-situ experimental cells testing, following *Directive 019*, Whabouchi mining residues are classified as:

- / Not “high risk”;
- / Not potentially “acid-generating”;
- / Not potentially “leachable” according to TCLP and kinetic tests results.
- / In this context, no groundwater protection measures are required for the waste rock and tailings pile.

As aforementioned, a research project was initiated in collaboration with Pr. Benoît Plante of the Université du Québec en Abitibi-Témiscamingue (“UQAT”). Two (2) Engage Grants (Engage and Engage Plus) were first obtained from the Natural Science and Engineering Research Council (“NSERC”) by Pr. Plante's team and Nemaska Lithium.

The objective of this first phase was to refine our understanding of the environmental behaviour of the future mine tailings produced as part of the extraction of the lithium-containing ore (spodumene) using mineralogical characterization and preliminary geochemical characterization of the Whabouchi materials. More precisely, the various lithologies of the Whabouchi deposit were sampled from exploration drill cores.

These samples then went through a series of assays; among others, samples were analysed for their chemical and mineralogical (X-Ray diffraction; electronic microscope analysis) content and a sample of spodumene concentrate was manually produced by hand-picking grains of spodumene from an ore sample. Also, all samples were submitted to kinetic testing in

alteration cells in order to test their reactivity and metal leaching potential. The results of this first phase confirmed the information depicted in this section.

The second phase of the Project was granted in 2017 an NSERC's Research and Cooperative Development Grant ("RCD") in order to implement *in-situ* experimental cells emulating the Whabouchi site conditions and using waste rocks and tailings produced on site. Construction of these cells started on October 11, 2017 and was completed on October 20, 2017. The results of this second phase gathered up to this date confirmed the information depicted in this section.

## 20.1.2 JURISDICTIONS AND APPLICABLE LAWS AND REGULATIONS

The legal framework for the construction and operation of the projected mine facilities is a combination of provincial, national, and municipal policies, regulations and guidelines. The design and the environmental management of the Mine Project facilities and activities must be done in accordance with this legal framework. Outlined below are the major steps through which Nemaska Lithium went or will have to go through as Mine Project development will move forward.

### 20.1.2.1 2013 Modifications to the Quebec Mining Act

The Quebec government is responsible for mining activities in the province. This activity is subject to the Mining Act which defines Ownership of the right to mineral substances (claims, mining exploration licenses, mining leases, mining concessions, etc.) and the rights and obligations of the claim holder or other mining right granted by the State.

The Act was substantially amended and modernized by Bill 70, which the Quebec National Assembly adopted on December 9, 2013. This fourth attempt to update Quebec's mining legislation follows on the heels of the defeat of Bill 43 and that of Bill 79 and Bill 14 in previous legislative sessions. Within the specific context of the Whabouchi Project, the following amendments are relevant:

- Provisions specific to aboriginal communities and referring to an aboriginal community consultation policy specific to the mining sector (obligation to consult aboriginal communities and requirement that the Minister consult aboriginal communities separately if the circumstances so warrant);
- On each anniversary date of a mining lease or mining concession, the lessee or grantee will have to send the Minister a report showing the quantity of ore extracted during the previous year, its value, the duties paid under the Mining Tax Act during that period and the overall contributions paid;
- Mining leases to be issued will require the prior approval of a rehabilitation and restoration plan and the issuance of a General Certificate of Authorization ("CA") under the Environment Quality Act ("EQA"), unless the time needed to obtain a certificate is unreasonable.

It should be noted that with regards to these specific amendments, Nemaska Lithium obtained its mining lease following the adoption of Bill 70 and thus is fully complying with the Act.



With regards to the environment, it should be noted that the Mining Act, Chapter IV, Division III, specifies that the holder of mining rights has the responsibility to rehabilitate and restore the lands on which exploration and/or development activities have been carried out. This work must be completed in accordance with the restoration plan pre-approved by the Department of Energy and Natural Resources (“**MERN**”). Under the Mining Act, the Regulation respecting mineral substances other than petroleum, natural gas and brine details certain procedural requirements of the Act, particularly in terms of the information and documents to be provided to the MERN on restoration measures and locations established to store mine tailings.

On July 23, 2013, the Government of Quebec passed amendments to the Regulation respecting mineral substances other than petroleum, natural gas and brine in order to set new rules concerning the financial guarantees required for the restoration of mining sites. Among other things, those result in an increase of the financial guarantee from 70% to 100% of the projected costs for the work required under the rehabilitation and restoration plan. The guarantee must cover not only restoration costs associated with the accumulation areas, but all costs for the entire mine site and associated infrastructure. It must be paid in three annual installments.

The first installment corresponds to 50% of the total amount of the guarantee and must be paid within 90 days following the receipt of the approval of the plan. The second and third installments each represent 25% of the guarantee and must be paid in full by the first and second anniversary date. To that regard, in June 2019, Nemaska Lithium paid the last installment of the financial guarantee required under the approved Rehabilitation Plan for the Whabouchi Mine Project and is thus fully compliant with the applicable Regulation.

Lastly, the Regulation respecting Environmental Impact Assessment and Review was amended to require an environmental impact assessment for all metal ore processing plant construction projects, and all metal mine openings and operation projects where the processing or production capacity of the plant or the mine is 2,000 metric tonnes or more per day. However, it should be noted that since the Whabouchi Mine Project is located in the territory governed by the James Bay and Northern Quebec Agreement (“**JBNQA**”), this last modification does not apply to it. Indeed, on that territory, all mining projects were already subject to the environmental impact assessment process, as outlined in the following section.

On December 31, 2015, amendments to the Regulation were also adopted in order to require mining project proponents to establish, within 30 days following the issuance of the mining lease, a monitoring committee to facilitate the participation of the local community. The further-described Chinuchi Agreement signed in 2014 by Nemaska Lithium and its Cree First Nation partners includes the implementation of committees which complies with this requirement.

#### 20.1.2.2 *Quebec Procedure relating to the Environmental Assessment of the Project*

The Quebec EQA comprises two (2) Chapters. Chapter I gives general provision and Chapter II gives provisions applicable to the Eeyou Istchee / James Bay and Northern Quebec Region in accordance with the JBNQA, signed by the Native peoples of the northern regions.

The environmental assessment procedures established for northern projects vary according to whether the project is located south or north of the 55<sup>th</sup> parallel.

Section 133 of the EQA defines the territory south of the 55<sup>th</sup> parallel as: “the territory bounded to the north by the 55<sup>th</sup> parallel, to the west by the boundaries of Ontario and of the Northwest Territories, to the east by the 69<sup>th</sup> meridian and to the south by a line that coincides with the southern limit of the middle zone and the Cree traplines located to the south of the middle zone, as determined under the Act respecting hunting and fishing rights in the Eeyou Istchee / James Bay and New Quebec territories (chapter D-13.1), as well as to the Category I and II lands for the Crees of Great Whale River.”

The Whabouchi Mine Site is located within the limit of the territory described above, also referred to as Eeyou Istchee / James Bay Region, or Eeyou Istchee for the Cree First Nation.

The procedure described in the EQA and the Regulation respecting the environmental and social impact assessment and review procedure applicable to the territory of Eeyou Istchee / James Bay Region and Northern Quebec is presented in Figure 20.3 – Provincial ESIA Process Applicable to the Whabouchi Mine Project .

a. Project Subject to the Environmental and Social Impact Assessment and Review Procedure

Section 153 of the EQA gives the list of the projects automatically subject to the environmental and social impact assessment (“**ESIA**”) and review procedure (as listed in Schedule A) and the project which are automatically exempt from that procedure (as listed in Schedule B).

The list of projects automatically subject to the procedure includes:

- All mining developments, including the additions to, alterations or modifications of existing mining developments.

The Whabouchi Mine Project is therefore subject to the procedure.

Section 154 of the EQA specifies that: “No person may undertake or carry out any project which is not automatically exempt from the assessment and review procedure, unless:

- A Certificate of Authorization has been issued by the Minister, after the application of the assessment and review procedure; or
- An attestation of exemption of the project from the assessment and review procedure has been issued by the Minister.”

The first step in the ESIA process involves the proponent gathering preliminary information on the project. The proponent must submit a Project Notice to the government administrator along with this preliminary information. Such Project Notice was tabled by Nemaska Lithium on August 2, 2011.

The Administrator sends this preliminary information to an Evaluation Committee (“**COMEV**”) which is responsible for defining the nature and extent of the impact study (ESIA). The COMEV formulates guidelines outlining the extent of the ESIA document to be prepared by the proponent. The guidelines

are submitted to the administrator who transmits them to the proponent, something that was done on February 2, 2012.

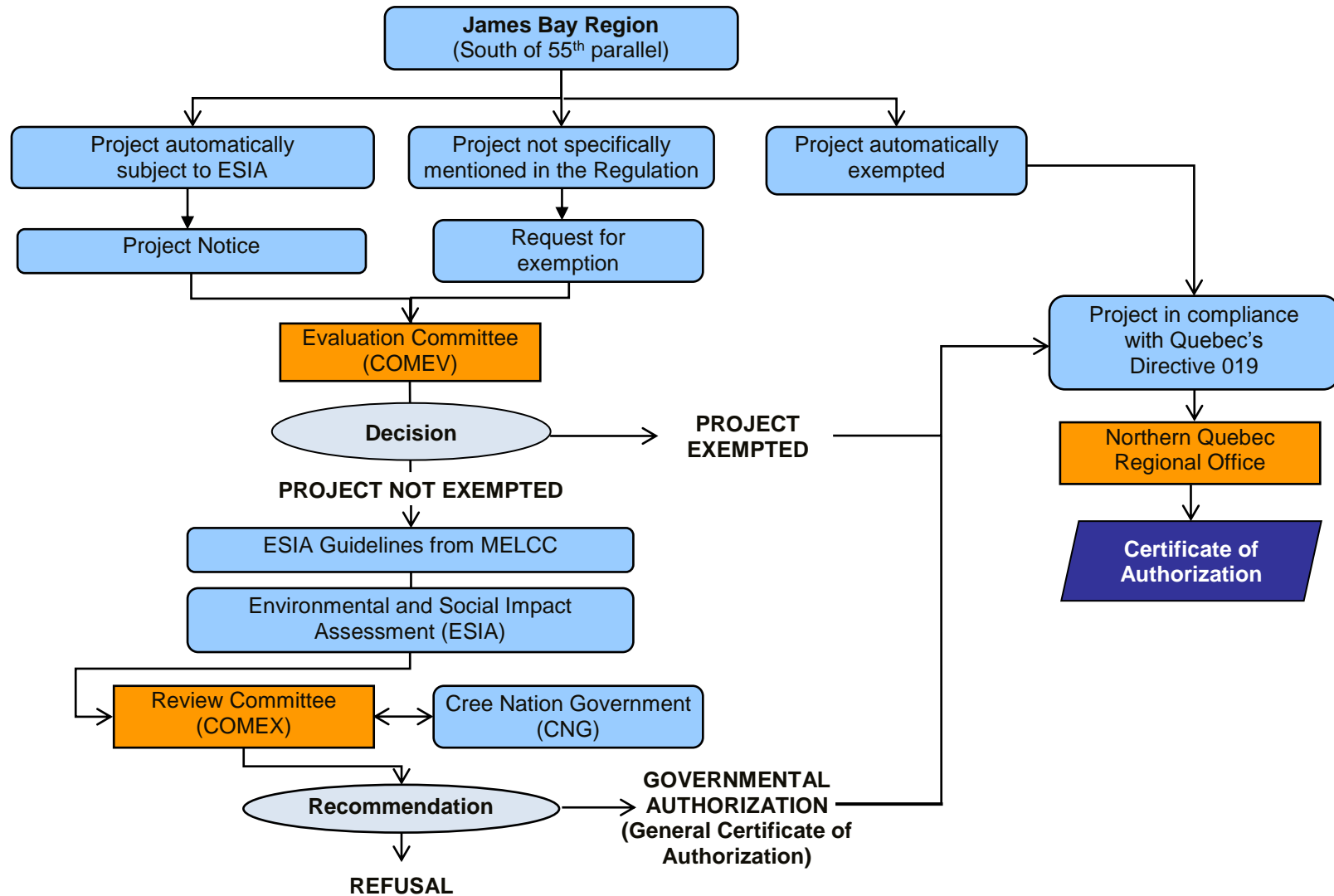
The proponent prepares the ESIA document in accordance with the administrator's guidelines. Nemaska Lithium submitted its ESIA document to the Administrator on April 2, 2013, who forwarded the studies to a Review Committee ("**COMEX**"). First Nations, i.e. the Cree Nation Government, and the public then made representations to the committee, which may decide to hold public hearings or any other type of consultation. The COMEX held public hearings in March-April 2015 as well as other forms of consultation, enabling the Committee to consider the concerns of the people in the territory and ensure they were accounted for in the Whabouchi Mine Project and reflected in the General CA.

On September 4, 2015, following a positive recommendation by the COMEX, the Administrator granted authorization for the Project and Nemaska Lithium announced that it has received the General CA for the Whabouchi Project from the MELCC. Nemaska Lithium has already begun and is continuing to fulfill the provisions included in the General CA.

#### 20.1.2.3 *Quebec's Directive 019*

In Quebec, *Directive 019* is the tool used by the authorities to analyse mining projects requiring the issuance of a CA. *Directive 019* is not a statutory instrument, but an orientation text that provide with expectations from the MELCC pertaining to mining projects. The MELCC uses this Directive within the scope of powers it has by the EQA. The Directive defines tailings characteristics (low risk, acid-generating, leachable, etc.) and if it requires leak proofing measures to be applied when soils do not meet criteria for the protection of groundwater (see Section 20.1.1.3c). *Directive 019* contains similar requirements than the Canadian Metal and Diamond Mining Effluent Regulations ("MDMER") regarding the quality of mining effluent.

**Figure 20.3 – Provincial ESIA Process Applicable to the Whabouchi Mine Project**



#### 20.1.2.4 Federal Procedure

The Canadian Environmental Assessment Act (CEAA 2012) was introduced on July 6, 2012. Under this Act, an Environmental Assessment (“EA”) focuses on potential adverse environmental effects that are within federal jurisdiction, including:

- Fish and fish habitat;
- Other aquatic species;
- Migratory birds;
- Federal lands;
- Impacts that will or could potentially cross provincial or international boundaries;
- Impacts on Aboriginal peoples, such as land use and traditional resources;
- Impacts that are directly linked or necessarily incidental to any federal decisions about a project.

An EA will consider a comprehensive set of factors that include any cumulative effect, mitigation measure and comments received from the public.

The Regulations designating Physical Activities (RDPA) identifies the activities that are subject to the federal environmental assessment procedure under the CEAA 2012 by the Canadian Environmental Assessment Agency (hereafter the Agency) or by the Canadian Nuclear Safety Commission or the National Energy Board. The RDPA identifies types of major projects that may require an environmental assessment under the CEAA 2012. These projects have the greatest potential for significant adverse environmental effects in areas of federal jurisdiction and are called “designated projects”.

According to the RDPA, the construction, operation decommissioning and abandonment of a “metal mine, other than a rare earth element mine or gold mine, with an ore production capacity of 3,000 t/day or more” is subject to the federal environmental assessment procedure.

According to CEAA (2012), proponents of designated projects are required to submit a description of the designated project to the Agency to inform on whether or not an EA of the designated project is required. The project description for the Whabouchi Mine Project was tabled by Nemaska Lithium on December 14, 2012.

After having approved the Project Description and determined that an EA is required, the Canadian Environmental Assessment Agency (the “Agency”) posted on January 29, 2013, a Notice of Commencement of the EA on the registry. The Agency then prepared a preliminary version of the guidelines relative to the environmental impact assessment. These guidelines were posted on the registry on January 29, 2013, allowing the public to comment on the proposed studies and methods as well as on the information that will be required for the environmental impact assessment.

The Agency took into account the general public's comments, including the observations made by Aboriginal groups and federal ministries before providing the final version of the environmental impact assessment guidelines to the proponent, which it did in April 2013.

The proponent then has to submit to the Agency an environmental impact assessment identifying the environmental effects of the project and propose measures to mitigate these effects, while accounting for the Agency's guidelines. Nemaska Lithium tabled its Environmental Impact Statement ("EIS") in March 2013.

Following the submission of the EIS to the Agency, the latter will ensure of its relevancy and accuracy. The Agency may require that the proponent provides further clarifications or additional information to better understand the potential environmental effects and the proposed mitigation and preventive measures. Such additional information was requested by the Agency in late November 2013 and Nemaska Lithium provided that information on May 5, 2014. The Agency may also decide to hold public hearings, something which was completed in November 2013.

Following the completion of its analysis, the Agency prepares a preliminary version of the EA report, which includes the Agency's conclusions on the potential environmental effects of the Project, the proposed mitigation measures, the significance of the residual adverse environmental effects of the Project and the requirements of the monitoring program. The Agency then invites the public to comment on this preliminary report before finalizing it and submitting it to the Minister of Environment. The preliminary EA report was issued by the Agency on May 6, 2015.

On July 29, 2015, following a comprehensive assessment of the Whabouchi Mine Project, the Canadian Minister of Environment decided that the Project is not likely to cause any significant adverse environmental effects, and set out in her positive decision statement the conditions relative to the mitigation measures and monitoring program to be respected by Nemaska Lithium. The Agency issued on that same date its final EA report. Nemaska Lithium has already begun and is continuing to fulfill the provisions included in the Decision Statement.

It should finally be noted that on June 2, 2019, Bill C-69 ("An Act to enact the Impact Assessment Act and the Canadian Energy Regulator Act, to amend the Navigation Protection Act and to make consequential amendments to other Acts") received Royal Assent. The new Impact Assessment Act will overhaul both the National Energy Board Act (NEBA) and CEAA 2012, changing how major infrastructure projects are reviewed and approved in Canada. Changes would include replacing the National Energy Board with a new "Canadian Energy Regulator" and an altered federal environmental assessments process to include a broad range of impacts to be reviewed by a new "Impact Assessment Agency." However, since the Whabouchi Mine Project was approved in 2015 under CEAA 2012, this new Bill will have no effect on project development and permitting requirements at the federal level.



a. Metal and Diamond Mining Effluent Regulations (“**MDMER**”) and Environmental Effects Monitoring Program (“**EEMP**”)

The EEMP is a requirement for regulated mines in accordance with the MDMER under the authority of the Fisheries Act. The objective of the EEMP is to evaluate the effects of mine effluents on fish, fish habitat and the use of fisheries resources by humans. Directive 019 sets at the provincial level the criteria that mine effluents must comply with at the end-of-pipe. The EEMP examines the effectiveness of the environmental protection measures directly in the aquatic ecosystems, i.e. downstream of the final discharge point. The EEMP consists of biological monitoring studies as well of effluent and water quality studies. In the case of Whabouchi Mine Project, the monitoring will have to include the following elements:

- Effluent characterization;
- Effluent sublethal toxicity testing;
- Water quality monitoring;
- A study respecting the benthic invertebrate community.

The requirement of an EEMP is to be reviewed as more information is collected and when a better assessment of the impact of effluents on the aquatic environment is available.

Finally, it should be noted that the Whabouchi Project was designed in a way that no fish habitats will be directly impacted by the implementation of any accumulation areas (no encroachment in fish habitat). Consequently, those infrastructures will not have to be listed in Appendix 2 of the MDMER.

#### 20.1.2.5 *Environmental Permitting*

Even though the Project underwent an environmental impact assessment and was authorized by the Government pursuant to the EQA and CEAA, it is still subject to other sections of the EQA, the Mining Act and to other applicable provincial and federal laws and regulations. Indeed, in addition to the authorizations required under Section 22 of the EQA, the proponent must obtain the permits, authorizations, approvals, certificates and leases required from the appropriate authorities. Those are described in Table 20.3.

As well, along with the mitigation measures set out as part of the environmental impact assessment, the final Project design must comply with all applicable standards relating to the proposed infrastructure and equipment.

It must also be noted that the issuance of the certificate of authorization required under Section 22 of the EQA, however, should only be a formality as the certificate issued pursuant to the approval of the ESIA binds the Minister as to where he exercises the powers provided in Section 22. The authorization application and permitting process is expected to last the full construction phase and has started in Q1-2016. Applications are being filed in a timely manner with the construction works and have therefore no impact on Project schedule.

a. Recent Modifications to the Quebec Environment Quality Act (**EQA**)

On March 23, 2017, the Québec National Assembly passed Bill No. 102, entitled An Act to amend the Environment Quality Act to modernize the environmental authorization scheme and to amend other legislative provisions, in particular to reform the governance of the Green Fund ("**EQA 102**"). The adoption of EQA 102 follows on from the publication of the Green Paper in June 2015 and the introduction of Bill 102 in June 2016.

The new Environment Quality Act (new EQA) entered into force on March 23, 2018. This date marks the beginning of the progressive implementation of a new environmental authorization scheme in Quebec. The majority of associated regulations are currently being amended and will come into force progressively in the coming months or years. In the meantime, the Regulation respecting certain measures to facilitate the carrying out of the Environment Quality Act and its regulations helps to link the new authorization scheme with current regulations.

One of the most important amendments to the new, EQA is the establishment of a simplified and modulated authorization process based on environmental risks. Henceforth, projects, and the authorizations they require, will be classified in four (4) categories, according to the degree of risk they entail, namely:

- High-Risk Activities subjected to the environmental impact assessment and review procedure before any authorization is granted by the Government of Québec. Those activities are designated under the new Regulation respecting the environmental impact assessment and review of certain projects that came into force on March 23, 2018;
- Moderate-Risk Activities, designated by Regulation (not yet issued), subjected to prior ministerial authorization, such as those historically provided for by the former EQA (ex. hazardous materials permit; authorizations under Sections 32, 48, etc.). These are activities designated by the EQA and the applicable regulations, as well as those which, although not specifically so designated, are not considered to be of a low or negligible risk nature. They will be subject to prior ministerial authorization.
- Low-Risk Activities, designated by Regulation (not yet issued), that must be disclosed in a declaration of compliance, at least 30 days before the activities commence (ex. extensions to waterworks or sewer systems and certain rehabilitation works on contaminated lands).
- Negligible-Risk Activities, which necessitate no prior ministerial authorization or prior declaration of compliance. An Instruction Note was published on that point in April 2019 and is untitled "Activités à risque négligeable - Listes des exemptions administratives de l'application des articles 22 et 30 de la LQE". However, it must be pointed out that it is an administrative document and that it has no official value.

With few exceptions (e.g. water treatment and water withdrawal activities), municipal certificates of compliance that were required in the past to support authorization applications

under the EQA are no longer required. Copies of authorization applications submitted to the MELCC must, however, be submitted to the municipality concerned as required under Section 23 of the new EQA.

Information concerning authorization applications and issued authorizations will also be more readily accessible, since the new EQA expands the required content of the environmental registers to be kept by the MELCC and provides that certain information shall be accessible to the public, such as the authorizations and documents that are an integral part thereof, the studies and other analyses submitted by the applicant on which authorizations were based, except, however, information that constitutes industrial or trade secrets as provided for in the EQA.

Finally, the new EQA further groups together the Minister's powers to issue orders and authorizations, which were formerly scattered in various sections throughout the former EQA (ex. CA under Sections 22, 32, 48, etc.). This will significantly facilitate the authorization process and associated follow-up. It should be noted that to maintain consistency since project inception, authorizations listed in Table 20.3 are presented according both to the former EQA sections and new EQA sections.

With the above being mentioned, it should however be noted that, as the permitting process for Whabouchi Mine Project has already been initiated under the former EQA and since the most significant changes to the EQA only came into force in 2018, no significant impact due to this change is anticipated on Project schedule.

b. Future Modifications to Initial Permits and Authorizations

As described earlier in this Report, there will be a need to increase the area dedicated to waste rock and tailings management as part of the normal operations over the 33-year mine life. In order to do so, additional permitting will be needed since the initial General CA and other regional authorizations were obtained to cover the Project as it was described prior to the current Feasibility Study. However, such modifications (as provided for under section 30 of the new EQA) can be obtained in a timely manner without delaying by any mean the normal mine operations, especially considering that the already-permitted capacity enables mining operations to take place over a significant period of time.

**Table 20.3 – Whabouchi Mine Project – List of Permits and Authorizations to be Obtained**

Provincial (Quebec)	
<p>Subparagraph 4 of the first paragraph of Section 22 and paragraph 2 of Section 22 - new EQA</p> <p>Authorization ("AU")</p> <p>Section 22 – former EQA</p> <p><u>Certificate of Authorization ("CA")</u></p> <p><b>Status: Obtained</b></p> <ul style="list-style-type: none"> <li>• Site preparation works</li> <li>• Overburden pile</li> <li>• Mine roads</li> <li>• Administrative buildings</li> <li>• Borrow pits</li> <li>• Construction of the mill</li> <li>• Temporary crushing and concrete plants</li> <li>• 60,000-t Bulk sampling program and associated DMS modular mill</li> </ul> <p><b>Status: To be obtained in 2019/2020 or when needed</b></p> <p>Mine Operations</p> <p>New waste rock and tailings management facilities</p>	<p>In order to carry out the Whabouchi Mine Project, one or more AUs are required from the MELCC under Section 22 of the EQA. For mining activities, AU applications must comply with the Directive 019 requirements. They must also include, among other things, the information specified under Section 7 of the Regulation respecting the application of the Environment Quality Act as well as in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i>" pour un projet industriel" and in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>".</p> <p>Moreover, because the Whabouchi Mine Project will involve discharges into the aquatic environment, it will be necessary to attach the list of applicable effluent discharge objectives to the CA application.</p> <p>The CA application forms and all required documents must be sent to the MELCC's Northern Quebec regional office. The time required to analyse an application for an AU directly depends on the complexity of the project. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p> <p>The number of AUs applications to prepare will depend on the timeline of the project activities and its associated work items. By dividing the project into predefined items, it will enable a step-by-step implementation process.</p>
<p>Subparagraph 2 of the first paragraph of Section 22 – new EQA</p> <p>Section 31.75 – former EQA</p> <p><u>Authorization (AU) for the withdrawal of surface water or groundwater</u>, including related work and works</p> <p><b>Status: Obtained</b></p> <p>Fresh water wells for the administrative buildings</p> <p><b>Status: To be obtained in 2019/2020 or when needed</b></p> <p>Fresh water well for the plant</p> <p>Mine dewatering</p>	<p>The Whabouchi Mine Project will require the withdrawal of more than 75 m<sup>3</sup>/d of groundwater and thus is subject to the authorization of the Minister under Section 31.75 of the former EQA (Subparagraph 2 of the first paragraph of Section 22 of the new EQA).</p> <p>Among other things, the authorization application must contain the information listed under Section 7 of the Water Withdrawal and Protection Regulation. The authorization application form entitled "<i>Formulaire de demande d'autorisation pour un prélèvement d'eau assujéti à l'article 31.75 de la Loi sur la qualité de l'environnement</i>" must be completed and signed by an engineer, and the required documents must be attached. The application must be sent to the MELCC's Northern Quebec regional office.</p>

### Provincial (Quebec) (cont'd)

<p>Subparagraph 3 of the first paragraph of Section 22 – new EQA</p> <p>Section 32 – former EQA <u>Authorization (AU) for Waterworks, Sewers and Water Treatment</u></p> <p><b>Status: Obtained</b></p> <p>Domestic wastewater treatment at the administrative buildings</p> <p>Installation of the mine effluent discharge pipeline</p> <p><b>Status: To be obtained in 2019/2020</b></p> <p>Domestic wastewater treatment at the garage/plant and the camp</p> <p>Drinking water treatment system at the camp</p> <p>Water/oil separator</p> <p>Mine sedimentation ponds</p> <p>Mine wastewater treatment plant</p>	<p>According to the subparagraph 3 of the first paragraph of Section 22 of the new EQA: "[...] no one may, without first obtaining an authorization from the Minister, carry out a project involving one or more of the following activities: [...] the establishment, alteration or extension of any water management or treatment facility referred to in section 32, and the installation and operation of any other apparatus or equipment designed to treat water, in particular in order to prevent, abate or stop the release of contaminants into the environment or a sewer system".</p> <p>Section 32 of the new EQA reads as follows: "For the purposes of subparagraph 3 of the first paragraph of section 22 and this subdivision, a water management or treatment facility is (1) a waterworks system; (2) a sewer system; or (3) a rainwater management system. The Government may, by regulation, define the terms mentioned in the first paragraph."</p> <p>In the case of work involving drinking water or domestic wastewater, the application form entitled "<i>Formulaire de demande d'autorisation pour réaliser un projet assujéti à l'article 32 de la Loi sur la qualité de l'environnement</i>" must be completed and signed by the project engineer, and the required documents must be attached as well as in the guide "<i>Présentation d'une demande d'autorisation pour réaliser un projet assujéti à l'article 32 de la Loi sur la qualité de l'environnement</i>".</p> <p>In the case of industrial wastewater treatment, the authorization application must include, among other things, the information specified in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i> pour un projet industriel" as well as in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>".</p> <p>The applications must be sent to the MELCC's Northern Quebec regional office. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p>
<p>Subparagraph 6 of the first paragraph of Section 22 – new EQA</p> <p>Section 48 – former EQA <u>Authorization (AU) to Install an Apparatus or Equipment to Prevent, Reduce or Cause the Cessation of the Contaminants Release into the Atmosphere</u></p> <p><b>Status: To be obtained in 2019</b></p>	<p>According to the subparagraph 6 of the first paragraph of Section 22 of the new EQA: "[...] no one may, without first obtaining an authorization from the Minister, carry out a project involving one or more of the following activities: [...] (6) the installation and operation of an apparatus or equipment designed to prevent, abate or stop the release of contaminants into the atmosphere [...]".</p> <p>The authorization application must include, among other things, the information specified in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i> pour un projet industriel" and in the modules (Section 8) concerning dust collectors and air quality, as well as in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>".</p> <p>The applications must be sent to the MELCC's Northern Quebec regional office. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p>

Provincial (Quebec) (cont'd)	
<p>Section 100 – Mining Act <u>Mining Lease</u></p> <p><b>Status: Obtained</b></p>	<p>According to Section 100 of the Mining Act: “No person may mine mineral substances, except surface mineral substances, petroleum, natural gas and brine, unless he has previously obtained a mining lease from the Minister or a mining concession under any former Act relating to mines”.</p> <p>In order to obtain a mining lease, a claim holder must establish the existence of the presence of an economic deposit. Applications must be submitted to the Registrar's Office or to the regional office. The initial term of a mining lease is 20 years. The lease can then be renewed every 10 years for the duration of the mining operation. The procedure for obtaining a mining lease is described in the MERN's online publication “Mining Leases and Concessions”.</p>
<p>Section 109 – Mining Act <u>Non-Exclusive Lease for the Mining of Surface Mineral Substances</u></p> <p><b>Status: Obtained</b></p>	<p>According to Section 109 of the Mining Act: “A lessee or a grantee may use, for their mining activities, sand and gravel that is part of the domain of the State except where the land that is subject to the lease is already subject to an exclusive lease to mine surface mineral substances in favour of a third person”.</p> <p>The mining of sand and gravel located outside of mining leases requires a non-exclusive lease for the mining of surface mineral substances, under Section 140 of the Mining Act which reads as follows: “No person may extract or mine surface mineral substances unless he has obtained a lease to mine surface mineral substances from the Minister”.</p> <p>The information to provide in the application for a non-exclusive lease is listed under Sections 46 to 50 of the Regulation respecting mineral substances other than petroleum, natural gas and brine. The applicant must complete the form “<i>Demande de bail non exclusif (BNE) pour l'exploitation des substances minérales de surface</i>” and send it to the MERN.</p> <p>It must be noted that an AU under Section 22 of the EQA has to be obtained from the MELCC in order to operate a borrow pit, except if the material is used for the construction or the maintenance of a road.</p>
<p>Section 239 – Mining Act Section 47 - Act respecting the Lands in the Domain of the State <u>Lease for the Occupation of the Domain of the State</u></p> <p><b>Status: Obtained</b></p> <p>Status: To be obtained when needed</p> <p>Lease for new waste rock and tailings management facilities</p>	<p>According to Section 239 of the Mining Act: “The holder of mining rights or the Owner of mineral substances may, in accordance with the Act respecting the Lands in the Domain of the State, obtain that public lands be transferred or leased to him to establish a storage site for tailings, or a site for mills, shops or facilities necessary for mining activities”.</p> <p>Some components of the Whabouchi Mine Project may be located outside of the lands covered by the mining lease. Since the project is located on public lands, the land in question will need to be leased under Section 47 of the Act respecting the Lands in the Domain of the State which reads as follows: “The Minister may lease any land under his authority and any building, improvement and movable property thereon which forms part of the domain of the State, on the conditions and at the price he determines in accordance with the regulations of the Government to that effect”.</p> <p>The request must be sent to the MERN.</p>



### Provincial (Quebec) (cont'd)

<p>Sections 240 and 241 – Mining Act</p> <p><u>Approval for the Location of the Process Concentration Plant and Mine Tailings Management Facility</u></p> <p><b>Status: Obtained</b></p> <p>Status: To be obtained when needed</p> <p>Lease for new waste rock and tailings management facilities</p>	<p>According to Section 240 of the Mining Act: “Any person who intends to operate a mill for the preparation of mineral substances, a concentration plant, a refinery or a smelter shall, before commencing its operations, have the site approved by the Minister or, where the project is subject to the environmental impact assessment and review procedure provided for in Division IV.1 of Chapter I of the Environment Quality Act, by the Government.” Section 241 of the same Act also states, “Every person responsible for the management of a concentration plant, refinery or smelter shall, before commencing activities, have the site intended as a storage yard for tailings approved by the Minister. The same applies to every holder of a mining right, Owner of mineral substances or operator who intends to establish a mine tailings site”.</p> <p>Consequently, a request for approval must be submitted to the MERN before the activities begin at the Whabouchi Mine. For the site used for the storage of mine tailings, the request must include the information and documents as set out in Sections 124 and 125 of the Regulation respecting mineral substances other than petroleum, natural gas and brine.</p>
<p>Subparagraph 1 of the first paragraph of Section 22 – new EQA</p> <p>Authorization (AU) to operate an industrial establishment</p> <p>Section 31.16 – former EQA Depollution<sup>1</sup> Attestation</p> <p><b>Status: To be obtained in operation phase</b></p>	<p>According to the subparagraph 1 of the first paragraph of Section 22 of the new EQA: “[...] no one may, without first obtaining an authorization from the Minister, carry out a project involving one or more of the following activities: (1) the operation of an industrial establishment referred to in Division III, to the extent provided for in that division; [...]”.</p> <p>Section 31.10 of the new EQA reads as follow: “The operation of an industrial establishment belonging to any of the classes determined by government regulation is subject to the Minister’s authorization under subparagraph 1 of the first paragraph of section 22. This division applies, in addition to subdivision 1 of Division II, to an authorization to operate such an industrial establishment, and is aimed at providing a framework for the operation of such establishments with a view to, among other things, reducing their releases of contaminants into the environment.”</p> <p>Until the new regulation comes into force, the Regulation respecting industrial depollution attestations still apply.</p> <p>This authorization, which is renewable every 5 years, identifies the environmental conditions that must be met by the industrial establishment when carrying out its activities. The authorization gathers together all of the environmental requirements relating to the operation of an industrial facility.</p> <p>The operator of an industrial facility which is subject to the Regulation respecting industrial depollution attestations must apply to the Ministry for a depollution attestation within 30 days following the issuance of the certificate of authorization issued under Section 22 of the EQA for the operation of its mine project. This application must be made using the form provided by the Ministry that identifies all of the required information.</p> <p>The operator is responsible for requesting a renewal of its depollution attestation at least six months before it expires. The original certificate will remain in effect until a new certificate is issued.</p>

<sup>1</sup> In French, « assainissement ». This term refers to the set of measures implemented to remove the causes of pollution and meet the requirements of public health and the protection of the environment.

Provincial (Quebec) (cont'd)	
<p>Section 213 – Mining Act            Section 73 – Sustainable Forest Development Act  <u>Forest Management Permit</u></p> <p><b>Status: Obtained</b></p> <p>Status: To be obtained when needed</p> <p>Forest management permit for new waste rock and tailings management facilities</p>	<p>Section 213 of the Mining Act states that: “The holder of a mining right may, in order to construct buildings or perform any other operation required for his mining activities, cut timber forming part of the domain of the State on the parcel of land that is subject to his right, in accordance with the rules set forth in the Sustainable Forest Development Act (chapter A-18.1) and the regulations. [...]”</p> <p>According to Section 73 of the Sustainable Forest Development Act: “A forestry permit is required to carry out the following forest development activities in the forests in the domain of the State: [...] (4) activities carried out by a holder of mining rights in exercising those rights; [...]”</p> <p>Prior to proceeding with its timber cutting operations, the holder of mining rights must submit a written request to the proper MFFP forest management unit in order to obtain a permit for its mining operations.</p> <p>It is important to note that the holder of a forest management permit must scale all timber harvested in public land according to the standards prescribed by the Government regulation and as specified in Section 75 of the Sustainable Forest Development Act. The holder is responsible for paying the prescribed duty as stipulated in Section 6 of the Regulation respecting Forest Royalties.</p>
<p>Section 120 – Safety Code  <u>High-Risk Petroleum Equipment Operating Permit</u></p> <p><b>Status: Obtained</b></p>	<p>According to Section 120 of the Safety Code: “The Owner of a petroleum equipment installation that includes at least one component that is high-risk petroleum equipment must obtain a permit for the use of all the high-risk petroleum equipment situated at the same address, until the equipment is removed from its respective place of use”.</p> <p>“High-risk” petroleum equipment are defined in Section 8.01 of Chapter VIII of the Construction Code. They include gasoline tanks with a capacity of more than 2,500 litres and diesel tanks of more than 10,000 litres.</p> <p>The form “<i>Demande de permis d'utilisation pour des équipements pétroliers à risque élevé</i>” must be completed and submitted to the <i>Régie du bâtiment</i>. This application must include all of the information and documents identified in Section 121 of the <i>Safety Code</i>, including the statement of compliance signed by a recognized verifier. A permit is valid for 24 months. The issuance and renewal of a high-risk petroleum equipment permit are subject to compliance and performance monitoring under the provisions of the Construction Code and the Safety Code.</p>
<p>Act respecting Explosives  <u>Explosives Permit</u></p> <p><b>Status: Obtained</b></p>	<p>No person shall possess, store, sell or transport any explosives unless he is holding a permit for such purpose. Depending on the intended usage, several permits are required for the possession of explosives for industrial or commercial purposes. Division II of the <i>Regulation under the Act Respecting Explosives</i> describes the different types of permits that are required. A general explosives permit entitles the holder to have explosives in his possession. Solely the holder of a general permit can obtain a magazine, sale or transport permit. A magazine permit entitles the holder of a general permit to purchase and store explosives in a container or a building that complies with the regulations. A transport permit entitles the holder of a general permit to transport explosives.</p> <p>In order to obtain these permits, the “Application for a General Explosives Permit” and the “Application for a Sales, Magazine or Transport Permit” forms, which are available from the <i>Sûreté du Québec</i> (“SQ”), must be completed. The required documents and fees must be submitted to the SQ. Permits are valid for a period of five years.</p>

### Provincial (Quebec) (cont'd)

<p>Section 19 – Regulation respecting the water property in the domain of the State  <u>Lease of a part of the water property</u></p> <p><b>Status: To be obtained in 2019</b></p>	<p>According to Section 19 of the Regulation respecting the water property in the domain of the State: “The Minister is authorized to lease a part of the water property if the conditions provided for in this Subdivision are met”. It will be necessary to obtain this kind of lease from the MELCC in order to install the mining effluent pipeline in Mountain Lake.</p> <p>According to Section 5 of the Regulation respecting the water property in the domain of the State, before granting rights in the water property, the Minister must ensure that a certificate of authorization, if required, has been issued for the project under the EQA.</p> <p>The request must be address to the CEHQ of the MELCC.</p>
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### Federal (Canada)

<p>Section 35(1) – Fisheries Act  <u>Authorization to alter, disrupt or destruct fish habitat</u></p> <p><b>Status: To be obtained in 2019/2020 and when needed</b></p>	<p>According to Section 35(1) of the Fisheries Act: “No person shall carry on any work, undertaking or activity that results in the harmful alteration or disruption, or the destruction (“HADD”), of fish habitat.”</p> <p>When a project includes a known risk of affecting fish and fish habitat, such a project must be submitted to Fisheries and Oceans Canada (“DFO”) for its review. The general process that must be followed is described on the DFO website. The “Proponent’s Guide to Information Requirements for Review under the Fish Habitat Protection Provisions of the Fisheries Act” identifies the information requirements for a detailed review by DFO. In order for a project to be reviewed, the proponent must have previously completed the form “Request for Review under the Fish Habitat Protection Provisions of the Fisheries Act”. The request must be submitted to the local Fish Habitat Management Office.</p> <p>The Whabouchi Mine Project is expected to require an authorization for HADD and a compensation for the loss of habitat.</p>
<p>Section 7(1) a) – Explosives Act  <u>Licence for Explosives Factories and Magazines</u></p> <p><b>Status: Not required</b></p>	<p>A licence issued by the Minister of Natural Resources Canada is required for the operation of explosives plants and magazines in Canada.</p> <p>It is reported that there will be no explosives plant on site. Also, according to Section 2 of the same Act, the term “magazine” excludes: “a <i>place where an explosive is kept or stored exclusively for use at or in a mine or quarry in a province in which provision is made by the law of that province for efficient inspection and control of explosives</i>”.</p> <p>In Quebec, the <i>Act Respecting Explosives</i> provides for the issuing of permits, the inspection and the control of activities associated with explosives.</p> <p>Thus, no licence for explosives should be required from Natural Resources Canada. If modifications were to be implemented to the Project so that it would require the operation of an explosives plant or magazine, such license would be necessary.</p>

### Federal (Canada) (cont'd)

<p>Section 3 – Environmental Emergency Regulations</p> <p><u>Notice to the Minister of Environment for the Storage of Substances Likely to Explode</u></p> <p><b>Status: To be obtained in 2019</b></p>	<p>According to Section 3(1) of the Environmental Emergency Regulations: “Any person who owns or has the charge, management or control of a substance set out in column 1 of Schedule 1 that is located at a place in Canada, must submit to the Minister a notice containing the information requested in Schedule 2 for each such place in either of the following circumstances: (a) the substance is in a quantity that at any time is equal to or exceeds the quantity set out in column 3 of Schedule 1 for that substance; or (b) the substance is in a quantity that is greater than zero and is stored in a container that has a maximum capacity equal to or exceeding the quantity set out in column 3 of Schedule 1 for that substance.”</p> <p>During the operation of the Whabouchi Mine, it will be necessary to store more than 20 metric tonnes of ammonium nitrate, an activity which exceeds the quantity set out in column 3 of Schedule 1 of the Environmental Emergency Regulations. Therefore, the Minister of Environment will have to be advised of this storage.</p>
<p>Regional Government of Eeyou Istchee James Bay (RGEIJB)</p> <p>Certificate attesting that the municipality does not object to authorization</p> <p>Status: to be obtained in 2019/2020</p> <p>Construction Permits Construction of groundwater wells Permit</p> <p>Status: Obtained</p>	<p>As provided for under Section 32.3 of the EQA, "In addition to any requirements prescribed by any government regulation, an applicant for an authorization with regard to a water management or treatment facility not operated by a municipality, or operated by a municipality outside its territorial limits, must submit, in support of the application, a certificate from the clerk or secretary-treasurer of the municipality in whose territory the facility is located attesting that the municipality does not object to the authorization being issued for the sector served by the facility. If the municipality objects to the issuing of the authorization, the Minister must make an investigation and allow interested persons to present observations before making his decision."</p> <p>In addition, Section 7 of the Water Withdrawal and Protection Regulation states that "a certificate from the clerk or secretary-treasurer of the local municipality or regional county municipality concerned stating that the withdrawal complies with the applicable municipal by-laws" must be joined to any application for authorization for a water withdrawal. .</p> <p>Requests for certificates must therefore be submitted to the City of Shawinigan for some of the Electrochemical Plant Project's activities.</p> <p>Copies of other authorization applications filed to the MELCC must, however, be submitted, for information purpose, to the municipality concerned as required under Section 23 of the EQA.</p> <p>Finally, it is necessary to obtain a global construction permit from the Regional Government of Eeyou Istchee James Bay before the beginning of construction work and to renew it annually.</p>

## 20.1.3 REHABILITATION AND MINE CLOSURE PLAN

Section 232.1 of the Mining Act states that:

“The following persons must submit a rehabilitation and restoration plan to the Minister for approval and carry out the work provided for in the plan:

1. every holder of mining rights who engages in exploration work determined by regulation or agrees that such work be carried out on the land subject to his mining rights;
2. every operator who engages in mining operations determined by regulation in respect of mineral substances listed in the regulations;

3. every person who operates a concentration plant in respect of such substances;
4. every person who engages in mining operations determined by regulation in respect of tailings.

The obligation shall subsist until the work is completed or until a certificate is issued by the Minister under Section 232.10.”

As stated in Section 101, “the [mining] lease cannot be granted before the rehabilitation and restoration plan is approved in accordance with this Act, and the CA mentioned in Section 22, 31.5, 164 or 201 of the EQA (chapter Q-2) has been issued.”

Hence, a rehabilitation plan was prepared as part of the Project and approved by the MERN in September 2017. The rehabilitation and restoration plan were elaborated in accordance with the provincial Guidelines for Preparing a Mining Site Rehabilitation Plan and General Mining Site Rehabilitation Requirements (2016) which provides to the proponents the rehabilitation requirements. This study accounted for costs of all works needed for the rehabilitation of a mining site following the Regulation respecting Mineral Substances other than Petroleum, Natural Gas and Brine. Mine rehabilitation and closure costs, as approved by the MERN, are estimated at \$9.2 M.

In June 2019, Nemaska Lithium paid the last installment of the financial guarantee required under the approved Rehabilitation Plan for the Whabouchi Mine Project and is thus fully compliant with the applicable Regulation.

#### 20.1.3.1 General Principles

The main objective of mine site rehabilitation is to restore the site to a satisfactory condition by:

- Eliminating unacceptable health hazards and ensuring the public safety;
- Limiting the production and circulation of substances that could damage the receiving environment and trying to eliminate long-term maintenance and monitoring;
- Restoring the site to a condition which is visually acceptable to the community;
- Reclaiming the areas where the infrastructures are located (excluding the accumulation areas) for future use.

Specific objectives are to:

- Restore degraded environmental resources and land uses;
- Protect important ecosystems and habitats of rare and endangered flora and fauna, which favors the re-establishment of biodiversity;
- Prevent or minimize future environmental damage;
- Enhance the quality of specific environmental resources;
- Improve the capacity of eligible organizations to protect, restore and enhance the environment;
- and

- Undertake resource recovery and waste avoidance projects and prevent and/or reduce pollution.

The general guidelines of a rehabilitation plan include:

- Favouring a progressive restoration to allow for a rapid re-establishment of biodiversity;
- Implementing a monitoring and surveillance program;
- Maximizing recovery of previous land uses;
- Establishing new land uses;
- Promoting habitat rehabilitation using operational environmental criteria;
- Ensuring sustainability of restoration efforts.

The mine site rehabilitation plan focuses on land reclamation, reclamation of tailings area and water basins, and of surface drainage to prevent erosion. The successful completion of a rehabilitation plan will ensure that the Whabouchi Mine Project will result in a minimum of disturbance. Site inspections will be carried out before the Property is returned to the Government.

The rehabilitation concept for the current mine project is described below and complies with the requirements described in the Guidelines for Preparing a Mining Site Rehabilitation Plan and General Mining Site Rehabilitation Requirements and the current legislation.

#### 20.1.3.2 Mining Site Rehabilitation Plan Concept

The rehabilitation and restoration plan concept is summarized as follows:

a. Waste Rock and Tailings Pile

Exposed surfaces of the accumulation areas (waste rock and tailings piles, overburden piles) will be covered with a layer of top soil/overburden and revegetated when feasible. The production of filter-pressed tailings co-disposed with coarse waste rocks will enable the progressive revegetation of the pile during operation, thus limiting potential dust emissions and runoff.

b. Haul Roads

Surface will be scarified and revegetated.

c. Industrial Complex and Buildings

- No building will be left in place. Whenever possible, buildings will be sold with the equipment they contain, completely or partially. During dismantling works, beneficiation/recycling of construction material will be maximized. Remaining waste will be disposed of in an appropriate site.
- All equipment and machinery will be disposed of or recycled off-site.
- The explosives magazine, if any, and related facilities will be dismantled.



- The drinking water supply and domestic wastewater treatment facilities will be dismantled.
- Infrastructure relating to electricity supply and distribution will be dismantled with the exception of Hydro-Québec requirements.
- All underground services (power lines, pipelines, water and sewer pipes, etc.) shall remain in place since they are unlikely to cause any environmental damage. Openings and access to such pipelines, however, shall be sealed.

#### 20.1.3.3 Open Pit

The surface exploitation of a mineral substance is common in Quebec. Many open pits that are created to extract a mineral substance or ore are therefore found throughout the province. Unlike quarries that are essentially developed on rock outcrops, ore deposits can be located below the surface, which means pits could be filled with groundwater. In many open pit mines, water could rise to the overburden contact without the dewatering wells.

Once mining activities cease, the pit will gradually fill up to its equilibrium level with rainfall and groundwater. The overburden slope around the pit will have already been established for a safe operation of the mine. No special work in this regard will be required upon the cessation of mining activities.

To permanently close pit access roads, an embankment 2-m high will be built using waste rock, along with an equivalent crest line. A ditch 2-m wide and 1-m deep will be excavated in front of the embankment.

#### 20.1.3.4 Environmental Aspects

##### a. Drainage

Whenever possible, the surface water drainage pattern will be re-established to a condition similar to the original hydrological system. The open pit discharge will flow towards the natural low point where an outlet will be implemented.

##### b. Topsoil Management

During the site construction period and overburden stripping over the orebody, overburden and topsoil will be stored separately and used for revegetation purposes. Slopes of the overburden storage area and flat surfaces will ultimately be seeded and revegetated.

##### c. Waste Management

Waste material from demolition activities will be:

- Decontaminated when required;
- Recycled when cost-effective;
- Buried in an appropriate site.

All non-contaminated waste will be sent to an appropriate site.

d. Hazardous Materials

Facilities containing petroleum products, chemicals, solid waste, hazardous waste, and/or contaminated soil or materials will be dismantled and managed according to regulatory requirements.

All hazardous waste will be managed according to existing laws and regulations and will be transported off site.

e. Characterization Study

The Land Protection and Rehabilitation Regulation, which came into force on March 27, 2003, contains several provisions concerning land protection in the new Section IV.2.1 of the EQA. The term “land” also includes groundwater and surface waters. The Regulation sets limit values for a range of contaminants and specifies the categories of targeted commercial or industrial activities. The mining industry is one of the categories subject to the Regulation.

For the mining industry, this generally entails an undertaking of a site characterization study within six (6) months following the termination of the mine operations. In cases where the contamination was to exceed the criteria set for in the Regulation, a rehabilitation plan which would specify the environmental protection measures to be undertaken must be submitted to the MELCC for its approval.

Waste rocks and mine tailings are not soils and are not covered by this Regulation. The characterization study will address the areas that are likely to have been contaminated by human activities, specifically the handling of petroleum products.

20.1.3.5 *Monitoring Program and Post-Closure Monitoring*

According to *Directive 019*, a Monitoring Program will have to be implemented during the mine operation to account for all the requirements specified in that Directive, especially with regards to noise levels, vibrations, surface and ground waters.

a. Physical Stability

The physical stability of dams and of the Waste Rock and Tailings pile will need to be assessed, and signs of erosion will be noted. This monitoring will be conducted on an annual basis for a minimum of five (5) years following mine closure.

b. Environmental Monitoring

Monitoring of the water quality (surface and groundwater) will continue for a minimum of five (5) years after the completion of the restoration work.

c. Agronomic Monitoring

The agronomic monitoring program is designed to assess the effectiveness of the revegetation which will be done as part of mining rehabilitation efforts.

To document the success of the revegetation efforts over the accumulation areas, an agronomic monitoring will be undertaken following the establishment of a vegetative cover on the areas subject to the progressive restoration program. This monitoring will be conducted annually for three (3) years following the revegetation efforts. Reseeding will be carried out, as required, in areas where revegetation is found unsatisfactory.

20.1.4 WATER MANAGEMENT

20.1.4.1 Assumptions

a. Surface Runoff

Weather data from existing weather stations, i.e. Chapais-2 (229 km), Nemiscau A (21 km) and La Grande Rivière A (241 km), was used to estimate rain and snowfall in the area. Interpolated climatic design data was also obtained from Environment Canada and Weather Analytics. The annual average precipitation was estimated at 772 mm/y (including both rainfall and snowmelt).

Following modifications to the Site General Arrangement Plan adopted since the NI 43-101 compliant Feasibility Study dated 2014 and further refined, the total surface area covered by the projected infrastructure (roads, dams, open pit, Waste Rock and Tailings pile, overburden pile, mill and garage, sedimentation ponds, etc.) was reduced by about 43 ha (-21%), thus reducing the amount of water to be managed by the site water management plan. To that regard, on-site runoff water to be managed annually on the projected Whabouchi mine site will vary accordingly to the increase in surface footprint as mine infrastructure will be developed.

For the Whabouchi Project, all the surface water collection ponds, pumping stations, and treated water outfall were designed to manage a spring surface runoff based on a 1:100-year snowpack depth melting over a 30 days period in conjunction with a 1:1,000-year, 24-hour rainfall event, thus in accordance with the Directive 019 guidelines in order to meet the final effluent requirements.

Water collection ditches are designed based on 1:100-year rainfall event and design criteria were established in accordance with the *Directive 019* guidelines.

b. Pit Dewatering

As outlined in Section 20.1.1 of this Report, hydrogeological data was gathered as part of field works completed in 2011 (WESA-Envir-Eau, 2012) and 2012 Qualitas, 2012). Field data was used in order to perform hydrogeological modelling (Richelieu Hydrogéologie, 2012 and 2014). The model prepared in 2012 was also updated using the revised site general arrangement

plan (pit design). The results of that modelling enable portraying the hydrogeological conditions prevailing on the projected mine site and identifying the potential impacts of the Project on groundwater. It concluded that infiltration into the pit will take place over the majority of the mine Project and that it will generate gradually from 230 m<sup>3</sup>/d at Year 6 to 2,300 m<sup>3</sup>/d at the end of the mine life (including open pit and underground infrastructure).

c. Final Effluent

There will be only one final effluent as per Quebec's Directive 019 and federal regulations and it will be located in the Nemiscau River; a terrestrial pipeline will transfer the final effluent from the mine basins to the river and the final discharge point is installed underwater at a location determined in collaboration with the Cree land users and provincial as well as federal authorities, considering maximum dispersion in natural waters to facilitate total compliance with Quebec's Environmental Discharge Objectives ("EDO") determined for the Whabouchi Mine Project by the MELCC.

20.1.4.2 *Water Management Plan*

The mine Water Management Plan ("WMP") addresses the management of runoff water collected in the open pit, industrial area, overburden/topsoil stockpiles and co-disposal storage facilities at the Whabouchi mine site.

The WMP mitigates the volume of contact water inflows to be managed on site by diverting clean, non-contact water around the pit, industrial area, overburden/topsoil stockpiles and co-disposal storage facilities to the environment. Diversion ditches have been designed to minimize the amount of non-contact water that runs onto the facilities. To that regard, water running off areas not to be managed with the final effluent (i.e. non-contact) will be discharged in the natural environment always at least 20 m away from the nearest lake or river (at high-water mark), as per the Regulation respecting the sustainable development of forests in the domain of the State.

Contact water, including runoff water in direct contact with the ore stockpiles, overburden stockpile, industrial area and co-disposal storage facilities, as well as runoff and seepages into the open pit, will be directed to a collection pond system via a network of collection ditches, collection ponds, pumping stations and pipelines. All the collection ponds located on the mine site will provide an area for suspended solids settling prior to discharge to the environment. Furthermore, runoff water collected in the open pit will be transferred to a water collection pond that will provide sufficient residence time in order to promote the natural degradation of ammonia that could be present in the pit runoff from explosive use.

As outlined previously in this Report, it should be noted that all process waters will be recirculated/reused and that no discharge of any process water is projected, except for entrapped (interstitial) water in tailings (less than 15% w/w) and occasional purge for maintenance which will be dealt with in full compliance with applicable regulations, guidelines and standards. Such recirculation rate is possible considering the type of tailings management that was selected as part

of the Whabouchi Mine Project, i.e. Co-Disposal Storage Facility of waste rock and filter-pressed tailings.

a. Water Management Facilities by Project Phase

The development of the WMP for the Whabouchi Project is divided into four (4) distinct phases, including one pre-production phase (namely Phase 1A) and three (3) phases (namely Phases 1, 2, and 3) during production. For each phase, the water management infrastructure (i.e. ponds, ditches, and pumping requirements) are sized based on the required volume of surface runoff to manage, which varies according to the catchment area of the co-disposal storage facilities.

By Phase 3 of the Project, a total of thirteen (13) water collection ponds, located in strategically selected areas, are required to manage the surface runoff on the Whabouchi mine site. The ponds, ditches, pumping stations, and pipelines for each phase of the Project are illustrated in Figures 20.4 and 20.5.

Phases 2B and 3 of the water management strategy will have to be optimized during the detailed engineering phase when detailed deposition plans will be available, i.e. in a timely manner to secure the required environmental authorizations prior to its use, as outlined in Section 20.1.2. For all phases, the pumping stations will be designed with sufficient redundancy and flexibility for maintenance.

In the pre-production phase, due to the small catchment area influenced by mining activities, three (3) new ponds and adjacent ditches need to be constructed, of which one (1) pond is dedicated for the co-disposal storage facility (BC-5) and two (2) ponds for the industrial and overburden area #1, including the associated process water reservoir/pond (BC-11 Nord) which is not connected to the surface water management system and the mine final effluent.

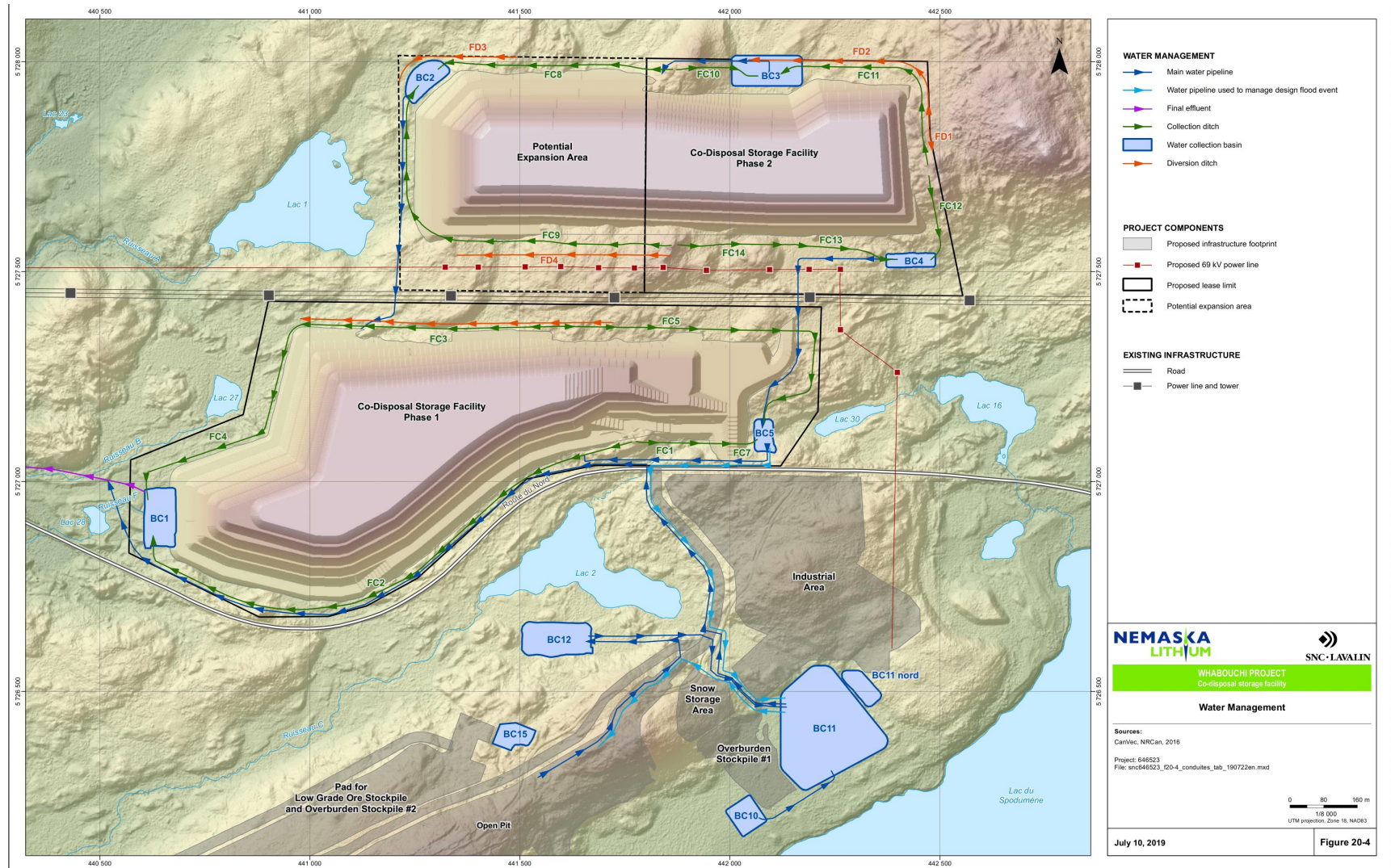
It is to be noted that existing pond BC-10 will also contribute to the management of the runoff from the overburden area #1 and the existing BC-15 will receive the mine pit dewatering before the construction of the pond BC-12.

During the production period, the water collection ditches, water collection ponds and pumping stations will be designed and constructed to be in line with the development of the co-disposal storage facilities. Phase 1 consists of the implementation of two (2) new ponds (BC-1 and BC-12) and Phase 2A integrates three (3) more ponds (BC-2, BC-3 and BC-4) surrounding the expansion of the co-disposal storage facility.

The block flow diagrams of Phase 1 and 2A are presented in Figures 20.6 and 20.7. Four (4) more ponds (BC-6 to BC-9) will be required to manage water from Phases 2B and 3. The design also allows for transfer of surface water from some water collection ponds to the open pit for temporary storage (i.e. BC-5 to BC-11 and BC-11 to the open pit) in case of extreme flood events.

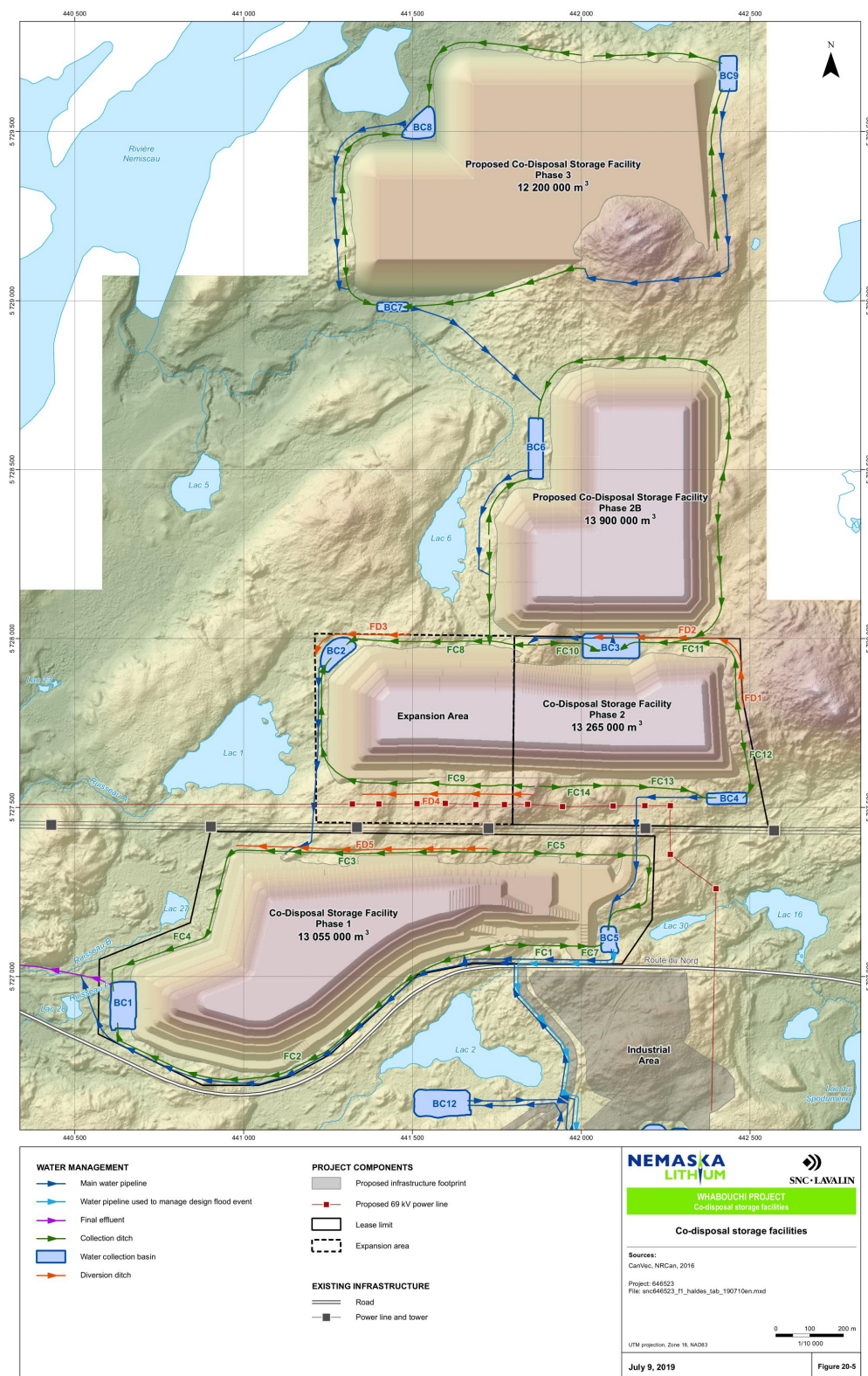


Figure 20.4 – Water Management Strategy for Phases 1 and 2A

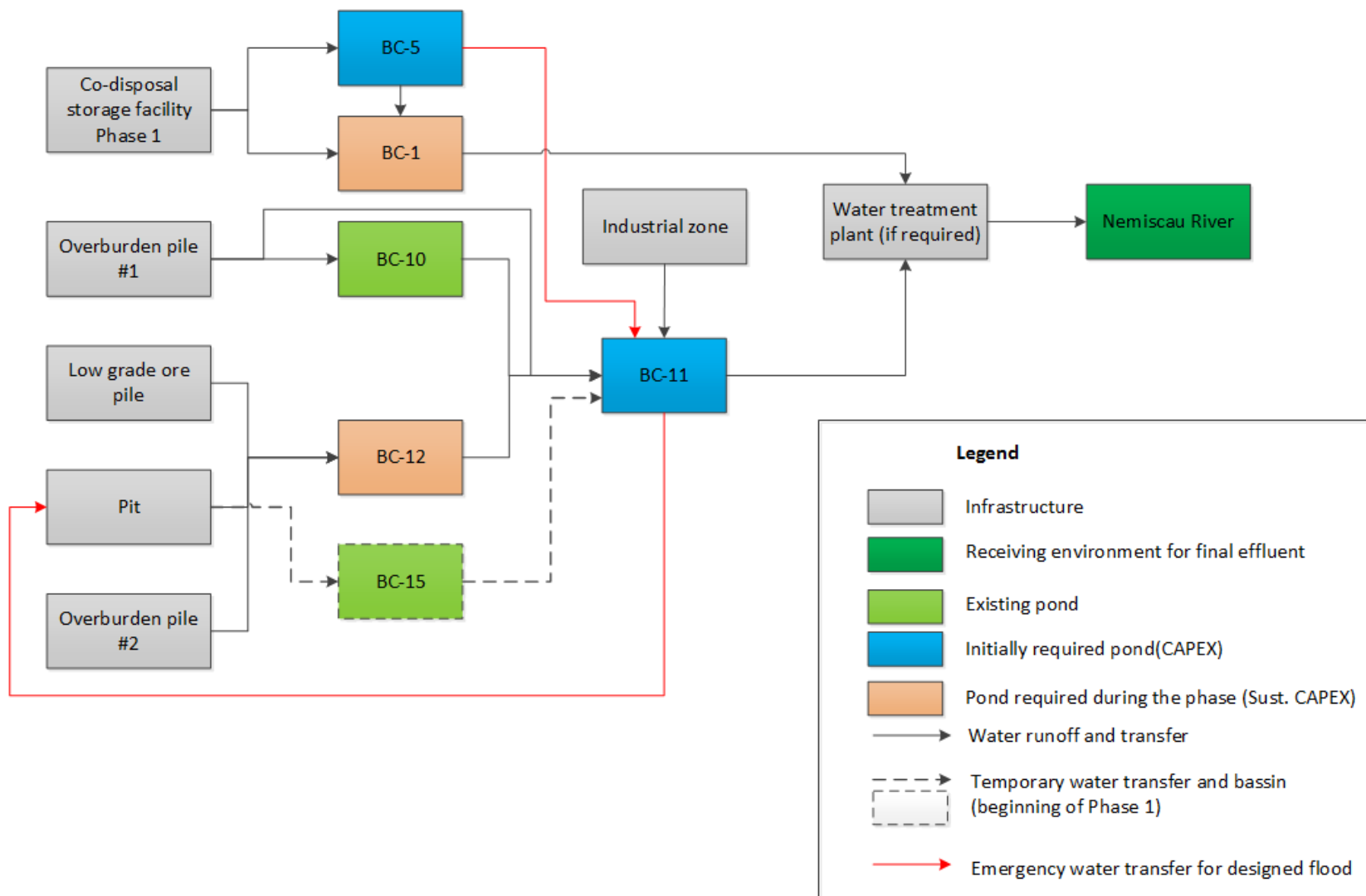




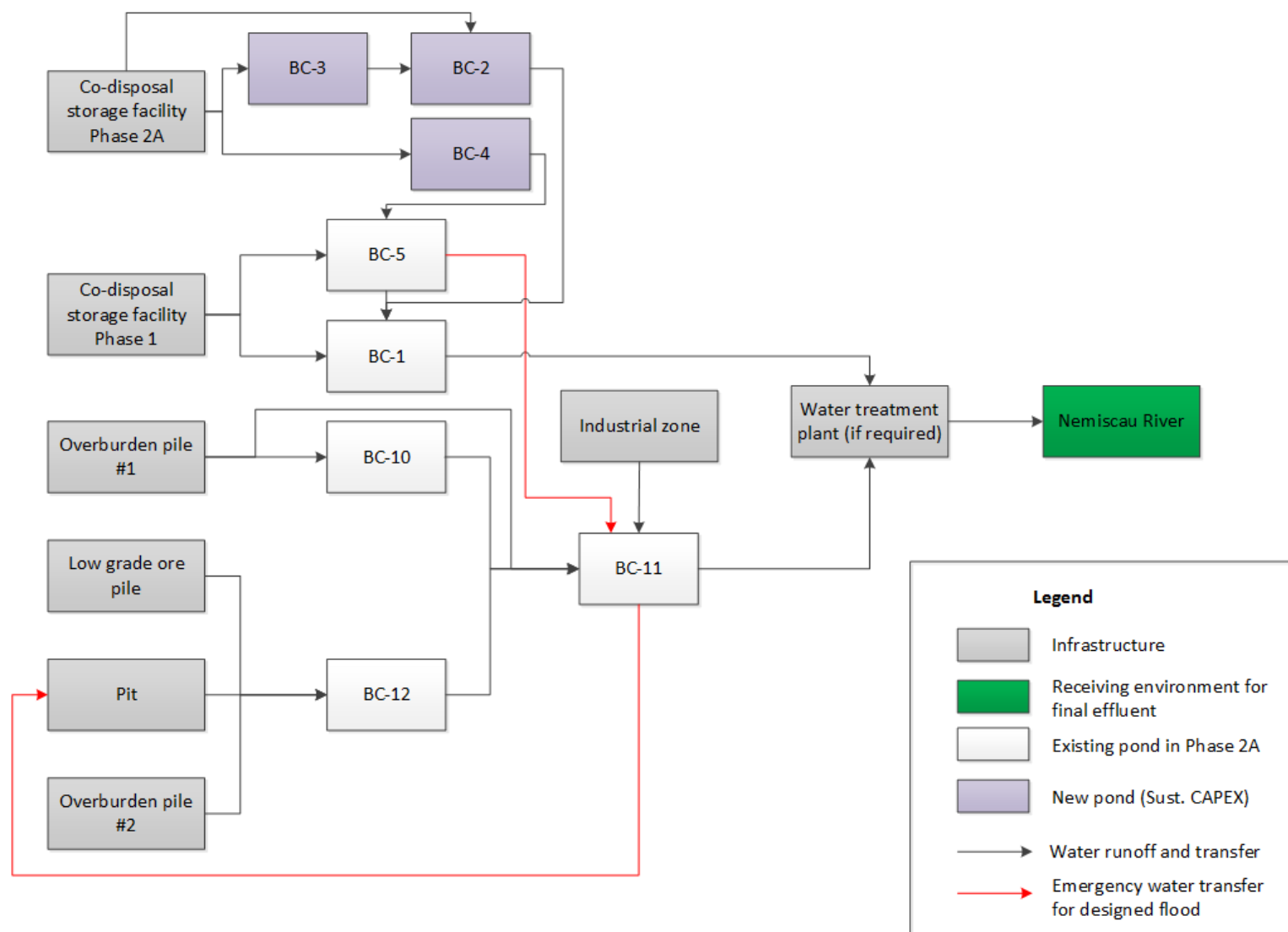
**Figure 20.5 - Water Management Strategy for Phases 1, 2 and 3**



**Figure 20.6 – Surface Water Management Block Flow Diagram for Phase 1**



**Figure 20.7 – Surface Water Management Block Flow Diagram for Phase 2A**



The final effluent pipeline of Whabouchi mine will direct water from either the collection pond BC-1 or the collection pond BC-11 to the final effluent in Nemiscau River with regular monitoring of flow and water quality in full compliance with applicable laws, regulations and standards. To that regard, as outlined in Section 20.1.1, additional hydrological measurements (flow, stage gauging, water level, bathymetry, etc.) were completed in 2014 (spring, summer, and fall) in order to precisely model the dispersion of the final effluent in the Nemiscau River and ensure its full compliance with all provincial and federal quality criteria (ex. Directive 019, EDO, MDMER, etc.).

The 1,450-m long HDPE pipeline will have a nominal 12-inch diameter and will be installed directly along an access road, which will be constructed with materials from authorized adjacent sources, including waste rocks generated as part of the open pit preparation works. This access road is planned to facilitate the pipeline maintenance.

The pipeline will be uninsulated and laid down by the road that requires to be constructed. At the highest topographical elevations, air valves will be installed to maintain a sufficient air supply in the pipeline. At the lowest topographical elevation, a drain valve will be installed to drain the pipeline in fall and thus prevent ice formation during the cold season. Nemaska Lithium will also be able to store, within BC-11, enough water for process use in summer months during which rainfall is less abundant. This helps to maximize the recycling of the contact water on the mine site and thus, reduce the fresh water intake.

It should be noted that since the WMP only manages rainfall and runoff water excluding the process water of the mill, it is expected that it will only be operational from May to November and not during winter conditions. To ensure process make-up supply in winter, sufficient storage capacity was included in pond design in order not to have water discharge at the mine final effluent.

Due to the coefficient of expansion and of the expected temperature variations, HDPE thermal expansion was accounted for to determine the length of the pipeline. Anchor blocks will also be installed to avoid significant displacements between each sections of the pipeline.

The aquatic portion of the pipeline is of about 80 m. The discharge point is located in a deeper portion of the Nemiscau River at a depth of 11 m. The pipeline was secured to the riverbed using prefabricated concrete blocks. The final effluent point was authorized by the MELCC and DFO, as depicted in Section 20.1.2. Protection of the pipeline from floating ice and other such potential hazards was provided using granular material placed around the pipe to a depth of 3 m below the high-water elevation. This material (MG-112) was placed from the riverbed and sloped at the sides at 3H:1V. Additional erosion protection was provided with riprap, placed over the granular material.

#### 20.1.4.3 Final Effluent Water Treatment

Based on the information depicted in Section 20.1.1 of this Report, it can be concluded that the risk related to water quality is low. In the beginning of the operation, the pond BC-11 will provide sufficient residence time for particles sedimentation due to its large volume designed for the entire life. Thus, no specific treatment will be required at the final effluent other than the presence of the polishing

pond to ensure full compliance with the applicable Total Suspended Solids ("TSS") criteria. In the following years, NMX will collect more geochemical data and conduct effluent quality monitoring. If the final effluent does not comply with the applicable provincial and federal regulations (Directive 019, MDMER, etc.), an active water treatment plant (WTP) based on physico-chemical treatment will be implemented to treat raw water either from BC-1 or BC-11. TSS will be removed from the effluent through coagulation and flocculation processes. Preliminary engineering has been completed by ASDR (ASDR, 2019).

It should be noted that besides the active WTP, there will be multiple sedimentation ponds located around the Waste Rock and Tailings Pile, the mill and garage area, the temporary ore stockpile and the overburden pile to control TSS (Figure 20.4 and Figure 20.5), thus enabling full compliance with applicable TSS criteria. This being said, Nemaska Lithium did commit as part of the ESIA process to implement a treatment unit in case additional treatment (ex. if the projected ponds do not provide with sufficient TSS polishing capacity) would be required and so such unit will be installed if needed.

Monitoring at the final effluent will take place on a continuous basis as per applicable provincial and federal regulations (Directive 019, MDMER, etc.) to ensure full compliance with all applicable quality criteria.

#### 20.1.4.4 *Risks Associated with Climate Change*

In Quebec's boreal region, scientific literature shows that the most significant impact of climate change will be associated with increased precipitation. Even though this phenomenon will be coupled to increased average temperature, thus increasing evaporation and limiting theoretically the impact of increased rainfall, it is actually the increased occurrence of extreme events (high rainfall, rapid snowmelt, etc.) that will have the most significant impact on the Whabouchi Mine in the next decades based on modelling studies performed, among others, by the Ouranos Consortium for the Northern Quebec region.

To that regard, as aforementioned for the Whabouchi Mine's WMP, all the surface water collection ponds, pumping stations, and treated water outfall were designed to manage a spring surface runoff based on a 1:100-year snowpack depth melting over a 30 days period in conjunction with a 1:1,000-year, 24-hour rainfall event, thus accounting for extreme events to occur. Water collection ditches are designed based on 1:100-year rainfall event and thus have the capacity to support rapid extreme events. It should also be noted that such criteria exceed by far the legally required design criteria for water management at mine site designated as low risk as per Directive 019.

With regards to the impact of the Whabouchi Mine on climate, project design accounts for multiple factors to minimize its global carbon footprint including, among others:

- Optimizing general site layout to minimize direct impacts on wetlands which act regionally as carbon sinks;
- Diverting all non-contact water to the environment before it enters the Whabouchi mine site, thus limiting the potential decrease in water inputs in existing lakes, streams and wetlands;



- Opting for a permanent transportation route for its spodumene concentrate that will minimize travelling distances (i.e. heading for Chibougamau instead of Matagami) and so associated GHG emissions;
- Minimizing on-site travelling distances for its heavy machinery;
- Performing preventive maintenance and ensuring that all machinery and equipment on site are in good operational conditions and thus avoiding waste of fuel, oils, etc.;
- Optimizing processing operations to minimize the consumptions of reagents;
- Maximize, when possible, local and regional employment and procurement to minimize associated transportation over long road distances and/or by plane.

#### 20.1.5 NOTE ON TAILINGS MANAGEMENT

With regards to tailings management, best economically and technically available technologies have been integrated to Project design so that filter-pressed tailings will be produced at the mine site to be co-disposed with waste rocks on a dedicated pile. The aforementioned method is associated to several advantages, as outlined in the Report on Mount Polley Tailings Storage Facility Breach issued in January 2015 by the Mount Polley Independent Expert Engineering Investigation and Review Panel. Indeed, the production of filter-pressed tailings, or dry stacking, especially when co-disposed with waste rocks, is commonly associated with the following technical and environmental advantages:

- No dyke required to store tailings and therefore no risk of dam failure;
- High process water reuse rate in the concentrator;
- High reagents reuse rate in the ore process;
- Significant reduction of the risks of leaks or spills (ex. damaged pipes, through dykes) and therefore of risk of environmental contamination;
- Filtered tailings can be compacted and/or leveled once disposed on the dedicated pile, enabling an easier co-disposal with waste rocks;
- Filtered tailings are geotechnically stable and can be stockpiled at greater height and with steeper slopes than conventional tailings, therefore reducing the surface footprint of the dedicated pile;
- Filtered tailings can be progressively revegetated, i.e. before mine closure, as the mine is still in operation;
- Significant reduction of the surface footprint of the whole Project by enabling the co-disposal of tailings and waste rocks.

#### 20.1.6 RELATIONS WITH STAKEHOLDERS

Information pertaining to local demographics, economic development, land use, cultural heritage, health and social services, and infrastructure has been collected in order to provide a snapshot of



the community's needs and priorities and to determine how current conditions may be affected by the proposed Whabouchi Mine Project.

Results are based largely on data obtained from the local First Nations government (Cree Nation of Nemaska Band Council), local social service providers, educational institutions, law enforcement, regional Cree entities and Census Canada, as well as on data obtained from engagement with land users and community stakeholders (ex. in-depth semi-structured interviews with trapline R20 family and other Cree land users, focus groups, etc.).

Efforts were made to create and maintain a collaborative and cordial relation with the community, in particular with families affected by the Mine Project, in order to address issues as they emerge throughout the course of consultations and Project development. To that regard, it should be noted that Nemaska Lithium has engaged in a Community Dialogue and Planning initiative led by the Cree Nation of Nemaska in collaboration with NetPositive and which aimed at planning for and managing natural resource development activities affecting the community.

The process also convened a discussion among the Nemaska community and other key stakeholders (ex. Nemaska Lithium, Cree Nation Government) about the socio-economic development of Nemaska and the community's vision for the future. A phase 2 is being developed and will implement several priority recommendations from the first assessment phase and continue the visioning and planning work that was begun.

Phase 2 will focus on formalizing the community of Nemaska's vision by linking existing visioning activities to mining. Furthermore, the project will focus on formalizing a comprehensive community plan for mining aligned with that vision, including by building internal community capacity and by establishing the necessary communication and coordination structures. Historical Background and Social Changes

The James Bay Crees occupy the immense territory called Eeyou Istchee, of which the limits are defined in the James Bay and Northern Québec Agreement ("**JBNQA**"), the first major agreement concluded between the Government of Quebec, the Crees and the Inuits of Northern Quebec in 1975. The JBNQA, the *Paix des Braves* (Agreement Respecting a New Relationship Between the Cree Nation and the Government of Quebec) and the Agreement Concerning a New Relationship Between the Government of Canada and the Cree of Eeyou Istchee constitute the legal, political and administrative framework throughout which we can understand the accelerated growth and social development of the signatory communities, which in turn influenced the way of life and the occupation of the land.

The territory of the Crees, namely Eeyou Istchee, comprises nine communities. These communities are located on the shore of the James and Hudson bays (Whapmagoostui, Chisasibi, Wemindji, Eastmain, Waskaganish) as well as inland (Nemaska, Waswanipi, Oujé-Bougoumou, Mistissini). The total population of the Cree Nation of Eeyou Istchee is currently estimated at close to 17,000 persons (in 2015), the majority of which speaks English.

The territory of each Cree community is subdivided into a variable number of family hunting grounds or trapping territories (traplines), each under the authority of a tallyman whose role consists, among others, in ensuring the proper management of exploitable resources and of the areas to preserve.

The Cree communities are united under the Grand Council of the Crees of Eeyou Istchee (“**GCCEI**”) and its administrative branch, the Cree Nation Government (“**CNG**”). Furthermore, since January 1, 2014, the Cree and Jamesians (the non-Aboriginal regional population) are unified under the new Eeyou Istchee / James Bay Regional Government, established pursuant to the Agreement on Governance in the Eeyou Istchee / James Bay Territory. This regional government offers a new model, formally constituted with equal representation of Aboriginal and non-Aboriginal populations. It exercises powers of local and regional municipal governance, regional development and land and resource use planning over the Category III lands of the Eeyou Istchee / James Bay region.

#### 20.1.6.1 *Socio-Economic Baseline of the Cree Nation of Nemaska*

The Cree Nation of Nemaska, which means “plenty of fish”, is situated on the shores of Champion Lake in Eeyou Istchee. Nemaska is a new and modern village comprised of Cree families originally living at the Nemiscau trading post on Lake Nemiscau. The community of Nemaska is accessible all year long from Matagami via the James Bay Highway (over 390 km away), and from Chibougamau by the Route du Nord (approximately 330 km).

It is a fairly small but fully serviced community of around 800 people. Nemaska followed the trend seen in other Eeyou Istchee communities, with a rapid population growth over the last 30 years. However, for the past ten (10) years, this growth rate has been decreasing gradually, as in the rest of the Cree population of Eeyou Istchee.

The main demographic feature of the Nemaska community is its youth. Thirty-one percent (31%) of the Nemaskau Eenouch (the “people of Nemaska”) is less than 15 years old and according to the 2006 Canada census data, the mean population age was 25 years old. Elders represent the smallest age group at 4% of the total population.

The Nemaska community is an important Cree administrative center in the Eeyou Istchee region. The offices of the GCCEI and of the CNG are located in the community.

Social service facilities in the community include the wellness center, Nemaska clinic, social services center, school, daycare, sports complex and multi-service center and youth center.

#### 20.1.6.2 *Land and Resource Use*

Since the creation of beaver preserves that began in the 1930s, the territory of each Eeyou Istchee Cree community is subdivided into a number of family hunting grounds or trapping territories (traplines).

The Whabouchi Mine Project is located on part of the traditional territory of the Cree Nation of Nemaska, more specifically on Trapline R20. The Whabouchi Mine is located in the extreme south corner of Trapline R20, and thus occupies only a minor portion of it. The trapline is under the direction

of a hunting leader or tallyman, known as *uuchimaau* in Cree, who is responsible for the continued monitoring and management of the resources.

Trapline R20 is regularly used by family members and their extended family, as well as by other Crees who have camps along the *Route du Nord*, who frequent the Bible Camp or fish in Mountain Lake and the Nemiscau River.

Traditional harvesting activities continue all year long. The spring goose hunt is practiced in several sectors of the trapline, and many lakes and rivers offer good fishing grounds. Big-game hunting, as well as waterfowl and ptarmigan hunting, are practiced mainly in the fall and winter. Furbearer trapping is practiced in the winter. Harvesting activities decrease during the summer season, except for fishing and berry harvesting.

Trapline R20 hosts a site that has long been used for community activities and that was recently transformed into a Bible Camp to receive Nemaska children and families for summer camps, religious gatherings and traditional Cree ceremonies.

Non-Natives also visit the territory during the summer for fishing and camping, or during the hunting season. Among them are workers from Nemaska community and from nearby work camps such as Hydro-Québec's Nemiscau Camp.

#### 20.1.6.3 *Economy, Employment and Education*

Even though Eeyou Istchee is considered a resource region (i.e. where the main work providers are primary sector companies such as hydroelectricity, forests and mineral), Nemaska is distinct from other Cree communities in that it is an important administrative center for the Eeyou Istchee territory.

In fact, in 2008, the tertiary sector (health, social and education services, municipal services or other governmental services) was the predominant economic sector, representing 85.4% of the employment in the community. Moreover, nearly a third (31%) of the jobs is in public administration, while this category of employment provides only 20% of the jobs elsewhere in Eeyou Istchee.

In Nemaska, the primary sector represented only 8.3% of the jobs in the community in 2008 compared to close to one fourth (4<sup>th</sup>) of the jobs (23.8%) in the whole Cree Nation. As in the case of the primary sector, construction is a marginal economic activity in Nemaska, representing only 4.9% of the jobs in the community while, in Eeyou Istchee, it represents almost twice the proportion of jobs (8.7%).

Several regional organizations and businesses are active in the Eeyou Istchee territory, and more specifically in Nemaska. These organizations and businesses (ex. CreeCo, Cree Construction and Development Company, Air Creebec, PetroNor, Kepa Group, Nemaska Eenou Company, NDC-Fournier, VPC, Iywaashtin Enterprises, Meeyobin Company) belong to the Crees, the Band Councils or to a Cree-held entity. Although Nemaska constitutes an administrative center, very few among these businesses have their headquarters within this community.

However, local economic opportunities in Nemaska have increased over the past several years. Contributing factors include Hydro-Québec contracts being awarded to local contractors for construction projects and environmental monitoring, as well as new community infrastructure projects undertaken by local government and associated economic spin-offs. Taking into consideration the large youth population in Nemaska, the Cree School Board, in partnership with Nemaska Lithium and other regional partners, is currently rolling out various training and skills development programs (ex. heavy machinery operation, ore processing, drilling and blasting, etc.) which will play a key role in building local capacity to meet future needs.

A recent development in the community is the emergence of employment at the entrepreneurial level. Individuals are offering such services as equipment rentals (dump trucks, snowmobiles), video rentals, painting, laundry, towing and equipment maintenance and repairs. As well, the Nemaska clinic, fire hall, band council headquarters and justice facilities were recently built. However, in spite of efforts to stimulate the local economy, people in the community still report a lack of jobs.

In general, the Cree communities experience a higher unemployment rate than the Quebec average. In 2008, although the unemployment rate in the community of Nemaska was lower than in the Eeyou Istchee territory, it was much higher (16.4%) than for the population of 15 years old and more in Quebec as a whole (6.9%). Furthermore, the unemployment rate among the youth (15 to 20 years old; 23%) is much higher than among adults (24 to 64 years old; 15%).

Another important element that must be accounted for is that the rate of graduation and participation in post-secondary education programs is generally lower in the Cree communities than in the rest of Quebec. The graduation rate in the community of Nemaska is similar to the Cree average with 11.2% of vocational diplomas and 11.2% for college diplomas, which is significantly lower than the Quebec average.

#### 20.1.6.4 *Community Health and Wellness*

Health and social services in all Eeyou Istchee communities are provided by the Cree Board of Health and Social Services of James Bay (“**CBHSSJB**”). Each of the nine (9) Cree communities is served by a clinic that offers mainly primary care and a dental clinic.

The community of Nemaska has a Wellness Center, a social services office, a multiservice day care center (MSDC) and a Youth office. Looking at the high birth and fecundity rate trends in the population, it is foreseeable that the demand for this type of service will increase in the upcoming years.

#### 20.1.6.5 *Cultural and Archaeological Heritage*

A study on the archaeological potential and an archaeological inventory were completed in 2011 and 2012. Even if a consultation of the archaeological sites inventory database in Quebec (ISAQ) identified three (3) known archaeological sites in the vicinity of the Project, no remains of human establishments prior to the 1950s were identified. Therefore, no significant issues have emerged that would be considered jeopardizing to the Whabouchi Mine Project.

#### 20.1.6.6 *First Nations*

Early in the preliminary phases of the development of its Project, Nemaska Lithium devoted time and resources to ensure a concrete and constructive involvement of the various stakeholders, notably the Cree Nation of Nemaska. Even before launching the ESIA process, the local authorities of the Nemaska Cree community took part in information and consultation activities.

Since project inception, i.e. in 2009, different activities were undertaken to present the Project to the stakeholders and collect their concerns about the Project and its potential environmental and social impacts. Various subjects were discussed during these information and consultation activities, for example the open-pit mining processes, the main project infrastructure planned and the lifecycle of the ore.

Such consultation led to significant modifications to the site general arrangement plan from what was presented in the previous NI 43-101 compliant Preliminary Economic Assessment report. Indeed, the location of the Waste Rock and Tailings pile, as well as of sedimentation basins and final effluent, were modified so that they are now located further from Mountain Lake.

In August 2009, the financial arm of the Cree community, Nemaska Development Corporation, agreed to purchase shares in Nemaska Lithium, therefore ensuring their financial participation in the development of the Project.

In the fall 2009, discussions were held on negotiating and signing a Memorandum of Understanding ("**MOU**") between the community and Nemaska Lithium that recognized the respective rights and expectations of the parties, and particularly the need for the company to respect Cree culture and traditions in its activities on the territory. The MOU was signed in August 2010.

The implementation of the Communication and Consultation Plan began in November 2011, after a series of discussions with the Nemaska Band Council administration and an initial presentation of the Project during a community general assembly. The Communication and Consultation Plan included the completion of various engagement activities with the following stakeholders:

- Nemaska Band Council (meetings);
- Members of the Community of the Cree Nation of Nemaska and local organizations (interviews);
- Trapline R20 tallyman, neighboring tallymen (R16, R18, R19, and R21) and other Cree land users (in-depth semi-structured interviews, meetings);
- Youth; Elders; Land users, hunters and trappers; and Women (focus groups);
- Community Consultative Committee which was set up to provide a platform for exchanges between the proponent and the various stakeholders in the Nemaska community (meetings).

A 3D video animation describing the main elements of the Project through the construction, operation, and closure phases was made available to the community of Nemaska along with multiple

documents and reports, including all those produced as part of the provincial and federal environmental and social impact assessment processes.

Several field visits on the Whabouchi Mine Project site were also organized to explain the Project to the representatives of the Nemaska community and to the Cree land users. Moreover, in March 2012, Nemaska Lithium opened a local office in Nemaska and hired a community liaison agent to facilitate the exchanges of information between Nemaska and the community.

The comments, concerns, demands, and suggestions expressed by stakeholders during the information and consultation activities were documented and compiled by topic. Following the filing of the ESIA in April 2013, Nemaska Lithium and its consultants were still actively involved in the public information and consultation sessions held in Nemaska by the Cree Nation Government's Environment and Remedial Works Department and the Canadian Environmental Assessment Agency ("the **Agency**").

In November 2013, Nemaska Lithium participated to public consultations held by the Agency in Nemaska, and in March 2015, it participated to the public hearings organized by the Quebec's Review Committee ("**COMEX**") also in Nemaska.

In November 2014, the GCCEI, the CNG, the Cree Nation of Nemaska and Nemaska Lithium announced that they have entered into the Chinuchi Agreement regarding the development and operation of the Whabouchi Mine Project. The Chinuchi Agreement is a binding agreement that will govern the long-term working relationship between Nemaska Lithium and the Cree parties during all phases of the Whabouchi Mine Project.

Community approval was expressed through the support of the Chief and Council of the Cree Nation of Nemaska on September 18, 2014. The approval of the Chinuchi Agreement by the GCCEI and the CNG on September 23, 2014, represents the support of the Cree Nation as a whole, and ensures a stable regional environment for the development and operation of Nemaska Lithium's Project.

After extensive and cooperative negotiations, the Cree announced that they were satisfied that concerns expressed regarding a range of issues, including business opportunities, training and employment, as well as other matters, will be addressed by Nemaska Lithium. The Agreement, which will be in effect throughout the life of the mine, contains items pertaining to training, employment and business opportunities for the Crees during construction, operation and closure of the mine.

In addition, the parties have established a framework to ensure Cree involvement and participation in environmental matters, such as monitoring, mitigation and closure. The Chinuchi Agreement reflects the commitment of the Crees to collaborate with Nemaska Lithium during the development and operations of this new mine in the Eeyou Istchee territory. Moreover, the Agreement aligns the parties' respective interests in the economic success of the Project and ensures that the Crees will receive financial benefits from the Project in compliance with the best practices in the industry and with the Cree Nation Mining Policy.



#### 20.1.6.7 Non-Aboriginal Communities

Chibougamau is a town in the territory governed by the Eeyou Istchee James Bay regional government, located on Lake Gilman about 500 km north of Quebec City. In 2011, the population was of 7,541 people. Chapais is located along Road 113 about 45 km west of Chibougamau (population 1,610). The Chibougamau-Chapais region is located about 310 km south of the Whabouchi Mine Project to which it is connected by the *Route du Nord*.

Due to its remoteness from Lac-Saint-Jean (over 200 km) and Abitibi-Témiscamingue (over 250 km) areas, the Chibougamau-Chapais region provides services for the few small communities surrounding it (ex. Cree villages of Mistissini and Oujé-Bougoumou) and for the regional resource-based industries (ex. Stornoway Diamond's Renard mine, Chantiers Chibougamau). Access to region is by Road 167 from Lac-Saint-Jean and by Road 113 from Abitibi-Témiscamingue. Chibougamau's airport is along Road 113, about halfway to Chapais. The region is also the railhead of Canadian National's *Chemin de fer d'intérêt local interne du Nord du Québec* ("CFILNQ").

Chibougamau's history is directly linked to the richness of its soil, and the Town has long depended on the exploitation of natural resources. Today, although it is still fed by its mining and forestry heritage, the town has integrated service, energy, and tourism industries to its economy; it is indeed now recognized for its important assets in terms of business and entrepreneurship. Following the closure of the local mine in 1991, Chapais' primary industry has been forestry, and the community opened the first cogeneration plant in Quebec to produce electricity from the sawmill's wastes.

The Chibougamau-Chapais region is also renowned for its skilled workforce in the mining and forestry domains. Moreover, the presence of various training centers (professional, collegial) brings a constant flow of qualified workers to the region.

In April 2015, the Government of Quebec relaunched its Plan Nord program which, over the next 20 years, is projected to represent about \$22 B investments, 10,000 jobs in construction phase and 9,730 jobs in operation phase. Plan Nord is an economic development strategy launched to develop the natural resources extraction sector in Northern Quebec, i.e. north of the 49<sup>th</sup> parallel. The geographical situation and history of the Chibougamau-Chapais makes it a hub when it comes to northern economic and social development, especially considering that it hosts one of the few regional offices of the *Société du Plan Nord*.

As part of the Whabouchi Mine Project, the Chibougamau-Chapais region, and most precisely the City of Chibougamau, will ultimately serve as a transportation hub to which the spodumene concentrate produced at the mine site will be trucked. From that site, the concentrate will be boarded on a train and transported by Canadian National (CN) to a second processing facility located in Shawinigan, Quebec.

The City of Chibougamau is implementing a regional transshipment center, a facility Nemaska Lithium is committed to use it as part of its Project when it will be operational and as long as it offers competitive and quality transboarding services. Up until this facility will have been constructed and

be operational, Nemaska Lithium intends to temporarily transport its spodumene concentrate via an existing facility located in Matagami, about 400 km south-west of the Whabouchi Mine.

Nemaska Lithium has been in contact with representatives of both Chibougamau and Chapais since Project inception. Discussions are ongoing towards the signature of a *Déclaration des partenaires* with the *Administration régionale Baie-James* (formerly the “*Conférence régionale des élus de la Baie-James*”) and which would cover items such as local and regional employment and procurement as well as socio-economic diversification and development.

Nemaska Lithium and the regional-municipal leadership have developed an engagement and communication program that is adapted to the anticipated impacts that the Project will potentially have on the community. Among others, Nemaska Lithium participated in April 2015 to the public hearings organized by the COMEX in Chibougamau.

#### 20.1.6.8 Governmental Authorities

Finally, Nemaska Lithium has taken part in numerous meetings with the Quebec's MERN and MELCC as well as with the Agency to discuss mutual interests and to ensure that all involved parties could be satisfied. All parties are working towards common objectives, including the development of the Whabouchi Mine Project, and have been fully cooperating with Nemaska Lithium. Section 20.1.2 of this Report depicts both provincial and federal ESIA process applicable to the Whabouchi Mine Project which led to the issuance of the General Certificate of Authorization by the MELCC and a positive decision statement by the Canadian Minister of Environment, both in 2015.

## 20.2 Electrochemical Plant

### 20.2.1 ENVIRONMENTAL BASELINE STUDIES

Baseline environmental studies at the Electrochemical Plant Project site were initiated in 2015 through a comprehensive review of:

- Aerial photographs and/or satellite images, maps, and geomatics tools;
- Information provided by various governmental agencies as well as by other project proponents active in the territory (municipality, other mine or hydropower projects, etc.);
- Studies completed by former operators of the site;
- Studies from the scientific and technical literature.

Considering that the Project site is a brownfield area, i.e. the former Resolute Forest Products' ("RFP") Laurentide pulp and paper mill, the aforementioned review enabled the elaboration of an environmental database providing with sufficient information to fulfill the requirements of a complete baseline study. Environmental aspects covered by this review are:

- Climate and weather data;
- Geology and soils, including information on past land use and potential contamination (Phase I and II Environmental Site Characterization) as well as site rehabilitation plan;

- Hydrogeology and groundwater quality;
- Adjacent St-Maurice River's hydrology and water and sediment quality, as well as information on aquatic habitats, fisheries and benthic invertebrate communities;
- Air quality and noise;
- Adjacent terrestrial habitats and wetlands of importance, if any;
- Terrestrial wildlife (birds, mammals, amphibians and reptiles);
- Special-status species and protected areas, if any.

Following that review, gaps were identified in the database, with regards to air quality, noise levels, hydrology as well as groundwater and soil quality, thus additional field surveys have been performed since 2016 to ensure a complete characterization of the biophysical environment prior to operation start-up.

#### 20.2.1.1 *Environmental Site Characterization and Rehabilitation of Contaminated Lands*

Following discussion initiated in November 2014, Nemaska Lithium announced in May 2016 that it completed the acquisition of part of the land and of existing manufacturing facilities of the former RFP Laurentide plant for the installation of its Electrochemical Plant. That site operated from the late 1880s to 2014 when it was shut down by RFP. The facilities acquired by Nemaska Lithium are mostly from the 1960's to the 1990's.

As part of the acquisition process, the City of Shawinigan and RFP are fully responsible for the environmental site characterization and associated site rehabilitation, in full compliance with the applicable laws and regulations pertaining to Soil Protection and Contaminated Lands Rehabilitation.

To that regard, the Purchase Agreement signed by both the City of Shawinigan and Nemaska Lithium specifies that all environmental liabilities associated to the past activities which took place at that site are under the full responsibility of the City of Shawinigan and that Nemaska Lithium will not be accounted for those. As well, the Agreement entails provisions related to the conditions in which the site will be delivered to Nemaska Lithium, i.e. all lands complying with applicable soil quality criteria for industrial use and no contamination above applicable criteria for all environmental components.

Finally, as part of the ongoing process of environmentally characterizing and rehabilitating the site, as well as during the dismantling works which will take place in the facilities that Nemaska Lithium is not acquiring, close collaboration and communication channels have been established to ensure full coordination during construction and operation works.

#### 20.2.2 JURISDICTIONS AND APPLICABLE LAWS AND REGULATIONS

The legal framework for the construction and operation of the projected Electrochemical plant facilities is a combination of provincial, national, and municipal policies, regulations and guidelines. The design and the environmental management of the Project facilities and activities must be done in accordance with this legal framework.

#### 20.2.2.1 *Quebec Procedure relating to the Environmental Assessment of the Project*

The EQA and associated Regulation respecting the environmental impact assessment and review of certain projects provide with a list of projects subject to the EIAR procedure in southern Quebec. Since the Electrochemical Plant Project will be producing less than 40,000 tons per year, it is not subject to provincial EIAR procedure.

#### 20.2.2.2 *Federal Procedure*

The CEAA (2012) and associated RDPA provide with a list of projects subject to an EA. None of the activities associated to the Electrochemical Plant Project are designated physical activities and thus, the Project is not subject to the federal EA procedure.

#### 20.2.2.3 *Environmental Permitting*

The Electrochemical Plant Project is subject to several sections of the EQA and to other applicable provincial and federal laws and regulations. Indeed, in addition to the certificate of authorization required under Section 22 of the EQA, the proponent must obtain the permits, authorizations, approvals, certificates and leases required from the appropriate authorities. Those are described in Table 20.4.

As well, along with the mitigation measures that will be set out as part of the environmental authorization process, the final Project design must comply with all applicable standards relating to the proposed infrastructure and equipment.

Applications may be filed concurrently with the construction works and should therefore not impact on the Project schedule.

Finally, in line with the information provided in Section 20.1.2, it should be noted that, as the permitting process for Electrochemical Plant Project began mostly in 2018 after the most significant changes to the EQA came into force, the applicable permitting process is complying with the new EQA. However, this being said, no associated significant impact on Project schedule arise from the new EQA with specific regards to the Project.

This was confirmed by the issuance in January 2018 of the *Regulation respecting the environmental impact assessment and review of certain projects* which confirms that the Shawinigan Electrochemical Project is not subject to the EIAR procedure. Also, in order to ensure consistency with the information provided in Table 20.4 for the Whabouchi Mine, authorizations are presented according to both the former EQA sections and the new EQA sections.

**Table 20.4 – Electrochemical Plant Project –  
 List of Permits and Authorizations to be Obtained**

Provincial (Quebec)	
<p>Paragraph 2 of Section 22 - new EQA            Authorization ("AU")            Section 22 – former EQA  <u>Certificate of Authorization ("CA")</u></p> <p><b>Status:</b></p> <ul style="list-style-type: none"> <li>• AU for Site Preparation obtained in 2018</li> <li>• AU for Construction to be obtained in 2019</li> <li>• AU for Operation to be obtained in 2020</li> </ul>	<p>In order to carry out the Electrochemical Plant Project, AUs will be required from the MELCC under Section 22 of the EQA.</p> <p>The information specified under Section 7 of the Regulation respecting the application of the Environment Quality Act as well as in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i>" and in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>" must be included in the CA application.</p> <p>Moreover, because the Project will involve discharges into the aquatic environment, it will be necessary to complete the effluent discharge objectives application form (<i>Demande d'objectifs environnementaux de rejet (OER) pour les industries</i>) and attach it to the CA application.</p> <p>The AU application form and all required documents must be sent to the MELCC's Mauricie and Centre-du-Quebec regional office. The time required to analyse an application for a certificate of authorization directly depends on the complexity of the project. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p>
<p>Subparagraph 2 of the first paragraph of Section 22 – new EQA            Section 31.75 – former EQA  <u>Authorization (AU) for the withdrawal of surface water or groundwater</u>, including related work and works</p> <p><b>Status: To be obtained in 2019-2020</b></p>	<p>The Electrochemical Plant Project will require the withdrawal of fresh surface water for process make-up water needs. If the volume of the withdrawal is higher than 75 m<sup>3</sup>/d, it would be subject to the authorization of the Minister under Section 31.75 of the former EQA (Subparagraph 2 of the first paragraph of Section 22 of the new EQA).</p> <p>Among other things, the authorization application must contain the information listed under Section 7 of the Water Withdrawal and Protection Regulation (WWPR). The authorization application form entitled "<i>Formulaire de demande d'autorisation pour un prélèvement d'eau assujetti à l'article 31.75 de la Loi sur la qualité de l'environnement</i>" must be completed and signed by an engineer, and the required documents must be attached. The application must be sent to the MELCC's Mauricie and Centre-du-Quebec regional office.</p>

### Provincial (Quebec) (cont'd)

<p>Subparagraph 3 of the first paragraph of Section 22 – new EQA</p> <p>Section 32 – former EQA</p> <p><u>Authorization (AU) for Waterworks, Sewers and Water Treatment</u></p> <p><b>Status:</b></p> <p>AU for water intake to be obtained in 2019-2020</p> <p>AU for wastewater treatment to be obtained in 2019-2020</p>	<p>According to the subparagraph 3 of the first paragraph of Section 22 of the new EQA: "[...] no one may, without first obtaining an authorization from the Minister, carry out a project involving one or more of the following activities: [...] the establishment, alteration or extension of any water management or treatment facility referred to in section 32, and the installation and operation of any other apparatus or equipment designed to treat water, in particular in order to prevent, abate or stop the release of contaminants into the environment or a sewer system".</p> <p>Section 32 of the new EQA reads as follows: "For the purposes of subparagraph 3 of the first paragraph of section 22 and this subdivision, a water management or treatment facility is (1) a waterworks system; (2) a sewer system; or (3) a rainwater management system. The Government may, by regulation, define the terms mentioned in the first paragraph."</p> <p>In the case of industrial wastewater treatment, the authorization application must include the information specified in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i>" as well as in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>".</p> <p>The applications must be sent to the MELCC's Mauricie and Centre-du-Quebec regional office. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p>
<p>Subparagraph 6 of the first paragraph of Section 22 – new EQA</p> <p>Section 48 – former EQA</p> <p><u>Authorization (AU) to Install an Apparatus or Equipment to Prevent, Reduce or Cause the Cessation of the Contaminants Release into the Atmosphere</u></p> <p><b>Status: To be obtained in 2020</b></p>	<p>According to the subparagraph 6 of the first paragraph of Section 22 of the new EQA: "[...] no one may, without first obtaining an authorization from the Minister, carry out a project involving one or more of the following activities: [...] (6) the installation and operation of an apparatus or equipment designed to prevent, abate or stop the release of contaminants into the atmosphere [...]".</p> <p>The authorization application must include, among other things, the information specified in the form "<i>Formulaire de demande de certificat d'autorisation (art. 22 de la LQE) ou d'autorisation (art. 31.75, 32 et 48 de la LQE et art. 128.7 de la LCMVF)</i>" and in the modules (section 8) concerning dust collectors and air quality, as well as in the guide "<i>Guide explicatif – Projet industriel – Demande de certificat d'autorisation ou d'autorisation</i>".</p> <p>The applications must be sent to the MELCC's Mauricie and Centre-du-Quebec regional office. Under the Declaration of Services to the Public, the ministry is committed to providing an official response within 75 days following the receipt of the application for a certificate of authorization or approval.</p>
<p>Section 120 – Safety Code</p> <p><u>High-Risk Petroleum Equipment Operating Permit</u></p> <p><b>Status: Most probably not required</b></p>	<p>According to Section 120 of the Safety Code: "The Owner of a petroleum equipment installation that includes at least one component that is high-risk petroleum equipment must obtain a permit for the use of all the high-risk petroleum equipment situated at the same address, until the equipment is removed from its respective place of use".</p> <p>"High-risk" petroleum equipments are defined in Section 8.01 of Chapter VIII of the Construction Code.</p> <p>The form "<i>Demande de permis d'utilisation pour des équipements pétroliers à risque élevé</i>" must be completed and submitted to the <i>Régie du bâtiment</i>. This application must include all of the information and documents identified in Section 121 of the Safety Code, including the statement of compliance signed by recognized verifiers. A permit is valid for 24 months. The issuance and renewal of a high-risk petroleum equipment permit are subject to compliance and performance monitoring under the provisions of the Construction Code and the Safety Code.</p>



#### Provincial (Quebec) (cont'd)

Section 19 – Regulation  
 respecting the water property  
 in the domain of the State  
Lease of a part of the water  
 property

**Status: To be obtained in  
 2019-2020**

According to Section 19 of the Regulation respecting the water property in the domain of the State: "The Minister is authorized to lease a part of the water property if the conditions provided for in this Subdivision are met". Existing infrastructures will be used for effluent discharge and water intake in the St-Maurice River. Consequently, existing leases will have to be transferred to Nemaska Lithium.

According to Section 5 of the Regulation respecting the water property in the domain of the State, before granting rights in the water property, the Minister must ensure that a certificate of authorization, if required, has been issued for the project under the EQA and that a certificate of non-infringement to municipal by-laws has been obtained from the municipality.

The request must be address to the CEHQ of the MELCC.

#### Federal (Canada)

Section 35(1) – Fisheries Act  
Authorization to alter, disrupt  
 or destruct fish habitat

**Status: Most probably not  
 required**

According to Section 35(1) of the Fisheries Act: "No person shall carry on any work, undertaking or activity that results in the harmful alteration or disruption, or the destruction ("HADD"), of fish habitat."

When a project includes a known risk of affecting fish and fish habitat, such a project must be submitted to Fisheries and Oceans Canada ("DFO") for its review. The general process that must be followed is described on the DFO website. The "Proponent's Guide to Information Requirements for Review under the Fish Habitat Protection Provisions of the Fisheries Act" identifies the information requirements for a detailed review by DFO. In order for a project to be reviewed, the proponent must have previously completed the form "Request for Review under the Fish Habitat Protection Provisions of the Fisheries Act". The request must be submitted to the local Fish Habitat Management Office.

The Electrochemical Plant Project is not expected to require an authorization for HADD as both the implementation of an effluent discharge pipeline and a water intake in the St-Maurice River would be done using existing infrastructures and thus without generating HADD of fish habitat.

### Municipal Permitting

City of Shawinigan  
Construction Permits

**Status: Obtained** for the Construction works done in 2018-2019 and to be obtained for works projected in 2020

As provided for under Section 32.3 of the EQA, "In addition to any requirements prescribed by any government regulation, an applicant for an authorization with regard to a water management or treatment facility not operated by a municipality, or operated by a municipality outside its territorial limits, must submit, in support of the application, a certificate from the clerk or secretary-treasurer of the municipality in whose territory the facility is located attesting that the municipality does not object to the authorization being issued for the sector served by the facility. If the municipality objects to the issuing of the authorization, the Minister must make an investigation and allow interested persons to present observations before making his decision."

In addition, Section 7 of the Water Withdrawal and Protection Regulation states that "a certificate from the clerk or secretary-treasurer of the local municipality or regional county municipality concerned stating that the withdrawal complies with the applicable municipal by-laws" must be joined to any application for authorization for a water withdrawal.

Requests for certificates must therefore be submitted to the City of Shawinigan for some of the Electrochemical Plant Project's activities.

Copies of other authorization applications filed to the MELCC must, however, be submitted, for information purpose, to the municipality concerned as required under Section 23 of the EQA.

Finally, it will be necessary to obtain a global construction permit from the City of Shawinigan before the beginning of construction work.

## 20.2.3 WATER MANAGEMENT

As part of the provincial environmental authorization process depicted in Section 20.2.2c, a water management plan will be developed to be authorized by the MELCC regional branch. A detailed water balance will also be produced as part of that procedure. The water management plan will include the collection and treatment, if required, of all waters that will have been in contact with the Project activities (i.e. process waters and site run-off to be managed through a mix of existing and projected drainage ditches and underground culverts) prior to discharge in the receiving environment. It is however important to note that process water re-use will be maximized in order to reduce as much as possible water intake from and water discharge to the St-Maurice River.

Process wastewaters will be discharged through an existing pipeline (i.e. operational up to 2014 for the RFP's Laurentide pulp and paper mill, including ca.50,000-m<sup>3</sup> concrete-made water storage basins formerly used as biological treatment units) in the St-Maurice River once full compliance with all applicable water quality criteria will have been obtained.

Domestic wastewaters will be managed through the municipal wastewater collection system and drinking water will be provided by the City of Shawinigan. It is important to note that connections to both municipal networks are already in place and operational as part of the fully-permitted Phase 1 Plant Project.

#### 20.2.3.1 *Risks Associated with Climate Change*

In Quebec's boreal region, scientific literature shows that the most significant impact of climate change will be associated with increased precipitation. Even though this phenomenon will be coupled to increased average temperature, thus increasing evaporation and limiting theoretically the impact of increased rainfall, it is actually the increased occurrence of extreme events (high rainfall, rapid snowmelt, etc.) that will have the most significant impact on the Project in the next decades based on modelling studies performed, among others, by the Ouranos Consortium for the Quebec region.

To that regard, all the surface water collection ditches will be designed to account for extreme events (1:100-year rainfall event). This will also include protection of the site main sub-station infrastructure from flooding event of up to 1:500-year recurrence occurring in the adjacent St-Maurice River. To that regard, it should be noted that the site is located immediately downstream of Hydro-Québec's Grand-Mère facility which includes a dam that helps reducing the impact downstream of extreme flooding event by controlling water discharge.

With regards to the impact of the Project on climate, its design accounts for multiple factors to minimize its global carbon footprint including, among others:

- Developing and implementing a patented process for the production of lithium salts that is based on electrochemistry instead of conventional chemistry, thus minimizing GHG emissions in the operation phase by up to 78% when compare to the conventional process used elsewhere in the world;
- Developing and implementing a patented process that enables the recirculation of sulfuric acid and thus limits its consumption by up to 75% when compare to the conventional process used elsewhere in the world;
- Maximizing, when possible, the valorization of all by-products instead of opting for ultimate disposal. A good example of this approach is the valorization of the aluminum silicate by-product as cement additive in the concrete industry, something which will not only reduce GHG emissions associated with the Project, but also with the production of concrete in North America and potentially abroad;
- Maximizing, when possible, the use of train transportation for all goods shipped in and out of the Electrochemical Plant and so reducing road transportation and associated GHG emissions;
- Minimizing on-site travelling distances for its heavy machinery;
- Performing preventive maintenance and ensuring that all machinery and equipment on site are in good operational conditions and thus avoiding waste of fuel, oils, etc.;
- Optimizing processing operations to minimize the consumptions of reagents;
- Avoiding any impacts on wetlands which acts regionally as carbon sinks;
- Maximize, when possible, local and regional employment and procurement to minimize associated transportation over long road distances.

## 20.2.4 RELATIONS WITH STAKEHOLDERS

Information pertaining to local demographics, economic development, land use, cultural heritage, health and social services, and infrastructure has been collected in order to provide a snapshot of the community's needs and priorities and to determine how current conditions may be affected by the proposed Electrochemical Plant Project.

Results are based largely on data obtained from local social service providers, educational institutions, law enforcement, regional entities and Census Canada.

Efforts were made to create and maintain a collaborative and cordial relation with the community to address issues as they emerge throughout the course of consultations and Project development. To that regard, Nemaska Lithium and the City of Shawinigan have been continuously collaborating on multiple local and regional initiatives aiming globally at diversifying the local and regional economy and promoting the region as a hub for innovation and project development related to clean technologies, the Lithium-ion battery supply chain and the electrification of transportation.

### 20.2.4.1 *Historical Background and Social Changes*

The City of Shawinigan is located in the Mauricie region of Quebec, about 140 km west of Quebec City, 170 km east of Montreal and 530 km southwest of Chibougamau. In 2011, the population was of 50,060 people. The City has a long history of industrial development, mostly associated with the forest, aluminum and chemicals industries. However, it was born of the desire to exploit the hydroelectric potential of the Shawinigan falls.

In 1899, after an extension of the Great North Railway line, Shawinigan Water & Power (“SWP”) built a dam and organized the development of the settlement, which then grew rapidly. Several industries, attracted by the available electricity, moved there: in the late 1880s, the Laurentide Pulp Co. established the first industry in the region in *Grand-Mère*; in 1900, Belgo-Canadian Pulp (since 1967, Consolidated-Bathurst); in 1901, Pittsburgh Reduction (Alcan); in 1903, the Carbure Company of Shawinigan (Shawinigan Chemicals); in 1907, Prest-O-Lite; in 1909, Shawinigan Cotton; and in 1931, Canadian Industries Ltd.

After the Great Depression of the 1930s, the economy began picking up again in 1940. In 1963, Hydro-Québec took over the SWP installations. However, since the 1960s there has been a marked decline in the city's economy: the old industries have reduced or ceased activity and a net decline in employment is observed.

Following the closure of Alcan's aluminum plant in 2013 and of the Belgo pulp and paper mill in 2008, which followed the closure in 2001 of the Norton Advanced Ceramics Canada's plant, the announcement in October 2014 of the closure of the Laurentide pulp and paper mill hit again the industrial heart of Shawinigan.

The acquisition by Nemaska Lithium of part of the land and part of existing manufacturing facilities (RFP's former Laurentide plant) therefore represents a significant positive impact on the local and regional economy.

#### 20.2.4.2 *Socio-Economic Context*

Shawinigan is located along the St-Maurice River, in the southern part of the Mauricie region, about 30 km north of its mouth in the St-Lawrence River, where the City of *Trois-Rivières* is located. It is one of the 42 municipalities in the Mauricie region. Including the sections located in the Mauricie National Park, the area covered by the City of Shawinigan is 781 km<sup>2</sup>, or less than 2% of the Mauricie region.

Since 2002, the City of Shawinigan also includes the former municipalities of Lac-à-la-Tortue, St-Georges, St-Gérard-des-Laurentides and St-Jean-des-Piles as well as the cities of *Grand-Mère*, Shawinigan and Shawinigan-Sud. The former Laurentide pulp and paper mill is located in *Grand-Mère*, along the St-Maurice River.

The difficult economic and employment conditions prevailing over the last decades in the region led to a declining and aging population. Indeed, since 2001, the City has experienced several declines, with its population decreasing by more than 3,500 people over the last 15 years and those declines affecting more significantly the youth.

Census data from 2015 estimates population in Shawinigan to be in the range of 49,200 individuals. Demographic outlook for 2016-2036 indicates that population decline should continue over the next 25 years to about 47,500 people. However, even considering such recent decline, Shawinigan was in 2015 the second most populous territory in the Mauricie region and considered to be 20<sup>th</sup> in the Province of Quebec.

The population of Shawinigan is, as it is also the case in the Mauricie region, significantly older than in the rest of Quebec. In 2011, the median age in Shawinigan was 50.8 years, 47.5 years in Mauricie and 41.5 in the Province of Quebec. Population aging is increased by the departure of young families and the return of retired “boomers” in the region.

#### 20.2.4.3 *Economy, Employment, and Education*

From an economic standpoint, the last decade was quite difficult with the successive closures of the Abitibi-Bowater's Belgo plant in 2008 (560 jobs), the Rio Tinto Alcan plant in 2013 (425 jobs) and the RFP's Laurentide plant in 2014 (275 jobs). The various regional attempts to compensate those job losses were successful, but led to no growth. Therefore, total employment is today at the same level than a decade ago and short-term outlook is not more positive.

Employment market characteristics are also challenging in Mauricie and Shawinigan. Indeed, employment rate in the Mauricie region have declined over the last decade and the gap with the rest of Quebec is widening. In Shawinigan, employment rate has declined by 0.7% annually over the last ten years, while it increased in cities of similar size elsewhere in Quebec. Also, that decline was more

important for those workers being 35 to 54 years old. It should however be noted that the recent economic context in the Province of Quebec, including the Mauricie region, has significantly changed since this data was collected and thus it would not be surprising to notice an increase in local and regional employment rate from 2017 to today.

The Shawinigan workforce is also older than elsewhere in Quebec, with 55% being more than 45 years old. The workforce replacement rate, i.e. the ratio between those that are 15-24 years old and those that are 55-64 years old, is low (0.48) compare to the rest of Quebec, another sign of an aging population.

In 2011, 14.4% of the Shawinigan population obtained a university diploma or certificate, compare to 20.3% in the Mauricie region and 28.0% in the Province of Quebec. On the other hand, a significantly higher proportion of the population completed apprenticeship or trades certificate or diploma (27.7%), compare to 21.2% in the Mauricie region and 17.6% in Quebec.

#### 20.2.4.4 *Governmental Authorities*

Nemaska Lithium has taken part in meetings with the regional branch of MELCC as well as with the City of Shawinigan's Department of Land Planning and Environment to discuss mutual interests and to ensure that all involved parties could be satisfied. All parties are working towards common objectives, including the development of the Electrochemical Plant Project, and have been fully cooperating with Nemaska Lithium.



## 21 CAPITAL AND OPERATING COSTS

### 21.1 Capital Costs Summary – Whabouchi, Chibougamau, and Matagami

The Whabouchi Project scope covered in this estimate is based on the remaining construction work of a green field facility as of June 1, 2019, having a nominal processing capacity of 215,000 tonnes per year of spodumene concentrate. The capital cost estimates related to the mine, concentrator, and site infrastructure have been developed by DRA/Met-Chem while estimates related to the tailings co-deposition and the water management were provided by SNC. The costs associated with the open pit mining were provided by BBA Inc while the costs associated with the underground mining operation were provided by DRA/Met-Chem. Costs related to work at Chibougamau and Matagami were provided by Nemaska.

The estimated indirect costs were provided by Nemaska based on their experience during the past two years of construction. DRA/Met-Chem reviewed the indirect costs with Nemaska and are in agreement with the projections. The Owner's costs were provided by Nemaska. A working capital equal to three (3) months operating costs has been included as well.

The capital costs are reported in Canadian Dollars (“CAD”). Initial capital cost includes costs expended to date, pre-production capital cost, working capital and the initial required rehabilitation cost.

At the stage of advancement of the Project, the expended costs amount to \$222.6 M at the end of May 2019, including \$9.2 M for the payment of the rehabilitation fund. The pre-production capital cost at completion is estimated at \$447.1 M including a contingency of \$18.3 M. Table 21.1 presents a summary of the total estimated Capex for the Whabouchi Project.

**Table 21.1 – Summary of the Capex for Whabouchi (\$000's CAD)**

Description	Expended to Date	Estimate to Complete	Estimate at Completion
Direct Costs			
Chibougamau	334	0	334
Matagami	0	1,845	1,845
Whabouchi	125,333	136,824	262,157
Indirect Costs (incl. Owner's Cost)	87,742	39,695	127,437
Nemaska Corporate Costs	0	27,849	27,849
Contingencies	0	18,291	18,291
Rehabilitation Payment	9,206	0.	9,206
<b>Total Whabouchi Site Capex</b>	<b>222,615</b>	<b>224,504</b>	<b>447,119</b>

The totals may not add up due to rounding errors.

### 21.1.1 DETAILED CAPITAL COST ESTIMATE, ASSUMPTIONS AND EXCLUSIONS

The estimate performed for this Technical Report is based on a review of the current status of the Project, taking into consideration the work completed at site, the purchase orders and contracts of the suppliers and contractors and an evaluation of the work to be completed to obtain a fully functional project.

The Capex was developed on the basis that the Project construction activities would be shut down and then restarted at a later date with a seven to eight (7-8) month construction period remaining to complete the work. There is no allowance in the Capex to cover the demobilization and re-mobilization of the construction activities when the Project re-starts

The cost of preparation of the tailings and waste rock co-disposal and water management systems were provided by SNC. The Capex work includes the start of the co-disposal system, and construction of Basins 5, 11, 11 North, and 10. The construction of Basins 1 and 12 and the Effluent Treatment Plant are only required in later years and these costs are incorporated in the sustaining capital.

BBA Inc was selected by Nemaska to review and prepare the mine plan, capital costs and operating costs associated with the open-pit mine for the first 27 years. DRA/Met-Chem prepared the mine plans, capital costs and operating costs for the underground mine from Years 27 to 32.

The crushing system, with the exception of the ore sorting building, was designed by Metso Minerals Canada who also supplied much of the equipment for the crushing area. The air supported conveyors were supplied by Hudco as well as other equipment suppliers. The crushing system is further defined in this Section.

The design and supply of the electrical and instrumentation equipment and materials was under contract with ABB Inc. Along with many suppliers and contractors, the design work was reassigned; however, ABB will likely supply the remaining electrical equipment. The electrical and instrumentation systems are further defined in this Section 21.

A provision for contingency of 11% was evaluated to cover the remaining work to be completed. The work generally covered labour-intensive installation and site work. The majority of the equipment has been purchased and delivered to site. A discussion of the accuracy of the Capex is provided in this Section 21.

#### 21.1.1.1 Detailed Capex

The initial Capex for the base case scope of work at Whabouchi and Chibougamau is \$447.2M, of which \$222.6 M is reported as expended costs to date and \$224.5 M is the balance to be spent during the pre-production phase, including accrued costs and accounts payable related to completed work.

The total provision for closure and rehabilitation is \$9.2 M, of which \$6.9 M was paid previous to May 31, 2019 and the balance paid in June 2019. It was also included in the actual costs to date (May 31, 2019).

The Capex for each main Project area is summarized in Table 21.2.

**Table 21.2–Detailed Whabouchi Capex for Major Area (\$ 000's CAD)**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
Direct Costs				
C00000	Chibougama	334	0	334
M0000	Matagami	0	1,845	1,845
W10000	Mine Development	2,956	25,562	28,518
W20000	Crushing General Area	18,626	18,828	37,454
W30000	Concentrator General Area	40,098	49,702	89,800
W40000	Infrastructure General Area	63,652	31,396	95,048
W50000	Dryer and Loadout System	0	11,336	11,336
	<b>Sub-Total Direct Cost</b>	<b>125,666</b>	<b>138,669</b>	<b>264,335</b>
W90000	Indirect Costs	87,742	39,695	127,437
	Nemaska Corporate Costs	0	27,849	27,849
	Closure / Rehabilitation Costs	9,206	0	9,206
	<b>Sub-Total Indirect Costs</b>	<b>96,948</b>	<b>67,544</b>	<b>164,492</b>
	Contingency	0	18,291	18,291
	<b>Total Capex Whabouchi Mine Site</b>	<b>222,614</b>	<b>224,504</b>	<b>447,118</b>

The totals may not add up due to rounding errors.

#### 21.1.1.2 Detailed Sustaining Capex

A provision for sustaining capital of \$296.1 M has been included in the financial evaluation. Sustaining capital costs are detailed in Section 21.1.16.

#### 21.1.1.3 Major Assumptions

The Capex is based on the Project obtaining all relevant permits in a timely manner to meet the Project schedule.

The remaining power requirements will be provided from the main substation.

For earthworks at Whabouchi, the following was assumed:

- All backfill materials will be available from gravel pits, esker or other sources located within a radius of five (5) km;

- Mine waste rock is suitable for use in road construction (as established following preliminary assessment);
- Mass earthworks (other than water management basin construction) and haulage road construction is performed by the Owner's crews;
- Soil conditions will not require special foundation designs such as pilings;
- All excavated material will be disposed of within the site battery limits.

#### 21.1.1.4 *Major Exclusions*

The following items were not included in this capital cost estimate, but have been considered in the economic analysis:

- Provision for inflation, escalation, currency fluctuations and interests incurred during construction;
- Project financing costs;
- All duties and taxes.

### 21.1.2 BASIS OF ESTIMATE FOR DIRECT CAPITAL COST

#### 21.1.2.1 *Currencies*

All expenditures to date are in Canadian dollars (CAD). The exchange rates used for all outstanding work when quotations were received in foreign currencies are 1.30 CAD / 1.00 USD and 1.46 CAD / 1.00 EUR.

#### 21.1.2.2 *Scope of Work*

The basis of estimate for the DRA/Met-Chem's scope of work is described in this Section 21.1.2 while the basis of estimate for the SNC's scope of work is described in Section 21.1.7.

#### 21.1.2.3 *Construction Labour, Productivity Loss Factor*

For work in progress, DRA/Met-Chem used the actual construction manpower hourly rates and manhours quoted in the construction contracts. On the Project, two (2) major equipment contractors, one (1) structural steel contractor and a number of civil contractors were used.

For construction work to be completed and/or future work, the labour rates were developed for typical labour crews based on the construction contract as well as applicable labour convention. The all-inclusive hourly rates include the basic hourly rates for the tradesman, social benefits and employer's burden, industrial site premium as required, direct supervision, small tools and consumables, and contractor's overhead and profit.

The productivity loss factors were established in consideration of the climatic conditions and site conditions, the remoteness of work site and availability of skilled labour, the working calendar and

the work rotation, and also the probability of accelerated schedule, overcrowding of space and scattered items of work.

At Whabouchi, the working calendar was defined as one (1) shift per day, ten (10) hours per shift and seven (7) days per week for a total of 70 hours per week, and a rotation of three (3) weeks on and one (1) week out.

Consequently, for the work at Whabouchi, the average hourly rate is established at \$138 and productivity loss factors at 1.33 for the balance of the work to complete the Project.

#### 21.1.2.4 *Construction and Contractor's Costs*

The estimate reflects an EPCM type construction mode and is based on the assumption that construction contracts will be attributed on the base of a competitive bidding process amongst qualified contractors. Availability of local qualified contractors and skilled workers is expected. It is also expected that an average level of site management, contract administration, quality control and adequate safety requirements will be required from the contractors by the construction management. A realistic schedule, proper logistics and appropriate construction management are also expected as well as good site conditions, limited number of contractors on site, limited work outside in winter, limited work required in overtime and also limited work disruption due to changes, interferences or delays.

The costs for transportation to and from site, room and board and cafeteria is provided by Nemaska at no cost to the contractors and their workers. Special installation tools, cranes, and scaffolding are also included as well as workplace weather protection.

#### 21.1.2.5 *Freight, Duties and Taxes*

Freight costs were excluded from the equipment costs and were provided by Nemaska by way of a freight forwarding company. These costs are included in the indirect costs. All duties and taxes were excluded from the capital cost estimate.

#### 21.1.3 MINING (W10000)

The mining area covers the activities and facilities necessary to maintain the mining operation. The cost for the mine pre-production activities are covered elsewhere in the owner's costs and treated in the economic analysis. The descriptions and costs for the purchase of mine equipment and services purchased after the start of production as well as the development of the underground mine activities are included in the sustaining capital section. A permanent explosives plant will be required and is also included in the sustaining capital section.

This section covers the major mine support facilities such as the mine garage, warehouse, mine wash bay, bulk fuel storage, waste rock and tailings facility and low-grade stockpile.

Table 21.3 depicts the direct costs associated with the mine development.

**Table 21.3—Detailed Initial Capex – Mine Development (\$000's CAD)**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W11001	Mine Garage Building	2,843	2,036	4,879
W11002	Mine Dry and Office	0	0	0
W11003	Mobile Fleet	0	3,962	3,962
W11004	Fuel Oil Tank Farm	6	628	634
W11005	Explosives Magazine	100	0	100
W11006	Mine Development	0	11,559	11,559
W11007	Warehouse	0	3,182	3,182
W11010	Co-Disposal Storage Facilities	7	854	861
W11011	Mine Wash Bay	0	2,601	2,601
W11012	Low-Grade Stockpile	0	740	740
	<b>Total Capex Mine</b>	<b>2,956</b>	<b>25,562</b>	<b>28,518</b>

The totals may not add up due to rounding errors.

#### 21.1.3.1 Mine Garage Building

The mine garage building has been constructed and is currently used as a storage for equipment and materials awaiting installation. The balance of the work involves adding a concrete floor, offices on the mezzanine level, shop equipment and a new lift for small equipment.

#### 21.1.3.2 Mine Dry and Office

This facility will be incorporated in the permanent camp and therefore, no estimated costs are assigned to this facility. The additional cost to cover this facility has been included with the Camp facilities.

#### 21.1.3.3 Mobile Fleet

The mobile fleet comprises the support mine equipment necessary for mine operations. This fleet includes graders, excavators, service trucks, sand trucks, boom trucks, lighting plants and dewatering equipment.

The mining equipment cost relates to the purchase of the equipment as well as some additional items such as infrastructure related to the explosives storage, the purchase of mine design software, and certain important equipment spare parts such as shovel buckets and truck boxes. The equipment fleet that is currently at site as well as the additional machines that will be purchased in 2019 and 2020 are based on firm pricing and have been considered as initial capital cost.



The additional units which account for the growing fleet as well as replacement units which will be purchased when machines reach their operational lives are based on budgetary pricing and are included in the sustaining capital costs for the mine.

The initial fleet of Komatsu equipment, which includes three (3) haul trucks, two (2) hydraulic shovels, two (2) track dozers, two (2) large wheel loaders, one (1) utility loader, one (1) utility excavator, and one (1) small loader, will be leased over a five (5) year term. The leasing payments are treated as an operating expense other than the payments which are incurred prior to plant start up, which are included in the Mine Development Costs described above. The initial Capex for the mining equipment totals \$4.0 M.

#### 21.1.3.4 *Fuel Oil Tank Farm*

A new fuel oil tank farm will be constructed consisting of four (4) 50,000 litre diesel fuel tanks and one (1) 20,000 litre regular fuel tank. Based on DRA/Met-Chem's experience, material take-offs were prepared and pricing for equipment and materials were estimated based on DRA/Met-Chem's cost database.

#### 21.1.3.5 *Explosives Magazine*

The foundations for the explosive magazine building have been completed. The explosives will be delivered to the site during the early phases of the project with a permanent plant constructed and included in the sustaining capital. A new road to be constructed to this area will be provided by the mining group and is considered in the pre-production development costs.

#### 21.1.3.6 *Mine Development*

The open pit mine development costs account for the activities that will be carried out during pre-production to prepare the mine for operations. These activities include clearing and grubbing, topsoil removal, overburden stripping and the preparation of several ore faces. In order to estimate the mine development cost, BBA determined the cost to operate the mining fleet during the pre-production phase.

The total mine development Capex (which include the equipment lease payments as discussed in Section 21.1.3.3) is \$11.6 M. This amount also includes a one time royalty payment of 1.0% of the "net value" of the concentrate produced at the mill for \$1.0 M..

#### 21.1.3.7 *Warehouse*

A new warehouse facility is required to store sensitive materials away from the elements. The estimate for this facility was based on a firm quote from a contractor. Tools and racking were estimated on the basis of DRA/Met-Chem's historical costs of such items used in other projects.

#### 21.1.3.8 Co-Disposal Storage Facilities

The co-disposal storage facility is designed by SNC and is described in Section 18. The Capex was based on the design quantities prepared by SNC and priced using the current pricing from contractors currently working on the Whabouchi site. Only work required during the pre-production development phase has been included in the Capex. All future work is either included in the sustaining capital or in the operations costs section.

#### 21.1.3.9 Wash Bay Facility

A wash bay is required to clean the equipment prior to repairs to the equipment. The estimate is based on a permanent stand alone building adjacent to the mine garage building. The estimate was further based on designs of wash bays previously developed by DRA/Met-Chem. Material take-offs were prepared based on this previous work and the prices were adjusted to suit the current timeframe and location.

#### 21.1.3.10 Low Grade Stockpile

Prior to operations start, a stockpile is required to store low grade ore which would be excavated during the pre-production period and saved for future incorporation with higher grade material. The Capex required covers only clearing and stripping of the land and preparation of a suitable base for the material.

### 21.1.4 CRUSHING AND ORE SORTING GENERAL AREA (W20000)

The crushing and ore-sorting general area is comprised of the primary crusher, the ore sorter facility, the secondary and tertiary crushing facility and the inter-connecting conveyors and screening towers.

Table 21.4 depicts the direct costs associated with the crushing system.

**Table 21.4 – Detailed Initial Capex – Crushing and Ore Sorting (\$000's CAD),**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W20101	Primary Crushing	3,816	1,515	5,331
W20102	Coarse Ore Crushing	4,092	2,458	6,550
W20103	Ore Sorting Facility	5,836	3,445	9,281
W20104	Secondary Crushing	3,569	3,646	7,215
W20105	Tertiary Crushing	1,138	2,497	3,635
W20106	Crushing Electrical Room and Distribution	175	5,267	5,442
	<b>Total Capex Crushing</b>	<b>18,626</b>	<b>18,828</b>	<b>37,454</b>

The totals may not add up due to rounding errors.

#### 21.1.4.1 *Current Status*

At the end of May 2019, most of the foundations for the buildings and conveyors have been completed. The structure for the primary crusher and the ore sorting building are essentially completed. The structure for the secondary and tertiary crusher building has yet to be erected.

Most of the equipment has been delivered to site and some equipment has been installed. However, none of the conveyors have been erected and some of the transfer stations have been partially erected.

The Crushing and Ore Sorting Electrical Room is in place and is powered from the main substation via a buried cable.

#### 21.1.4.2 *Process Equipment*

The estimate is based on the mechanical equipment list prepared and priced by Metso. The owner furnished equipment for this area has been estimated based on the formal purchase orders and bid packages for equipment not purchased to date. All other equipment pricing is based on DRA/Met-Chem's extensive database of current equipment costs.

Installation manhours have been estimated based on the current construction contract pricing for costs to date, and on DRA/Met-Chem's database of manhours for selected mechanical equipment.

#### 21.1.4.3 *Buildings and Structures*

The estimate is based on actual work to date and balance to be completed by the various contractors. Where work has not been started and not covered by existing contracts, material take-offs were performed and estimated using the unit pricing of existing contracts. The conveyor support bents are provided as part of the conveyor packages. The building structure costs for the secondary and tertiary crusher has been included in the secondary crushing estimates.

#### 21.1.4.4 *Piping*

This crushing system is a dry process and water is not required for the process. Water is supplied to the facilities as fire protection water or potable water systems.

#### 21.1.4.5 *Dust Collection*

Dust collection systems are provided in the ore sorting building, the secondary and tertiary building and the screening towers. The dust collection units have been purchased and form the basis of the estimate. The dust collection ductwork has been estimated based on material take-offs from the 3D drawings.

#### 21.1.4.6 *HVAC*

Some HVAC work is required in the Ore Sorting building and the Cone Crusher building. The HVAC estimates are based on the mechanical equipment list and estimated quantities of ductwork.

#### 21.1.4.7 Electrical and Instrumentation

The design of the electrical and instrumentation systems was prepared by ABB Inc. DRA/Met-Chem has reviewed the work of ABB and has determined what is required to complete the work in this area.

The electrical room has been constructed and installed in place adjacent to the cone crusher building.

The balance of the electrical work comprises the supply and installation of cables and cable trays, lighting, welding plugs and some minor modifications to the existing crusher MCCs.

The instrumentation estimate comprises the supply and installation of cables, instruments (except those provided with each mechanical equipment), local control stations, etc., as well as intranet connections with the main control room located in the concentrator.

#### 21.1.5 CONCENTRATOR GENERAL AREA (W30000)

The concentrator area consists of the crushed concentrate ore and tailings storage, the concentrator, the process water tank, thickeners, and the offices, control room and mechanical/electrical room.

Generally, all costs included in the Concentrator Building – General include the site preparation, foundations, and structure for the concentrator and ore storage facility. The costs also include general costs such as all electrical, instrumentation and automation costs, HVAC and process ventilation, small bore piping systems, administration costs and control room equipment and services.

The concentrate crushing and drying system (W50000) is not included in the Concentrator General Area. Table 21.5 depicts the direct costs associated with the Concentrator facility.

**Table 21.5 – Detailed Initial Capex – Concentrator (\$000's CAD)**

Area	Description	Expenditures to Date	Estimate To Complete	Estimate at Completion
W30100	Concentrator Building – General	21,739	24,814	46,553
W30200	Pre-Concentration & Dense Media Separation	5,246	8,122	13,368
W30300	Muscovite Removal, Grinding and Wet Magnetic Separation	2,870	2,639	5,509
W30400	Spodumene Flotation	1,787	1,472	3,259
W30500	DMS Concentrate Drying and Dry Magnetic Separation	2,399	2,966	5,365
W30600	Concentrate Dewatering	2,097	1,581	3,678
W30700	Tailings Handling	2,990	2,896	5,886
W30800	Reagents and Utilities	970	5,212	6,182
	<b>Total Capex Concentrator</b>	<b>40,098</b>	<b>49,702</b>	<b>89,800</b>

The totals may not add up due to rounding errors.

#### 21.1.5.1 *Current Situation*

The building dome housing the equipment for the crushed ore storage and tailings disposal, has been installed but no equipment nor services have been installed. The two (2) conveyors between this dome and the main concentrator have not been installed.

The concentrator building shell is complete with two (2) operating electrical overhead travelling (EOT) cranes in place. Much of the interior steel and associated foundation work has been completed. Some of the process equipment has been installed or partially installed, including platforms, stairs and ladders.

The three (3) electrical room modules (99201, 99202, and 99203) are installed adjacent to the concentrator.

The administration offices and concentrator control rooms have been constructed awaiting architectural finishes, equipment and office equipment.

#### 21.1.5.2 *Process Equipment*

The estimate is based on the mechanical equipment list prepared by DRA/Met-Chem. The majority of the owner furnished equipment for this area has been purchased and therefore, the equipment pricing is based on actual costs, converted to Canadian dollars. All other equipment pricing is based on DRA/Met-Chem's extensive database of current equipment costs.

Installation manhours have been estimated based on the current construction contract pricing for costs to date, and on DRA/Met-Chem's database of manhours for selected mechanical equipment.

#### 21.1.5.3 *Buildings and Structures*

The balance of the work in the concentrator centers on the interior steel and foundations and the installation of the steel and building shell for the process water tank and the thickener. The exterior staircase at the end of the concentrator has yet to be installed. The steel for these areas has been ordered and is in fabrication. The estimated cost for this work is based on the actual quotations. Where work has not been started and not covered by existing contracts, material take-offs were developed and estimated using the unit pricing of existing contracts.

Architectural work for the central control room, offices and block walls for the generators on the ground floor is based on a bid package ready for purchasing. Man-doors and double doors, not covered by this package, have been estimated based on DRA/Met-Chem's extensive cost database.

#### 21.1.5.4 *Piping*

The piping work is divided into two (2) sections – 75 mm diameter pipe and above, and below 75 mm. The piping costs for pipe and accessories above 75 mm was developed based on material take-offs from the 3D model.

The piping costs for pipe and accessories below 75 mm is based on an allowance of the delivered cost of the equipment. Piping sized under 75 mm is considered to be field run fabricated.

#### 21.1.5.5 *Dust Collection*

Dust collection units have been purchased and form the basis of the estimate. The dust collection ductwork has been estimated based on material take-offs from the 3D drawings.

#### 21.1.5.6 *HVAC*

The HVAC systems are centered in the offices and control rooms. The HVAC equipment is identified in the mechanical equipment list and is priced on that basis. The ductwork has been estimated based on DRA/Met-Chem's cost database.

#### 21.1.5.7 *Electrical and Instrumentation*

The design of the electrical and instrumentation systems was prepared by ABB Inc. DRA/Met-Chem has reviewed the work of ABB and has determined what is required to be done to complete the work in this area.

The electrical room modules have been constructed and installed in place adjacent to the concentrator. The cost of these electrical room modules is not included in the concentrator area, but in a general account under the main substation.

The balance of the electrical work comprises the supply and installation of cables and cable trays (except for cable tray already installed) lighting, welding plugs minor electrical equipment located throughout the concentrator.

The instrumentation estimate comprises the supply and installation of cables, instruments (except those provided with each mechanical equipment), local control stations, etc. as well as intranet connections with the main control room located in the concentrator. The instrument list was prepared based on the P&ID drawings and equipment not provided by the supplier was priced based on DRA/Met-Chem's cost database.

#### 21.1.6 INFRASTRUCTURE GENERAL AREA (W40000)

This area covers the necessary infrastructure and services to support the mining and process operation. Support facilities such as laboratories, administration buildings, temporary facilities and camp construction have been included under this area. The water management and tailings co-disposal system are also included in the infrastructure section as well as the main sub-station and incoming power line.

For the purposes of this Technical Report, the Infrastructure General Area is further refined to include propane systems, support facilities, water management, temporary facilities, and power supply.



Table 21.6 summarizes the major components of the Infrastructure area.

**Table 21.6–Detailed Initial Capex – Infrastructure General Area (\$000's CAD)**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W40300	Propane Systems	0.0	735	735
W40900	Support Facilities	18,303	10,706	29,009
W40940	Water Management	5,461	8,051	13,512
W40950	Temporary Facilities	13,318	4,749	18,067
W40990	Power Systems	26,570	7,155.	33,725
	<b>Total Capex Support Facilities</b>	<b>63,652</b>	<b>31,396</b>	<b>95,048</b>

The totals may not add up due to rounding errors.

#### 21.1.6.1 Current Situation

Only the propane tanks for the camp facilities have been constructed. The propane systems for the Ore Sorting building, Concentrator building, and Garage have not yet been designed.

The administration complex is constructed and is being used by Nemaska field support personnel. The foundations for the laboratory facility are in place. The gate house is completed. The project site preparation and road work are basically complete.

Some of the water management facilities have been constructed such as Basin 10 and Basin 11 North, and partially constructed such as Basin 11. Eight (8) km of HDPE piping has been purchased and delivered to site for the water management system.

The temporary facilities comprise the camp facilities and associated facilities. The camp has been constructed complete with all services.

The three (3) electrical room modules for the concentrator are installed adjacent to the concentrator. The incoming 69 kV line and the main substation are complete and in operation supplying power to the various facilities.

In general, much of the work under this section has been completed. The outstanding work is covered under each item in this subsection 21.1.6.

Table 21.7 summarizes the major components of the Infrastructure support facilities.

**Table 21.7–Detailed Capex – Infrastructure – Support Facilities (\$000's CAD)**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W40901	Administrative Building	624	0	624
W40902	Laboratory	1,840	2,159	3,999
W40903	Guard House	7	0	7
W40911	Site Preparation, Access Road	13,638	107	13,745
W40912	Mine Haul Road Overpass	0	3,829	3,829
W40913	Weather / Environment Monitoring Station	00	128	128
W40914	Fire Protection and Water Wells	2,158	395	2,553
W40915	Sanitary Waste	0	300	300
W40916	Mobile Service Equipment	0	1,165	1,165
W40917	Route de Nord Repairs	0	2,000	2,000
W40930	Truck Scale	36	623	659
	<b>Total Capex Support Facilities</b>	<b>18,303</b>	<b>10,706</b>	<b>29,009</b>

The totals may not add up due to rounding errors.

#### 21.1.6.2 Administration Building

This facility is considered complete with very little upgrade required to meet the Project's requirement.

#### 21.1.6.3 Laboratories

The laboratories comprise five (5) pre-fabricated facilities which will be delivered fully furnished and ready for operation. Two (2) laboratory units are in place and three units are fabricated. The remaining work for this section covers the purchase of laboratory equipment and supply of power from the sub-station.

#### 21.1.6.4 Gate House

This facility is considered complete with very little upgrade required to meet the Project's requirement.

#### 21.1.6.5 Site Preparation

The remaining site preparation activities comprise the backfilling and leveling of the property following completion of the construction work.

#### 21.1.6.6 Access Road and Parking Areas

The main access to the site from the Route du Nord is complete. All internal roads have been completed and any additional road construction will be provided by the mining operations and all costs are included within the pre-production development costs for the mining operation.

An overpass will be constructed for the mine trucks to cross the Route du Nord to the waste rock and co-disposal stockpile. All development costs for ramp access on both sides of the overpass will be provided by the mining operations and all costs are included with the pre-production development costs.

#### 21.1.6.7 Fire Protection / Potable Water Supply

The fire tank, located near the concentrator, has been supplied and installed and is being used for water distribution to the site. Two (2) wells have been constructed adjacent to the fire tank which feeds fresh water to the fire tank. Two (2) water pumps, housed in a prefabricated insulated container, are in place and currently used.

The fire pumps will be housed in a prefabricated insulated container and is currently in production. The container will sit on a foundation which is in place. An estimate has been provided to cover the installation of the container and adjust the piping to suit the design,

A fire water distribution network, complete with fire hydrants, has been installed around the concentrator and the crushing operation. Further work is required to supply fire water to other individual facilities.

#### 21.1.6.8 Mobile Service Equipment

The mobile equipment comprises pick-ups, bobcats, forklifts and other warehouse equipment, a rescue truck and lighting towers.

#### 21.1.6.9 Route du Nord Repairs

An allowance is provided to improve the culverts and roadbeds on the existing *Route du Nord* towards Matagami.

#### 21.1.6.10 Truck Scale

The truck scale was originally located in the fine ore storage facility but will be relocated adjacent to the gate house. The truck scale has been purchased and delivered to site. The foundations for the truck scale have yet to be constructed. The expended costs for the truck scale refer to the existing foundations for the truck scale which had already been excavated and concrete poured.

### 21.1.7 WASTE ROCK AND TAILINGS DISPOSAL AND WATER MANAGEMENT

The estimate for the waste rock and tailings disposal and water management was developed by SNC as described in this section. The tailings will be filtered and disposed with the waste rock in a co-disposal storage facility.

As mentioned in Sections 18.1.2 and 20.1.4, co-disposal storage facility Phases 2B and 3 are at a preliminary stage and will have to be refined to confirm water management infrastructure, i.e. in a timely manner to secure the required environmental authorizations prior to its use, as outlined in Section 20.1.2.

All quantities included in the direct cost estimate exclude contingency of any kind.

#### 21.1.7.1 *Hourly Rate Development*

The construction estimate is based on one (1) shift per day, ten (10) hours per shift and seven (7) days per week for a total of 70 hours per week, and a rotation of three (3) weeks on and one (1) week off. Construction hours are based on SNC's experience and historical data and were adjusted for the complexity of specific elements and the Project specific area requirements.

It is assumed that 100% of labour will come outside of the Nemaska region. Room and board and travelling allowances are provided by Nemaska and therefore not included in the construction estimate, but included in the Owner's Costs.

Hourly rates were determined for each discipline and were associated with each item costs based on a mixture of several trades including, but not limited to foremen, journeymen, apprentices, and labourers.

#### 21.1.7.2 *Quantity Development*

All quantities included in the direct cost estimate exclude contingency of any kind. The principal quantities received from engineering were reviewed and distributed over the course of the four (4) phases of the Project (direct capital cost and subsequent sustaining capital phases).

Civil/Earthworks quantities (cut and fill) were calculated from the 2017 LiDAR survey. Organic, overburden, and rock quantities were estimated from extrapolation and interpretation of existing test pits and geotechnical boreholes. Budget unit prices were derived from budget proposals from qualified contractors or recent similar projects.

Concrete, structural steel, architectural, mechanical, piping, electrical and instrumentation/automation quantities were estimated from process flow sheet, layout and engineering drawings. Budget unit prices were derived from budget proposals from qualified contractors or recent similar projects.

Some quantities or allowances were developed by the estimators to include uncertainties related to quantities those are however negligible.

#### 21.1.7.3 *Pricing*

Pricing for bulk material is based on contracts currently being performed at site. These unit rates were provided by Nemaska to SNC for inclusion in their estimates.

## 21.1.8 TEMPORARY FACILITIES

Some of the facilities originally coded to indirect costs were transferred to the direct costs section. These include the supply and installation of the camp and associated facilities as well as initial site preparation activities and construction of temporary roads. As depicted in Table 21.6, an allowance has been provided to rehabilitate the construction camp to make permanent facilities for the site personnel. The allowance also includes for a mine dry facility.

## 21.1.9 ELECTRICAL AND AUTOMATION

The electrical room modules have been constructed and installed in place adjacent to the concentrator. The costs of these modules are not included in the concentrator area, but in a general account under the main substation.

Table 21.8 summarizes the major components of the electrical and automation facilities.

**Table 21.8 – Detailed Initial Capex – Electrical and Automation (\$000's CAD)**

Area	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W40997	Main Power Line	12,282	3,200	15,482
W40998	Main Sub-Station	12,198	806	13,004
W40999	Power Distribution	2,090	3,149	5,239
	<b>Total Capex Electrical / Automation</b>	<b>26,570</b>	<b>7,155</b>	<b>33,725</b>

The totals may not add up due to rounding errors.

### 21.1.9.1 Main Power Line

The main power line from the existing Hydro-Québec line to the main sub-substation was completed by Hydro-Québec prior to 2019 and there are no outstanding issues with the line. However, an allowance has been provided to increase the power capacity from 10 MW to 13 MW.

### 21.1.9.2 Main Sub-Station

The main sub-station has also been constructed and ready for operations. Some modifications are required and these include the addition of a new neutral grounding resister and the purchase and installation of power factor correction equipment. It should be noted that the crusher and concentrator electrical room costs are included in this area.

### 21.1.9.3 Power Distribution

The power distribution section covers the distribution of power throughout the project areas. Much of the distribution has been completed but distribution is required to the water management pump stations, the warehouse, from the electrical room to the concentrator and to the new drying and crushing facility. The costs were developed based on the current contracts.

#### 21.1.10 CONCENTRATE DRYING AND CRUSHING (W50000)

The concentrate drying and crushing facility consists of a crushing area, a drying area, a concentrate silo including truck loadout area, all described in Section 17.

A preliminary design was developed by Hatch who provided pricing for the equipment and prepared material take-offs for the major structures. The overall estimate was prepared by DRA/Met-Chem based on actual pricing from the contracts currently on-going at the Project site.

#### 21.1.11 CONCENTRATE STORAGE AND HANDLING IN CHIBOUGAMAU (C00000)

The cost in this area is sunk cost related to engineering studies and assessments to construct a new concentrate trans-loading facility in Chibougamau. This Project has been suspended, with concentrate now being planned to ship via an existing railhead in Matagami. There is no going forward cost for this sector.

#### 21.1.12 MATAGAMI CONCENTRATE RAILHEAD (M00000)

This sector includes the cost associated with capital equipment and buildings related to transloading concentrate from truck to rail at the existing Matagami railhead.

#### 21.1.13 BASIS OF ESTIMATE FOR INDIRECT COSTS

The provisions for indirect costs were established by detailed estimation of the items based on requirements, unit rates, recent similar projects and also some Owner's data.

Escalation and interests were excluded from the capital cost. Working capital, taxes and duties were also excluded from the Project capital cost estimate but were considered in the financial analysis.

Estimates for indirect costs are detailed in Table 21.9 and is explained in the following text.

##### 21.1.13.1 EPCM (Owner and Consultants)

EPCM costs were established by Nemaska, DRA/Met-Chem and includes detailed engineering, procurement and construction management services, Nemaska project management personnel, site surveying, QA/QC services, engineering for commissioning and site assistance, and vendor assistance during commissioning and start-up.

The work performed for process testing and geotechnical and the various studies is also included under the EPCM costs.



**Table 21.9 – Details of Indirect and Pre-Ops Capex – Whabouchi Mine Site**

	Description	Expenditures to Date	Estimate to Complete	Estimate at Completion
W90100	EPCM (Owner and Consultants)	38,958	11,908	50,866
W90200	Construction Facilities and Services	12,345	5,441	17,786
W90300	Logistics, Taxes and Duties	3,635	2,294	5,929
W90400	Operating Expenses	309	8,958	9,267
W91000	Mining Operations	1,034	1,401	2,435
W91200	Ore Treatment	647	650	1,297
W91400	General Services	22,279	7,174	29,453
W91900	Services	8,535	1,869	10,404
	Nemaska Corporate Costs	0.0	27,849	27,849
	<b>Total Indirect and Pre-Ops Capex</b>	<b>87,742</b>	<b>67,544</b>	<b>155,286</b>

The totals may not add up due to rounding errors.

#### 21.1.13.2 Construction Facilities and Services

Construction facilities and services comprise temporary structures during the construction period, power supply prior to commissioning of the sub-station, sanitary facilities, construction equipment furnished by Nemaska, aggregate plant and the indirect costs for the batch plant. The direct costs for the batch plant have been distribute throughout the direct costs and applied to quantities of concrete.

#### 21.1.13.3 Logistics, Taxes and Insurance

Nemaska used the services of a freight forwarder to manage and control the equipment and materials delivered to the Project site. The services included receipt of the equipment at the FOB point, delivery to the site and warehousing services.

The taxes and duties are specifically excluded from the project.

The costs of Project insurance are included in this section. Comprehensive insurance was purchased by Nemaska to cover all aspects of the Project activities.

#### 21.1.13.4 Operating Expenses

The cost for first fills and capital spares comprises the elements of the operating expenses.

#### 21.1.13.5 Mining Operations

The cost of the mine operators and services prior to start-up is included in the mining operations section.

#### 21.1.13.6 Ore Treatment

The ore treatment area covers the costs of the pre-production operations group, operation readiness and start-up and includes operations personnel training.

#### 21.1.13.7 General Services

The general services area covers road maintenance in summer and snow removal in winter, maintenance and cleaning of the site offices, maintenance crews, the management and catering of the camp and the costs of transporting construction workers and Nemaska personnel to and from Montreal and Quebec City.

#### 21.1.13.8 Services

Services cover Nemaska corporate costs associated with the Project. These include Health and Safety at site, medical facilities, corporate office overheads and costs, site security services, legal expenses, and environmental and social responsibilities which include environmental studies and permits, and recycling of waste materials on site.

#### 21.1.13.9 Nemaska Corporate Costs

The Nemaska corporate costs comprise the personnel, excluding mining personnel, until production is achieved. The amount also includes the corresponding costs for room and board and transportation of the personnel during this time.

Other corporate costs such as human resources, procurement, and information technology activities are also included.

#### 21.1.14 CLOSURE AND REHABILITATION COSTS

Based on site layouts, a provision of \$9.2 M was estimated separately for the closure and rehabilitation of the Whabouchi mine site. Requirements were established and estimates of the cost was based on material take-off and unit rates from recent database.

The rehabilitation plan was submitted and approved by the “*Ministère de l'Énergie et des Ressources naturelles du Québec*”. In accordance with the most recent Québec legislation, \$4.6 M was paid in 2017 and \$2.3 M was paid in September 2018 as pre-production capital while the remaining \$2.3 M was paid in June 2019.

#### 21.1.15 CONTINGENCY

Based on the level of engineering definition for the Project as well as assessment of major uncertainties, a factor of 11% on direct and indirect cost was established to estimate the provision for contingency. For the Whabouchi mine site, the provision amounts to \$18.3 M.

It is nevertheless expected that sufficiently developed engineering, adequate project management and tight construction cost control will be implemented at Project re-start in order to meet the budget.

#### 21.1.16 SUSTAINING CAPITAL

A provision of \$296.0 M has been estimated to cover the sustaining capital over the life of the mine. The sustaining capital refers to the purchase of equipment or development of facilities which would otherwise be capitalized. It is not a subset of the operating costs. The sustaining capital costs include mine equipment purchased in future years, replacement of equipment, development of the underground mining operation and required equipment, equipment replacement for the concentrator areas as well as the provision for a new ore sorting facility, and additional water treatment areas. The sustaining Capex is depicted in Table 21.10.

##### 21.1.16.1 *Mine*

The sustaining Capex for the fleet of open pit mining equipment totals \$59.9 M. These costs include equipment purchases (\$35.9 M) as well as equipment rebuilds (\$24.0 M) which are carried out during specified intervals of the operational life of each piece of equipment. For example, for this Report, the haul trucks are each considered to have an operational life of 72,000 hours and will undergo rebuilds every 18,000 hours. The cost for each truck rebuild is approximately equal to 40% of the cost of a new machine.

##### 21.1.16.2 *Underground Mine*

The capital expenditure for the development of the underground mine, considered as sustaining capital, is \$50.4 M. It is sub-divided into the development and the production phases. The underground development phase will last two (2) years from 2046 to 2047 and is estimated at \$36 M.

The mining contractor's service to develop the underground mine. It includes the manpower and the equipment that is mobilized. The capital cost is derived from the contractor's unit cost (\$/ linear metre or \$/unit) to develop the underground mine infrastructure.

When the underground mine commences operations which is planned at 2046, the ramp to Levels 122 m, 152 m, and 182 m and partially the haulage drift for each one will be excavated during that year.

The mining contractor will downsize its personnel and equipment for the steady ore production rate required to feed the concentrator. The estimated capex for the remaining underground mine development work is \$14.3 M and planned to be disbursed over a period of five (5) years.

The capital cost estimation for the Owner's purchased equipment is \$12.4 M. This includes the larger and stationary equipment that cannot be mobilized and demobilized by the mining contractor.

##### 21.1.16.3 *Concentrator and Process Facilities*

The sustaining capital for the process facilities include for a new ore sorting building in Year 4

Sustaining capital includes closure and rehabilitation provision, open pit mining equipment replacement, underground mine development and also underground mining equipment procurement.

Sustaining capital also includes waste and tailings storage expansion, and water management facilities expansion.

Any provision for royalties has been included in the financial model and not covered in the sustaining capital. Sustaining capital costs as well as the expense period are detailed in Table 21.10.

**Table 21.10 –Detailed Sustaining Capital Cost Estimate**

Description	Period (Year)	Cost (\$ M)
Mine Site, Development and Equipment Renewal	1 to 26	73.9
Waste and Tailings Storage	1 to 5	34.7
Underground Mine Eq. and Infrastructure	26 to 27	12.4
Underground Mine Development	26 to 33	50.4
UG Stockpile Re-handling Tailings Ore Sorter Rejects DMS Loading	26	4.7
Mill Site	1 to 33	77.3
Mine Phases 2B and 3	12/18	38.0
Water Management Systems	2 / 4	4.6
Sub-Total		<b>296.0</b>
The totals may not add up due to rounding errors		

## 21.2 Capital Cost Summary – Shawinigan Electrochemical Plant Site

The Shawinigan Electrochemical plant site covered in this estimate is based on the acquisition and the refurbishment of a recently decommissioned industrial plant. The capital cost estimates related to the plant and associated infrastructure have been developed by Hatch for the civil, concrete, structural, architectural, mechanical, piping, electrical and instrumentation.

Hatch developed the indirect costs estimate and consolidated the costs information from other sources. For instance, the owner's costs were provided by Nemaska. The capital costs are reported in Canadian Dollars ("C\$").

Expenditures to date of \$117.3 M are reported as already expensed. Sustaining capital of \$123.3 M is included in the estimate for the Electrochemical plant.

A contingency of 16% is included in the estimate. The contingency was established using Quantitative Risk Assessment (QRA) and Schedule Risk Assessment (SRA). Table 21.11 presents a summary of the total estimated initial Capex for the Shawinigan Site.

**Table 21.11 – Summary of the Capex (\$M CAD)**

Description	Actuals to Date	Estimate to Complete	Estimate at Completion
<b>Shawinigan Site Initial Capital Cost</b>			
Total Direct Costs	68.2	450.1	518.3
Total Indirect Costs	49.1	127.5	176.6
Contingency	0.0	92.3	92.3
Nemaska Corporate Costs	0.0	28.3	28.3
Labour Cost Escalation	0.0	5.9	5.9
<b>Total Shawinigan Site Capex</b>	<b>117.3</b>	<b>704.1</b>	<b>821.4</b>
The totals may not add up due to rounding errors.			

## 21.2.1 DETAILED CAPITAL COST ESTIMATE, ASSUMPTIONS AND EXCLUSIONS

The current estimate is based on the status of the project for Shawinigan at the end of May 2019. At the time of the estimate, the engineering is approximately 45% completed. Procurement of major packages is completed, and secondary packages are advanced. Construction has started for demolition, piling and foundations in Buildings # 67 and # 80.

The Shawinigan estimate is based on Hatch's standard methods for a control estimate and was developed bottom up with detailed quantity take-off for all disciplines. Based on the maturity level of the engineering deliverables, the QRA accuracy level for the estimate is defined as -12% / +13%.

The effective date for the cost estimate is May 31, 2019. The expended costs to date were calculated using that date.

### 21.2.1.1 Detailed Initial Capital Cost

The initial capital cost for the base case scope of work Shawinigan is \$793.2 M, of which \$117 M is reported as sunk costs already expensed.

The Initial Capex is summarized in Table 21.12.

**Table 21.12 – Detailed Initial Capex (\$M CAD)**

Area	Description	Estimate at Completion
	<b>Expenditures to Date (Incurred as of May 31, 2019)</b>	
	Expenditures, Direct	68.2
	Expenditures, Indirect	49.1
	<b>Sub-Total Expenditures to Date</b>	<b>117.3</b>
	<b>Capital Costs Shawinigan Electrochemical Plant</b>	
	<b>Direct Costs</b>	
S00000	General (capital spares, room & board, night shifts)	19.0
S10000	Concentrate preparation	47.4
S20000	Sulphating & leaching	43.4
S30000	Purification	36.2
S40000	Electrolysis	63.2
S50000	Anolyte treatment	33.1
S60000	Catholyte treatment	35.1
S70000	Spent acid concentration	4.5
S80000	Plant facilities (site, utilities, reagent, buildings, elec. & process)	168.2
	<b>Sub-Total Direct Costs Electrochemical Plant</b>	<b>450.1</b>
	<b>Indirect Costs</b>	
	EPCM	62.0
	Pre-operational Verification	8.4
	Owner's Costs	11.1
	Other Indirect Costs	46.0
	Nemaska Corporate Costs	28.3
	Financial Expenses	0.0
	Closure / Rehabilitation Costs (Not Required)	0.0
	<b>Sub-Total Indirect Costs Electrochemical Plant</b>	<b>155.8</b>
	<b>Contingency</b>	<b>92.3</b>
	<b>Labor Cost Escalation</b>	<b>5.9</b>
	<b>Total Pre-Production Capital Cost Electrochemical Plant Site</b>	<b>704.2</b>
	<b>Total Initial Capital Cost Electrochemical Plant Site</b>	<b>821.5</b>

The totals may not add up due to rounding errors.



## 21.2.2 BASIS OF ESTIMATE FOR DIRECT CAPITAL COST

### 21.2.2.1 *Major Assumptions*

The Capex is based on the Project obtaining all relevant permits in a timely manner to meet the project schedule.

The Capex is based on the implementation of a project execution plan with strategies to address the project drivers, constraints and risk profile. It assumes that the project is done in an EPCM mode with integrated mature systems and with an organization with the proper level of experience. It also assumes that the construction will be done using tier 1 type contractors with relatively large contracts to minimize the number of interfaces within buildings and site congestion. Finally, it also assumes that the Owner's team will be of a size suitable for a project of this magnitude.

Temporary power is already available. It is assumed that Hydro-Québec will provide the permanent power line in time for use as commissioning and operation power.

For earthwork, the following was assumed:

- All backfill materials will be available locally;
- Geotechnical survey is completed, and piling and foundation design are based on the results of this survey;
- All excavated material will be disposed off-site.

### 21.2.2.2 *Major Exclusions*

The following items were not included in this capital cost estimate:

- Provision to account for unforeseen geotechnical conditions not included in the geotechnical Report;
- Provision for currency fluctuations and interests incurred during construction;
- Provision for labor costs increase due to a change in market conditions;
- Project financing costs;
- Disposal of hazardous materials (none expected);
- Escalation of equipment and materials;
- All duties and taxes were excluded from the capital cost but were considered in the economic analysis.

### 21.2.2.3 *Currencies*

Updated indices were used for quotations received before Q4 of 2017. The exchange rates used when quotations were received in foreign currencies are 1.30 CAD / 1.00 USD and 1.46 CAD / 1.00 EUR.

#### 21.2.2.4 *Construction Labour, Productivity Loss Factor*

The labour rates were developed for typical crews based on recently completed projects. The all-inclusive hourly rates include the basic hourly rates for the tradesman, social benefits and employer's burden, industrial site premium as required, direct supervision, small tools and consumables, and contractor's overhead and profit. Indirect supervision and site establishment as well as contractor's mobilization/demobilization costs were excluded from the hourly rate but were provided for as indirect costs in the construction contractor's site management provision.

The productivity loss factor was established based on the site conditions and execution strategies.

The working calendar was defined as ten (10) hours per shift and five (5) days per week for a total of 50 hours per week, and no rotation as the labour force will all be local. Civil, structural and architectural will be done on the day shift. Mechanical & piping, electrical and instrumentation will be done on day and night shift. The day shift will have approximately 70% of the labor force and night shift 30%. Consequently, for the work at Shawinigan, the average hourly rate is established at \$145 and the average productivity factor at 1.4.

#### 21.2.2.5 *Construction and Contractor's Costs*

The estimate is based on construction contracts attributed on the basis of competitive bidding process amongst tier 1 qualified contractors. Based on a review of current industrial projects in the region, adequate availability of qualified contractors and skilled workers is expected. It is also expected that an average level of site management, contract administration, quality control and adequate safety requirements will be required from the contractors by the construction management. The construction schedule is realistic, based on average site conditions, limited number of contractors on site, limited work outside in winter and limited work required in overtime.

Provisions have been made for contractor's major equipment and supplies, including owned and rented construction equipment, vehicles and other facilities such as trailers, tool cribs, power panels, containers, maintenance of area, janitorial and clean-up, and also the mobilization and demobilization.

Special installation cranes and scaffolding were also included. Workers parking lot will be nearby the plant. Transportation for the parking lot to the site was included.

Provision has also been made for construction contractor's site management including supervision and support staff such as administration and procurement, coordination and scheduling, quality and safety.

#### 21.2.2.6 *Freight, Duties and Taxes*

Based on recently completed projects and when not included in the quoted cost, the freight was accounted for by adding a factor of 7% to the value of the equipment.

#### 21.2.2.7 Process Facilities

The process facilities at the Electrochemical plant include the spodumene reception, calciner area and the main process buildings.

a. Spodumene Reception

The spodumene reception will make use of the existing rail pathway. However, the rails will be redone to respect CN requirements and the required track layout. Rented bottom dump type rail cars will be used which will unload spodumene onto a reclaim conveyor which will transfer the spodumene towards the calciner area. Budget quotes were obtained for the bulk material handling equipment. The rail layout was reviewed with CN and prices obtained for rail and components from a contractor and validated unit costs with recent projects.

b. Calciner Area

The calciner will be located east of Building 67. Using the results of the geotechnical investigation, the calciner was located to take advantage of the existing rock profile, thus avoiding excessive piling costs. The purchase order for the calciner equipment was awarded to TKIS whose detail engineering is well advanced, and fabrication has started. The layout was developed using the detailed TKIS vendor drawings. Detailed engineering for structural and foundation was used to confirm material take offs for the estimate.

c. Process Buildings

The remaining process units will be mostly housed in existing industrial buildings that have been decommissioned. Surveys and structural evaluations of these buildings have been completed. The piling, foundation and structural material take offs are based on the design that was done for the approved layout. For instance, the piling contract was awarded and construction started at the end of May 2019. The structural contracts for Buildings # 67 & # 80 were also awarded and the estimate is based on these awarded contracts.

The cost for the demolition is based on the incurred costs paid to the contractor as of the end of May 2019 with a provision for the remaining scope.

Unit costs for material and labour for future scope were developed from awarded contracts and recently completed projects.

d. Process Equipment

The process equipment lists were derived from the P&ID's. Purchase orders were awarded and fabrication started for major equipment (calciner, electrolysis, LSM & LHM crystallizer, SAC) and several other process equipment (acid bake kiln & cooler, candle filters, belt filter, thickeners, filter press, slurry pumps).

For the remaining critical equipment, multiple fixed quotes were received from qualified suppliers. For minor equipment, budget prices were obtained from qualified suppliers based

on data sheets using stream table information and preliminary technical descriptions. The remaining equipment were estimated from recent similar projects or in-house data bases.

Labour for installation of process equipment was estimated with man hours required for each piece of equipment based on the supplier's information and in-house databases. Special cranes required for large lifts were estimated based on vendor information.

e. Piping and Pipelines

The estimation of piping work was done using the P&ID's, line list and stream table to perform line sizing and material selection. Using the equipment layout, a 3D model of the main pipe runs and reserve space for the secondary lines were developed. Material take offs were extracted from the 3D model. A design allowance was also added to cover for supports, minor items and small-bore piping.

Unit costs and labour rates and manhours were developed from recently completed projects.

f. Electrical

Equipment lists and quantities were derived from the single line diagrams. Equipment prices were obtained from ABB and qualified suppliers for major equipment or from recent projects. Material take offs for cable and cable trays were done from the 3D model and layout. Unit costs for material as well as man-hours were also established based on recently similar projects.

g. Instrumentation

Instrumentation material take offs were derived from the P&ID's. Equipment prices were obtained from ABB and miscellaneous items were based from recent projects. Installation man-hours were also established based on recent similar projects.

h. Buildings Ventilation, Dust Collection and HVAC

Preliminary design was done including schematics for building ventilation, dust collection and HVAC. Equipment and duct sizing were developed. A 3D model was also prepared and used for material take offs. Equipment costs were obtained from qualified suppliers. Installation man-hours were also established based on recent similar projects.

#### 21.2.2.8 Residues / By-Product Facilities

The design includes separate material handling equipment for each of the three (3) by-products: aluminum silicate by-product, gypsum residue and purge solution.

Water excess containing the process impurities will be treated in a water treatment system included as part of the processing equipment. Cleaned water will be re-used in the process. Residues will be thickened and send to an approved landfill site. The costs of disposal are included in the financial analysis as they vary from year to year.

#### 21.2.2.9 *General Services and Infrastructure*

General services such as propane, natural gas and general fire protection were estimated based on budget proposals or recent similar projects. Services such as sanitary waste disposal and potable water will be supplied by the City of Shawinigan and only the interconnections with the City are included in the Capex.

The estimate also includes site preparation, peripheral fencing and site roads based on the plot plan. Unit prices are based on recent projects.

#### 21.2.2.10 *Ancillary Buildings and Facilities*

The administration building was completed at the end of 2018. The other non-technical areas (control room, change room, laboratory) were estimated based on the approved layout. These areas will be housed in a new building south of Building 80.

Mechanical and electrical rooms will be located within the main process building and included in its cost.

A guard house with a turn stile is also included in the estimate.

#### 21.2.2.11 *Site Access*

Site will be directly accessible from the main existing road. The existing access road will be used during construction and for plant personnel when construction is completed.

A new access road for visitors and trucks will be constructed south of the site.

#### 21.2.2.12 *Power Supply, Main Sub-Station and Communication*

Requirements were established for a main sub-station based on the power demand and load list. Equipment prices and costs for material and installation were obtained from qualified suppliers and installation costs are from recent similar projects. Requirements were also established for emergency power supply.

Communication costs were estimated based on a developed system architecture.

#### 21.2.2.13 *Service Vehicles and Equipment*

A track mobile was included in Capex. Other service vehicles will be leased, and these costs were included in the Opex estimate.

### 21.2.3 BASIS OF ESTIMATE FOR INDIRECT COSTS

Estimations for indirect costs are summarized Table 21.12.

#### 21.2.3.1 *Project Development*

Project Development includes permitting, land acquisition and administration, various engineering and technical studies such as preliminary engineering, geotechnical and environmental studies, market studies and also independent reviews. No provision was made for development, implementation and operation of the existing demonstration plant.

#### 21.2.3.2 *EPCM Costs*

EPCM includes:

- Detailed engineering;
- Procurement;
- Project control;
- Construction management.

#### 21.2.3.3 *Pre-Operational and Verification*

POV (Pre-Operational and Verification) includes:

- POV specialist;
- Vendor support during POV;
- Construction labor force to support POV specialist.

#### 21.2.3.4 *Owner's Costs*

Owner's costs include construction indirect and Owner's Costs as tabulated below:

Construction indirect costs:

- Construction offices;
- Sanitary trailers;
- Road maintenance during construction;
- Site services;
- Temporary power;
- Material management;
- Special cranes.

Owner's costs include:

- Land acquisition;
- Permitting costs;
- Owner's project team and services, namely main office and site management personnel, pre-production operation group;



- Financial costs as NSR buyout, insurances and legal fees as well as training and manuals;
- Spares, consumables and first fills;

Escalation was included for construction man-hours in line with the union agreement.

Working capital, taxes and duties were also excluded from the Project Capex but were considered in the financial analysis.

#### 21.2.3.5 *Nemaska Corporate Costs*

The Nemaska corporate costs comprise the personnel until production is achieved.

Other corporate costs such as human resources, procurement, environment and information technology activities are included.

#### 21.2.3.6 *Closure and Rehabilitation Costs*

Since the Shawinigan site is considered as an industrial site, indications are that no provision will be required for closure and rehabilitation of the site. No costs were included in the estimate.

#### 21.2.4 CONTINGENCY

Based on the Quantitative Risk Assessment (QRA) and Schedule Risk Assessment (SRA) a contingency of \$92.3 M was included. The contingency was calculated at P80 level of confidence.

No contingency provision was made to cover technological risks associated with the process or external factors that could be caused by changing market conditions.

### 21.3 **Whabouchi Operating Cost**

Operating costs were estimated for the Whabouchi Mine operation and concentrate transport up to the Electrochemical plant and cover the costs related ore extraction, spodumene concentration, management of tailings, waste and water, General and Administration (“G&A”) costs including site services, transport and lodging of workers and operation expenses and concentrate shipping to the Electrochemical plant as described in more details in this Section.

The operating costs were based on Year 2021 to 2025 average spodumene concentrate production of 205,364 tonnes per year (dry).

The sources of information used to develop the operating costs include in-house databases and outside sources.

The average operating cost estimate is summarized in Table 21.13.

**Table 21.13 – Average Annual Operating Cost Estimate for Whabouchi**

Description	Operating Cost (\$/y)	Average Operating Costs <sup>2</sup> (\$/t of Concentrate)
Mining (Open Pit Year 1 to 26)	24,850,366	121.01
Stockpile Re-handle, Tailings, Ore Sorter Rejects, DMS Loading (Open Pit Year 1 to 26)	3,418,318	16.65
Tailings and Water Management Cost	14,595	0.07
Mill Operating Cost	22,307,680	108.63
G & A Operating Cost	20,492,778	99.79
Concentrate Transport Cost	17,742,218	86.39
Total <sup>1</sup>	88,825,955	432.53

1) Based on Year 2021 to 2025 average mill throughput of 1,086,990 tonnes per year.

2) Based on Year 2021 to 2025 average spodumene concentrate production of -205,364 tonnes per year

### 21.3.1 MINING OPERATING COST

The sources of information used to develop the operating costs include supplier pricing, in-house databases and outside sources particularly for materials, services, and consumables.

#### 21.3.1.1 Mining (Open Pit)

The open pit mine operating cost was estimated for each period of the mine plan. This cost is based on operating the equipment, the labour associated with operating the mine, the cost for explosives as well as pit dewatering, road maintenance and other activities.

The open pit mine operating cost was estimated to average \$6.88/t mined for the life of the open pit mine. Table 21.14 presents the mine operating cost by material type (the column for \$/t Mined considers the cost for the activity divided by the tonnage specific to that activity).

**Table 21.14 – Summary of Estimated Mine Operating Cost by Type of Material**

Type of Material	Cost (\$/t Mined)	Cost (\$/t Concentrate)	Total (%)
Ore	6.52	30.82	25.47%
Overburden	4.64	0.91	0.75%
Waste	5.85	74.10	61.24%
Stockpile Re-handle	1.03	4.86	4.02%
Tailings (load, haul & place)	1.88	7.02	5.80%
Ore Sorter Rejects (load & haul)	0.72	0.39	0.32%
DMS Loading	0.69	2.91	2.40%
<b>Total</b>	<b>6.88</b>	121.01	100.00%

The totals may not add up due to rounding errors.

a. Operating Cost Breakdown by Major Components

Tables 21.15 and 21.16 provide a breakdown of the mine operating costs into several major components.

**Table 21.15 – Operating Cost Breakdown by Activity**

Category	Cost (\$/t Mined)	Cost (\$/t Concentrate)	Total (%)
Production Loading	0.17	3.06	2.53%
Re-handle Loading	0.29	5.02	4.15%
Hauling	0.63	11.06	9.14%
Drilling and Blasting	1.37	24.13	19.94%
Support and Service	0.72	12.68	10.48%
Labour	3.54	62.21	51.41%
Leasing	0.11	1.86	1.53%
Other	0.06	0.99	0.82%
Total	6.88	121.01	100.00%

The totals may not add up due to rounding errors.

**Table 21.16 – Operating Cost Breakdown by Consumable**

Consumables	Cost (\$/t Mined)	Cost (\$/t Concentrate)	Total (%)
Fuel	1.29	22.63	18.71%
Tires	0.15	2.65	2.19%
Repair / Parts	0.55	9.63	7.96%
Explosives	0.58	10.21	8.44%
Labour	3.54	62.22	51.41%
Leasing	0.11	1.86	1.53%
Drilling Contract	0.62	10.82	8.94%
Other	0.06	0.99	0.82%
Total	6.88	121.01	100.00%

The totals may not add up due to rounding errors.

21.3.1.2 Mining Equipment

The cost to operate the major equipment such as the haul trucks, mining backhoes, track dozers, and wheel loaders has been calculated as a function of the hour intervals for each machine

throughout the life of mine. These costs are based on estimates that were provided by SMS Equipment, the local supplier for Komatsu Mining.

For the remaining equipment, BBA used its internal database to develop an average hourly operating cost. Equipment rebuilds, which were discussed in Section 16 have been considered as sustaining capital. The fuel cost also considers the cost for the diesel exhaust fluid additive for the machines with Tier 4 engines.

a. Workforce Salaries

The workforce cost for mine operations was estimated to be \$14.1 M per year. This salary was calculated based on the number of employees and their annual salaries. The salaries include a 15% bonus, 3.8% overtime for non-supervisory positions, and fringe benefits which are a function of the employee's position and range from 15% to 34%.

b. Equipment Leasing

The fleet of Komatsu equipment will be leased on a 5-year term with monthly payments which have been treated as an operating expense.

c. Explosives

The cost for explosives has been estimated at \$0.58/t of blasted rock which is based on pricing from Dyno Nobel. The pricing includes the cost for emulsion, transportation to site and down-the-hole service.

d. Production Drilling and Pre-Splitting

Production drilling will be carried out by a contractor who supplied a price per linear meter of drilling. The cost for pre-splitting has been estimated at 7% of the total drilling and blasting cost.

e. Other Miscellaneous Costs

The mine operating cost also includes provisions for ore grade control, contractual services, and miscellaneous activities.

f. Loading, Hauling and Placing of Coarse Tailings

BBA has estimated the cost to load and transport the tailings from the concentrator to the co-disposal facility, including the cost for a track dozer and backhoe for placement at \$1.88/t of tailings or \$7.75/t of concentrate.

g. Loading and Hauling of ore sorter rejects

BBA has estimated the cost to load and transport the ore sorter rejects from the ore sorter to the co-disposal facility at \$0.72/t of sorter rejects or \$0.43/t of concentrate.

h. DMS Loading

BBA has estimated the cost to re-handle the ore accepted by the ore sorters into the DMS plant at \$0.69/t of ore or \$3.21/t of concentrate.

21.3.1.3 *Underground Mining Operating Costs*

The Opex estimate for the production period planned from 2046 to 2053 was broken down into the following categories:

a. Owner Operating Cost

This includes the Owner's personnel salaries and the operating costs of the waste rock handling to the disposal area and the mine tailings operations. It also includes the propane and electrical energy for mine air heating and Owner's and mining contractor's equipment.

b. Mining Contractor Services

This cost estimate was based on the contractor's unit prices for the drilling, explosive and blasting, ore handling and transportation. It also includes the drift accesses to the stopes (waste and ore areas).

The average Opex estimate over the seven (7) years planned operation will be \$23.69/tonne of ROM. Table 21.17 presents the details of the Opex estimation.

21.3.2 CONCENTRATOR OPERATING COST

Annual and unit process operating costs for the concentrator were determined for the Year 2021 to Year 2025 average annual mill ore tonnage of 1,086,990 tonnes that will produce 205,364 t/y of spodumene concentrate.

The estimated Year 2021 to Year 2025 average concentrator operating costs are summarized in Table 21.18 and include personnel requirement for mill operation and maintenance, electrical power, grinding media and reagents consumption, dryer fuel consumption, consumables and wear parts, spare parts and miscellaneous. The total operating costs were estimated to be \$22.3 M/y or \$20.52 /tonne of feed processed for 2021 to Year 2025.

**Table 21.17 – Underground Mine Opex Estimation**

Description	Units	Year								Total
		2045	2046	2047	2048	2049	2050	2051	2052	(Excluding PP)
U/G OWNER'S OPERATING COST										
Manpower (Management Team)	\$	2,531,100	2,531,100	2,531,100	2,531,100	2,531,100	2,531,100	2,531,100	2,531,100	20,248,800
Waste Rock Hauling to Disposal Area	\$	212,312	246,628	180,111	41,253	44,940	42,491	17,334	20,196	805,265
Ore Hauling from Portal to Concentrator	\$	688,916	1,445,867	1,443,052	1,425,386	1,447,607	1,427,851	1,429,072	421,522	9,729,272
Surface Maintenance	\$	0	0	1,054,269	1,054,269	1,054,269	1,054,269	1,054,269	1,054,269	6,325,616
Air Heating (Propane)	\$	300,000	300,000	300,000	300,000	300,000	300,000	300,000	300,000	2,400,000
Intake Ventilation electricity	\$	191,264	191,264	191,264	191,264	191,264	191,264	191,264	191,264	1,530,108
Air Heating & Ventilation Maintenance	\$	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860	70,880
Electricity (contractor's equipment)	\$	382,294	382,294	382,294	382,294	382,294	382,294	382,294	382,294	3,058,355
Total	\$	4,314,745	5,106,013	6,090,950	5,934,426	5,960,334	5,938,129	5,914,193	4,909,506	44,168,297
U/G ORE EXTRACTION COST (Contractor)										
Drilling	\$	1,316,873	2,763,797	2,758,415	2,724,646	2,767,122	2,729,359	2,731,693	805,746	18,597,651
Explosive Products	\$	623,661	1,308,913	1,306,365	1,290,372	1,310,488	1,292,604	1,293,709	381,595	8,807,708
Blasting Services	\$	1,764,205	3,702,639	3,695,429	3,650,189	3,707,093	3,656,503	3,659,630	1,079,453	24,915,141
Ore handling & Transportation	\$	3,398,689	7,133,025	7,119,135	7,031,982	7,141,607	7,044,146	7,050,169	2,079,534	47,998,287
Backfill	\$	2,863,706	6,010,225	5,998,521	5,925,087	5,517,279	5,935,336	5,940,411	1,752,197	39,942,761
Total	\$	9,967,133	20,918,600	20,877,865	20,622,277	20,443,588	20,657,948	20,675,611	6,098,526	140,261,548



Description	Units	Year								Total
		2045	2046	2047	2048	2049	2050	2051	2052	(Excluding PP)
U/G DEVELOPMENT WORK (Contractor)										
Ore drive metres	\$	1,297,808	2,723,784	2,718,480	2,685,200	2,727,061	2,689,845	2,692,145	794,081	18,328,405
Crosscut metres (Waste)	\$	1,251,657	2,377,185	3,340,577	3,540,086	2,928,065	2,729,210	1,478,514	1,864,825	19,510,118
Total	\$	2,549,465	5,100,969	6,059,057	6,225,286	5,655,126	5,419,055	4,170,659	2,658,906	37,838,523
TOTAL MINE OPEX	\$	16,831,344	31,125,583	33,027,872	32,781,988	32,059,048	32,015,132	30,760,463	13,666,938	222,268,368
OPEX PER TONNE MINED	\$/t	20.97	20.65	22.84	25.09	24.11	24.44	23.88	34.74	23.69
OPEX PER TONNE OF CONCENTRATE	\$/t	162.29	146.42	158.79	155.26	162.14	154.93	141.27	210.46	156.26

**Table 21.18 – Process Plant Average Operating Cost for Year 2021-2025**

Description	Year 2021-2025			
	Average Annual Cost (\$)	Average Cost (\$/t milled <sup>1</sup> )	Average Cost (\$/conc. t <sup>2</sup> )	Average % of Total Cost
<b>Mill Operation</b>				
Mill Operation Manpower	6,043,971	5.56	29.43	27.1%
Maintenance Manpower	4,709,687	4.33	22.93	21.1%
Electrical power <sup>3</sup>	3,676,794	3.38	17.90	16.5%
Grinding media and reagents consumption	2,177,006	2.00	10.60	9.8%
Dryer fuel consumption	1,572,822	1.45	7.66	7.1%
Consumables, wear parts, spare parts and miscellaneous <sup>4</sup>	4,127,400	3.80	20.10	18.5%
<b>Total Mill Operating Cost</b>	<b>22,307,680</b>	<b>20.52</b>	<b>108.63</b>	<b>100.0%</b>

1) Based on Year 2021 to Year 2025 average mill throughput of 1,086,990 tonnes per year.

2) Based on Year 2021 to Year 2025 average spodumene concentrate production of 205,364 tonnes per year.

3) The electrical power cost of \$0.0492 \$/kWh for year 1 to 4 and \$0.052 \$/kWh for the remaining years.

4) Consumables, wear parts, spare parts and miscellaneous, estimated as 8.7% of total equipment capital cost.

#### 21.3.2.1 Mill Manpower Costs

The personnel requirement for the concentrator plant will be 81 employees, see Table 21.19. These employees will be required for the proper operation of the processing facility, including operations and maintenance. The maintenance area includes mechanical, electrical and instrumentation maintenance. 3.8% overtime is applied to non-management. The labour rates, prime and fringe were provided by Nemaska. The total estimate is \$10.8 M/y for life of mine, or \$9.89 /tonne of ore processed for Year 2021 to Year 2025.

**Table 21.19 – Concentrator Plant Manpower Average Operating Cost for Year 2021-2025**

Area	Number of personnel	Total Cost (\$/y)	Year 2021-2025 Average Unit Cost (\$/t)
Operations	48	6,043,971	5.56
Maintenance	33	4,709,687	4.33
<b>Total Manpower</b>	<b>81</b>	<b>10,753,658</b>	<b>9.89</b>

#### 21.3.2.2 Electrical Power

Total electrical power costs were calculated using the total load of the milling operation based on throughput of 1,086,990 annual mill ore tonnage. The breakdown of the process power consumption by area is presented in Table 21.20. The total power consumption of the plant was estimated at

10,853 kW. The electrical power cost is \$0.0492/kWh for the first four (4) years and \$0.052/kWh for the remaining years from Nemaska, and the total estimate electrical process power cost is \$3.30/tonne ore processed for the first four (4) and \$3.49/tonne ore processed for the remaining years.

**Table 21.20 – Electrical Process Power Operating Unit Cost**

Process Description	Power <sup>1</sup>		Unit Cost	
	Operational Electrical (kW)	Consumption (kWh/y)	Unit Cost (First 4 Years) (\$/t) <sup>2</sup>	Unit Cost (Year 5 onwards) (\$/t) <sup>3</sup>
ROM Crushing and Ore Sorting	2,006	10,962,853	0.50	0.52
Pre-Concentration and Dense Media Separation	921	6,943,394	0.31	0.33
Muscovite Removal, Grinding, Wet Magnetic Separation	734	5,533,879	0.25	0.26
De-sliming, Attrition & Spodumene Flotation	490	3,697,176	0.17	0.18
Dry Magnetic Separation	2,951	22,253,800	1.01	1.06
Concentrate Dewatering	788	4,827,713	0.22	0.23
Tailings Dewatering	280	1,976,086	0.09	0.09
Reagents Systems	957	5,413,515	0.25	0.26
Utilities - Air and Water Services + Fire water	1,169	9,585,301	0.43	0.46
Monitoring Station (ABB)	87	356,565	0.02	0.02
Power Distribution (ABB)	470	1,444,703	0.07	0.07
<b>Total</b>	<b>10,853</b>	<b>72,994,987</b>	<b>3.30</b>	<b>3.49</b>

1) Based on Year 2021 to Year 2025 average mill throughput of 1,086,990 tonnes per year.  
2) The cost is for year 1 to 4 based on the electrical power cost of \$0.0492 \$/kWh.  
3) The cost is for year 5 onwards based on the electrical power cost of \$0.052 \$/kWh.

### 21.3.2.3 Grinding Media and Reagents

The total grinding media balls and concentrator reagents operating costs were based on Year 2021 to Year 2025 average mill throughput of 1,086,990 tonnes per year. It is estimated at \$2.00/tonne of ore processed, see Table 21.21. The grinding media balls were estimated from Bond abrasion index and the Bond metal wear equations. The media ball cost was obtained from suppliers. The ferrosilicon consumption was estimated using DRA/Met-Chem's experience from multiple other operating plant. The estimated quantities of reagents were derived from the various pilot plant test work results and optimization, and reagents costs were obtained from suppliers.

**Table 21.21 – Grinding Media and Reagents Unit Cost**

Description	Price (\$/kg)	Unit Cost (\$/t)
Grinding Media		
Ball Mill Balls (75 mm)	1.51	0.24
Concentrator Reagents		
Dense Media - Ferrosilicon	1.90	0.58
Dispersant — Sodium silicate N (liquid)	0.64	0.06
Caustic Soda (NaOH) 50% Solution	0.78	0.32
Collector – B-100	2.82	0.73
Frother - MIBC	2.99	0.01
93% Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> )	0.30	0.02
Flocculant Magnafloc-10	4.36	0.04
Sub-Total Concentrator Reagents		1.75
Filter Cloths		0.01
<b>Total</b>		<b>2.00</b>

1) Based on Year 2021 to 2025 average mill throughput of 1,086,990 tonnes per year.

#### 21.3.2.4 Dryer Fuel Consumption

Total diesel consumption of the filtered spodumene flotation concentrate dryer is estimated as \$7.66/tonne concentrate.

#### 21.3.2.5 Consumables, Wear Parts, Spare Parts and Miscellaneous

Consumables, wear parts, spare parts and miscellaneous, estimated as 8.7% of total equipment capital cost using DRA/Met-Chem's experience from multiple other operating plant.

### 21.3.3 GENERAL AND ADMINISTRATION (WHABOUCHI)

Annual and unit process operating costs for the G&A were determined based on Year 2021 to 2025 with the average spodumene concentrate production of 205,364 t/y. The estimated G&A operating costs are summarized in Table 21.22 and include labour requirement, general services costs and general heating and lighting costs. The total operating costs were estimated to be \$20.5 M/y or \$106.01/tonne of concentrate produced.

**Table 21.22 – General and Administration Average Operating Cost for Year 2021-2025-Whabouchi**

Description	Year 2021-2025			
	Cost (\$)	Average Cost (\$/t milled <sup>1</sup> )	Average Cost (\$/conc. t <sup>2</sup> )	Average (% of Total Cost)
General and Administration				
Corporative Service Manpower Whabouchi) <sup>3</sup>	3,536,672	3.50	18.27	17.2%
General Services Manpower (Whabouchi) <sup>3</sup>	1,825,419	1.81	9.43	8.9%
General Services Costs (Whabouchi) <sup>3</sup>	13,869,000	13.76	71.81	67.7%
General Heating & Lighting Costs <sup>4</sup>	1,261,687	1.24	6.50	6.1%
<b>Total G&amp;A Operating Cost</b>	<b>20,492,778</b>	<b>20.31</b>	<b>106.01</b>	<b>100.0%</b>

1) Based on Year 2021 to Year 2025 average mill throughput of 1,086,990 tonnes per year.

2) Based on Year 2021 to Year 2025 average spodumene concentrate production of 205,364 tonnes per year.

3) The Corporative services manpower, general services manpower and general services costs are provided by Nemaska.

4) The electrical power cost of \$0.0492 \$/kWh for year 1 to 4 and \$0.052 \$/kWh for the remaining years.

#### 21.3.3.1 General and Administration Labour Costs

Twenty-nine (29) employees will be required for Corporative Services for Whabouchi and 15 employees for General Services for Whabouchi provided by Nemaska. The total is, therefore, \$5,362,091/y for the life of mine, or \$27.70/tonne concentrate produced for Year 2021 to 2025.

**Table 21.23 – General and Administration – Labour Cost**

Description	No of Employees	Total Cost (\$/y)	Year 2021-2025 Average Unit Cost <sup>1</sup> (\$/conc. tonnes)
Corporative Service Manpower (Whabouchi)	29	3,536,672	17.22
General Services Manpower (Whabouchi)	15	1,825,419	8.89
<b>TOTAL</b>	<b>44</b>	<b>5,362,091</b>	<b>26.11</b>

1) Based on Year 2021 to 2025 average spodumene concentrate production of 205,364 tonnes per year.

#### 21.3.3.2 General Services Cost

A total services cost was estimated at \$13.9 M/y for the first 5 years and \$13.6 M/y for the remaining years. Wetland Compensation is only for Years 1 to 3, and Fish Habitat Compensation is only for Years 1 to 5. This includes Management, Administration & Accounting, Human Resources, IT Maintenance & Supplies & Licences, Health, Safety and Security, Procurement & Logistics, Environment/Permitting, Community Relations and Technical Services.

The major cost items in this element are the camp operation cost as well as fly-in fly-out travelling. Other main elements are janitor contract, local taxes, training, PPE equipment, guardhouse, transport of goods etc.

### 21.3.3.3 General Heating and Lighting

The facilities will be mainly heated using propane direct heating air make-up units and partially by the electricity power. It was estimated it will cost \$1.2 M/y for Years 1 to 4 based on power cost of \$0.0492/kWh, and \$1.3 M/y for the remaining years based on power cost of \$0.052/kWh to maintain a proper working temperature environment in the maintenance garage and the concentrator building.

### 21.3.4 CONCENTRATE TRANSPORT

Table 21.24 shows the cost for concentrate transport provided by Nemaska. The cost includes Year 1 to St. Lawrence Port and Year 2 and onwards to Shawinigan. Both options include Whabouchi to Matagami Station Road Maintenance, Concentrate Drying, Silos, Loading at Whabouchi, Truck Hauling Cost to Matagami Railhead, and Matagami Terminal Fee. The total is \$92.05/tonne concentrate for Year 1, and \$86.39 /tonne concentrate for Year 2 and remaining years.

**Table 21.24 – Concentrate Transport Unit Cost**

Description	Unit Cost (\$/conc. t <sup>1</sup> )
Whabouchi to Matagami Station Road Maintenance	4.27
Concentrate Drying, Silos, Loading at Whabouchi	0.41
Truck Hauling Cost to Matagami Railhead	43.17
Matagami Terminal Fee - dry	7.14
Y1 CN Rail to St. Lawrence Port via Matagami - Hopper	31.95
Y1 Offloading cost on St. Lawrence Port	5.10
Y2 CN Rail to Shawinigan Plant via Matagami - Hopper	30.69
Y2 Direct Dump from Rail to Ore Bin in Shawinigan	0.70
Total Concentrate Transport to St. Lawrence Port (Year 1)	<b>92.05</b>
Total Concentrate Transport to Shawinigan (Year 2 to the end)	<b>86.39</b>
Provided by Nemaska based on spodumene concentrate production.	



## 21.4 Shawinigan Electrochemical Plant Operating Cost

### 21.4.1 SHAWINIGAN ELECTROCHEMICAL PLANT OPERATING COST SUMMARY

Operating costs were estimated for the Electrochemical plant and cover the costs related to the transformation of spodumene concentrate and lithium sulfate into lithium hydroxide monohydrate crystals.

The operating cost estimate includes reagents, consumables, rental equipment, personnel, power, fuel, maintenance and various other indirect costs.

The following items are not included in the operating cost estimate and are treated in the financial analysis, either because they normally vary with time, or because they reflect a temporary situation associated with the first years of operation:

- Normally vary with time:
  - Cost of Whabouchi concentrate and related shipping costs (production varies with mine plan);
  - Cost of concentrate purchased from the market to make-up for any variations in Whabouchi concentrate supply due to the mine plan (annual tonnage and/or grade of concentrate);
  - Cost of Green House Gas (GHG) emissions
- Temporary situations associated with the first years of operation:
  - Improvements in electrolysis current efficiency over the first four years as production experience improves;
  - Electricity cost discounts (Hydro-Québec electricity cost reduction program for clients at tariff L which provides 20% discount on the electricity cost for four (4) years for clients that invest in installations in Quebec);
  - Disposal costs for aluminum silicate by-product over the first five (5) years;
  - Disposal cost of purge solution over the first five (5) years;
  - Increased operations and maintenance manpower for the first four years;
  - Increased maintenance costs (materials and external maintenance costs) during first two years of operation;
  - Property tax credit for the first five (5) years equivalent to 75% of the amount by which the taxes increase due to the property modifications.
  - Debottlenecking projects during the first four years of operation.
- Other:
  - Cost of lithium sulfate and related shipping costs are included in the financial analysis to be coherent with the financial treatment of the concentrate.

The following items are excluded from the operating cost estimate:

- Corporate costs shared between the concentrator and the electrochemical plant, such as, General and Administrative Costs, R&D, etc. These are treated separately.
- A contingency of 5-10% is typically applied to operating cost estimates to cover the risks related to assumptions made during the estimate development (see Section 25.2). No contingency is included in the current estimate.

Quantities used in the operating costs are based on the heat and mass balance for reagents, the heat and mass balance and supplier information for utilities, and the equipment list for power.

The sources of pricing used to develop the operating costs include standard rate sheets (electricity), budgetary pricing (other utilities, reagents, residues), technical literature (maintenance), existing Nemaska experience from the demonstration plant (salaries, manpower) and detailed estimates by Nemaska for general expenses.

The expected operating costs for the design conditions are summarized in Table 21.25.

Design conditions assume:

- Ramp-up to full capacity is complete and all equipment is operating at the design efficiency;
- The facility receives 6.25%  $\text{Li}_2\text{O}$  spodumene concentrate at a feed rate of 215,000 t/y (dry), lithium sulfate at a feed rate of 2,000 tonnes per year  $\text{Li}_2\text{SO}_4 \cdot \text{H}_2\text{O}$  eq. (dry), and produces lithium hydroxide monohydrate at a rate of 37,000 t/y (dry);
- Aluminum silicate is sold at net zero cost to Nemaska. Gypsum is disposed. Purge solution is sold or disposed at net zero cost to Nemaska.

**Table 21.25 – Average Annual Operating Cost Estimate**

Cost Item	Total Operating Cost ****(\$M CAD/y)	\$CAD/t $\text{LiOH} \cdot \text{H}_2\text{O}$
<b>Directs</b>		
Plant Operations		
Concentrate and Lithium Sulfate Solution*	0	0
Reagents	6.93	187
Consumables	6.27	169
Mobile Equipment Rental	0.58	16
Residue Disposal**	4.10	111
Operating Personnel	7.31	197
Laboratory Personnel	1.80	48

Cost Item	Total Operating Cost ****(\$M CAD/y)	\$CAD/t LiOH.H <sub>2</sub> O
<b>Utilities</b>		
Power	16.6	449
Fuel	8.77	236
<b>Maintenance</b>		
Maintenance Parts & Supplies	10.7	288
Maintenance Personnel	4.73	128
External Maintenance Contracts	5.95	160
<b>Indirects</b>		
General Administration Personnel	1.15	31
Management Staff	0.51	14
General Expenses	2.78	75
Tax & Insurance***	4.88	132
Other External Services	0.50	13
<b>Total</b>	<b>83.6</b>	<b>2,253</b>

\* Cost of concentrate from Whabouchi or purchased from market and cost of lithium sulfate solution are not included in the Opex but are included in the financial analysis.  
\*\* Assumes no cost for aluminum silicate or purge disposal  
\*\*\* Cost of GHG emissions is not included in the Opex but is included in financial analysis.  
\*\*\*\* Excludes those costs treated in the financial analysis

Fixed and variable costs are summarized below for the design conditions. These costs are also used to estimate production costs during production ramp-up. Reagents, consumables, residue disposal costs, electricity for the electrolysis cells and fuel are considered variable costs. All other costs are considered fixed.

**Table 21.26 – Average Annual Operating Cost Estimate – Fixed Versus Variable Costs**

Description	Total Operating Cost* (\$M CAD/y)	\$CAD/t LiOH.H <sub>2</sub> O
Variable Costs	36.3	978
Fixed Costs	47.3	1,275
Total	83.6	2,253

\* Excludes those costs treated in the financial analysis

The following sections describe the basis for the operating cost estimate.

#### 21.4.2 CONCENTRATE & LITHIUM SULFATE

The cost of Whabouchi concentrate and Whabouchi concentrate transport to Shawinigan are excluded from the Electrochemical plant operating cost estimate. These costs are included in the financial analysis.

The cost of concentrate purchased from the market, to make up any shortfall in production from the Whabouchi concentrator, is treated as follows within the financial analysis:

- During the first 20 years, the Whabouchi concentrator production varies with the mine plan from about 200,000 t/y to 215,000 t/y with an average of approximately 205,000 t/y. On average, there will be a shortfall of about 10,000 t/y once the electrochemical plant is at full capacity.
- The concentrator will start production earlier and ramp up faster than the electrochemical plant. Therefore, there will be excess concentrate production until the electrochemical plant is at full capacity.
- It is assumed that during the electrochemical plant's ramp up period, the concentrator will stockpile the required amount of concentrate to make up for any shortfall until 2030. This will allow the electrochemical plant to operate at nameplate capacity until 2030 inclusively.
- After 2030, any shortfall in concentrate will be purchased on the market at \$600 USD/t plus \$150 USD/t of shipping. For 10,000 t/y the cost is \$9.75 M CAD/y. It is assumed that the concentrate is ground and has similar composition and properties as the Whabouchi concentrate.

The cost of lithium sulfate and its transport to Shawinigan is excluded from the Electrochemical plant operating cost estimate but is included in the financial analysis at \$6,000 USD/t plus \$117 CAD/t for shipping. For 2,000 t/y LSM equivalent, this cost is \$15.8 M CAD/y.

The financial analysis is based on using concentrate only for the ramp-up of the electrochemical plant until 93% of nameplate capacity is achieved. Only from that point onwards is lithium sulfate introduced.

#### 21.4.3 REAGENTS

Hydrated lime, sulfuric acid, carbon dioxide, nitrogen and miscellaneous minor reagents will be required by the electrochemical process. When not included in the purchase price, 5% was added for shipping to site. Reagents and chemicals costs total \$6.93 M annually.

#### 21.4.4 CONSUMABLES

Consumables are materials other than reagents which need to be used or replaced on a regular basis. Consumables include ion exchange resin, electrolysis cell membranes replacement and anode recoating (including cell dis-assembly and re-assembly costs), bags and pallets for product packaging, wear parts such as regular partial pug mill replacements and laboratory supplies. When

not included in the purchase price, 5% was added for shipping to site. Consumables are estimated to cost \$6.27 M on an average annual basis.

#### 21.4.5 MOBILE EQUIPMENT RENTAL

Mobile equipment will be used for continuous plant work, concentrate unloading, residue handling and final product handling. Personnel pick-up trucks costs have also been included in this cost category. Annually, an estimated \$0.58 M will be spent for mobile equipment rental, including associated maintenance and maintenance consumables.

#### 21.4.6 RESIDUE DISPOSAL

It is anticipated that the plant will generate 212,000 t/y (dried) aluminum-silicate, 42,700 t/y (wet) gypsum residues and 7,400 m<sup>3</sup>/y purge solution.

Work is underway to identify potential clients for aluminum-silicates, which would reuse this residue. It is assumed that during the first years of operation a fraction of the residue will need to be disposed. After that, it is assumed that sales value will cover shipping costs for a net zero charge to Nemaska.

Disposal costs for the aluminum silicate residue in the first years are estimated at \$90/t, including disposal, government tipping fees and shipping. This is considered in the financial model.

The gypsum residue will likely always need to be disposed and this is the base case retained. Disposal costs for the gypsum residue are estimated at \$90/t, including disposal, government tipping fees and shipping.

Purge solution can be partially disposed with the aluminum silicate by-product during the first years of operation. When this is not feasible it is assumed that the purge solution will be sent offsite for treatment at a cost of \$300 /m<sup>3</sup>. After five (5) years of operation, it is assumed that the purge can be sold or disposed as an effluent at a net zero charge to Nemaska.

#### 21.4.7 LABOUR

The Shawinigan Electrochemical Plant Manpower is summarized in Table 21.27. Total annual costs for manpower include base salary, fringe benefits and expected overtime.

**Table 21.27 – Electrochemical Plant Manpower Operating Cost**

Area	Number of personnel	Total Cost (\$M/y)	Unit Cost (\$/t)
Operations	63	7.31	197
Laboratory	17	1.80	49
Maintenance	41	4.73	127
General Administration	11	1.15	31
Management	3	0.51	14
<b>Total Manpower</b>	<b>135</b>	<b>15.5</b>	<b>418</b>

#### 21.4.7.1 *Operating Personnel*

In accordance with Nemaska's manpower plan, the operating labour cost estimate covers the production superintendent, four shift supervisors, 52 hourly technicians (47 working on shifts and 5 working in the daytime only) as well as four process engineers, a production planner and an operations coach/facilitator.

#### 21.4.7.2 *Laboratory Personnel*

The laboratory labour cost estimate covers a laboratory manager/chemist and 16 laboratory technicians.

#### 21.4.7.3 *Maintenance Personnel*

The maintenance labour cost estimate covers the maintenance superintendent, 13 mechanical maintenance workers, 12 electrical maintenance workers and 11 maintenance supervisors, maintenance planners and other maintenance related employees, including store personnel as well as two projects engineers, an electrical engineer and a draftsman.

#### 21.4.7.4 *General Administration Personnel*

General administration labour includes administrative, accounting, information technology, environmental, health and safety, purchasing and logistics personnel. Gate house personnel is considered sub-contracted and is part of general expenses.

#### 21.4.7.5 *Management Staff*

Management staff is composed of three (3) employees including the plant manager, a financial controller and a human resources manager. Other management personnel are included in the corporate operating cost estimate presented separately.

#### 21.4.8 ELECTRICAL POWER

Power requirements were estimated based on motor horsepower and, for electrolysis, the operating conditions of the electrolysis cells.

Electricity costs were calculated based on Hydro-Québec's 2019 L tariff, applying the \$2.19/kW credit for supply between 50 and 80 kV.

The Electrochemical plant total operating electrical power is anticipated to be 46.6 MW resulting in annual costs of \$16.6 M. Approximately 68% of this cost can be attributed to the operation of electrolysis, with the balance for the remainder of the plant.

#### 21.4.9 FUEL

Natural gas will be used to fire the flash calciner, the acid bake kiln, the aluminum-silicate by-product dryer and the boilers, as well as for process building heating.



Annual costs are estimated at \$8.8 M. Budget natural gas pricing (\$0.246/m<sup>3</sup>) was obtained from Energir (previously Gaz Metro).

Fuel costs also include diesel for mobile equipment operation.

#### 21.4.10 GREENHOUSE GAS (GHG) EMISSIONS

Nemaska produces greenhouse gas emissions primarily via the burning of natural gas in the flash calciner, acid bake kiln, boilers, and dryers as well as for process building heating. Another minor source of greenhouse gas emissions is the diesel fueled vehicles used on the site.

Quebec is part of the Western Climate Initiative. Nemaska will be obligated to pay a compensation for these emissions through the cap and trade program.

The applicable cost associated with the purchase of CO<sub>2</sub> emission units are covered in the financial analysis as they vary from year to year. Key assumptions are:

- Credits policy for new greenfield projects in Quebec will remain the same.
- The project will be granted a 95% assistance factor as is commonly done for chemical industries.

The market price for CO<sub>2</sub> emissions will increase by 5% every year from the current price of approximately \$26/t CAD to a maximum price of \$38/t USD. This maximum price is estimated by the International Energy Agency (IEA) on IEA's New Policies Scenario (NPS), which estimates the price required for Canada to meet its Paris Agreement commitment.

#### 21.4.11 MAINTENANCE

The following items are typically included in the maintenance cost:

- Maintenance labor expenses including:
  - Maintenance performed by in-house maintenance personnel;
  - Maintenance performed by contractors (contract services);
  - Total Productive Maintenance (TPM);
  - Other resources (support staff, planners etc.);
  - Management overheads;
- Spare parts storage & management cost;
- Spare parts & material costs;
- Infrastructure cost overhead (crane rental, etc.).

The overall maintenance cost for design conditions was estimated as 3.6% of replacement asset value (RAV) based on first quartile industry benchmarks for the mining and other heavy industries. Replacement asset value was considered to be equivalent to direct capital costs plus contingency on these costs. The overall maintenance cost was then assumed to be split into 50% labour (internal

and external) and 50% materials. This excludes End-of-Life asset replacement cost which is included as sustaining capital in the financial analysis.

For the first two (2) years, a further 20% was added to take into consideration early equipment failures. For the first four (4) years maintenance labour was increased by 20% to take into account the additional maintenance requirements that are typically seen during ramp up. Both of these temporary costs are considered in the financial analysis.

#### 21.4.11.1 *Maintenance Parts and Supplies*

The cost of maintenance parts and supplies was estimated based on the overall maintenance cost assuming 50% of that cost is for parts and supplies.

No costs were included for maintenance of rented mobile equipment, as maintenance is included as part of rental costs.

#### 21.4.11.2 *External Maintenance Contracts*

Labour-intensive or specialized tasks are expected to be performed by sub-contracted maintenance personnel, in addition to regular maintenance which will be performed by in-house maintenance labour. The cost of external maintenance contracts includes among others, refractory replacement, rebuilding of equipment off-site, extra labour required during shut-downs, etc.

The cost for external maintenance contracts was estimated by taking the overall estimated maintenance cost, assuming 50% of that cost is for labour and subtracting the in-house maintenance labour cost.

#### 21.4.12 GENERAL EXPENSES

General expenses totaling \$2.8 M have been estimated in detail by Nemaska and include the following (all these costs exclude manpower):

- Environmental costs (waste management, environmental monitoring, etc.);
- IT and telecommunications supplies (computers, software licenses, internet access, phones, phone lines, photocopiers, etc.);
- Procurement supplies;
- Safety and firefighting supplies;
- Human resources costs (largely personnel training costs);
- Miscellaneous general expenses (janitorial services, snow removal).

#### 21.4.13 TAX AND INSURANCE

Property and school taxes were estimated by Nemaska to total \$2.37 M based on a taxable property value between \$55-60 M. The five-year property tax credit is covered in the financial analysis.

Property insurance was estimated by Nemaska based on quotes from various insurance brokers at \$2.51 M for the Shawinigan site installations. Other insurances are covered in the corporate operating cost estimate.

#### 21.4.14 OTHER EXTERNAL SERVICES

As the plant staff only includes engineers to support operational improvement projects, it is expected that external engineering services will be required. An allowance of \$0.5 M was included in the estimate for these services.

### 21.5 General and Administration (Corporate)

Annual and unit process operating costs for the Corporate G&A were determined based Year 2021 to 2025 average spodumene concentrate production of 205,364 t/y. The estimated G&A operating costs are summarized in Table 21.28 and include labour requirement and general services costs. The total operating costs were estimated to be \$ 7.8 M/y for LOM, or \$ 38.08 /tonne of concentrate produced for Years 2021 to 2025.

Thirty-two (32) employees will be required for Corporate Services for Corporate provided by Nemaska.

General Services Costs (Corporate) includes Management, Administration & Accounting, Human Resources, IT Maintenance & Supplies & Licences and Health, Safety and Security. The major cost items in this element are insurance, HR consultation, medical expertise, training, annual report etc.

**Table 21.28 – General and Administration Average Operating Cost for Year 2021-2025–  
Corporate HQ**

Description	Year 2021-2025			
	Cost (\$)	Average Cost (\$/t milled <sup>1</sup> )	Average Cost (\$/conc. t <sup>2</sup> )	Average (% of Total Cost)
<b>General and Administration</b>				
Corporative Service Manpower (Corporate) <sup>3</sup>	5,682,884	5.23	17.67	72.7%
General Services Costs (Corporate) <sup>3</sup>	2,137,810	1.97	10.41	27.3%
<b>Total G&amp;A Operating Cost (Corporate)</b>	<b>7,820,694</b>	<b>7.19</b>	<b>38.08</b>	<b>100.0%</b>

1) Based on Year 2021 to 2025 average mill throughput of 1,086,990 tonnes per year.  
 2) Based on Year 2021 to 2025 average spodumene concentrate production of 205,364 tonnes per year.  
 3 The Corporative services manpower and general services costs are provided by Nemaska.

## 22 ECONOMIC ANALYSIS

The economic assessment of the Whabouchi Project of Nemaska is based on Q2-2019 price projections in U.S. currency and cost estimates in Canadian currency. An exchange rate of 1.30 CAD per USD was assumed to convert USD market price projections and particular components of the cost estimates into CAD. No provision was made for the effects of inflation. The base-case evaluation was carried out on a 100%-equity basis. Current Canadian tax regulations were applied to assess the corporate tax liabilities and the regulations adopted in 2013 were applied to assess the Quebec mining tax liabilities. This assessment is based on the fact that the Project is on-going, i.e., significant work on the property began in July 2016 and construction has been on-going since then. Consequently, all funds invested up until May 31, 2019 are considered sunk and are omitted from the capital expenses in the present economic analysis. Only that part of the capital expenditure that remains to be incurred to bring the project to the production phase is considered.

Table 22.1 presents the financial indicators under base case conditions.

**Table 22.1 – Base Case Scenario Results**

Base Case Financial Results	Unit	Value
Pre-Tax (P-T) NPV @ 8%	M CAD	3,127.6
After-Tax (A-T) NPV @ 8%	M CAD	2,330.3
P-T IRR	%	30.3
A-T IRR	%	27.4
P-T Payback Period	Years	4.5
A-T Payback Period	Years	4.6

A sensitivity analysis reveals that the Project's viability will not be significantly vulnerable to variations in capital and operating costs, within the margins of error associated with feasibility study estimates. However, the Project's viability remains more vulnerable to the CAD/USD exchange rate and to the larger uncertainty in future market prices.

### 22.1 Assumptions

#### 22.1.1 MACRO-ECONOMIC ASSUMPTIONS

The main macro-economic assumptions used in the base case are given in Table 22.2. The price forecasts for spodumene concentrate (6.25% Li<sub>2</sub>O) and lithium hydroxide monohydrate (LiOH·H<sub>2</sub>O) were based on projections from Roskill Information Services Ltd. Details concerning the derivation of these forecasts can be found in Section 19 of this Report. The sensitivity analysis examines a range of prices 30% above and below the base case price forecasts.

**Table 22.2 – Macro-Economic Assumptions**

Item	Unit	Base Case Value
Spodumene Concentrate (6.25% Li <sub>2</sub> O) Price Forecast – FOB St. Lawrence Port	USD/tonne	600
Lithium Hydroxide Monohydrate (LiOH·H <sub>2</sub> O) Price Forecast – EXW Electrochemical Plant	USD/tonne	14,000
Exchange Rate	CAD/USD	1.30
Discount Rate	% per year	8
Discount Rate Variants	% per year	6 and 10

An exchange rate of \$1.30 CAD per USD (\$0.7692 USD/CAD) was used to convert the USD market price projections into Canadian currency. The sensitivity of base case financial results to variations in the exchange rate was examined. Those cost components which include U.S. content originally converted to Canadian currency using the base case exchange rate were adjusted accordingly.

The current Canadian tax system applicable to Mineral Resource Income was used to assess the Project's annual tax liabilities. This consists of federal and provincial corporate taxes as well as provincial mining taxes. The federal and provincial corporate tax rates currently applicable over the Project's operating life are 15.0% and 11.5% (decreasing by 0.1% annually from 11.9% in 2016 to 11.5% in 2020) of taxable income, respectively. The marginal tax rates applicable under the mining tax regulations in Quebec are 16%, 22% and 28% of taxable income and depend on the profit margin.

For taxation purposes, the Project is divided into two (2) separate entities, the Whabouchi Mining Operation (subject to corporate and mining taxes), and the Electrochemical Plant in Shawinigan (subject to corporate taxes only). A processing allowance rate of 10% is assumed for mining tax purposes, as the Mining Operation produces a concentrate that is shipped to the Electrochemical Plant.

As the electrochemical operation represents an independent industrial process, it is assumed that the Quebec "Tax Holiday for Large Investment Projects" program is applicable. This program provides up to 15% of the Electrochemical plant's total capital expenditure in the form of annual corporate tax credits applied to the provincial corporate tax liabilities. Thus, a tax holiday is obtained until the credits are exhausted.

The base-case assessment was carried out on a 100%-equity basis. Apart from the base case discount rate of 8.0%, two (2) variants of 6.0 and 10.0% were used to determine the Net Present Value ("NPV") of the Project. These discount rates represent possible costs of equity capital.

## 22.1.2 ROYALTY AND RESOURCE DEVELOPMENT PARTNERSHIP AGREEMENT PAYMENTS

The present economic analysis incorporates provisions for both a net profit royalty agreement and a Resource Development Partnership Agreement ("RDPA").

The annual royalty payment was based on 2.0% (originally 3.0% less 1.0% bought out with a lump-sum payment of \$1 M) of the “net value” of the concentrate produced at the mill. The net unit value of the concentrate was calculated from a pre-established Free on Board (“**FOB**”) mine concentrate sales price of \$529.19 USD per tonne (\$687.95 CAD), less mine operating costs, mine capital expenses incurred over the life of the Project, and mine rehabilitation costs, all expressed per tonne of estimated concentrate production. Based on the capital and operating costs estimates associated with the Whabouchi Mine Operation, the net unit value of the concentrate amounts to \$214.21/tonne, leading to a royalty payment of \$4.28/tonne of concentrate produced.

Payments under the RDPA are based on the net after-tax cash flows of the project. The actual terms are confidential and cannot be disclosed.

### 22.1.3 TECHNICAL ASSUMPTIONS

The main technical assumptions used in the base case are given in Table 22.3.

**Table 22.3 – Technical Assumptions**

Item	Unit	Base Case Value
Open Pit Resource Mined	k tonnes	27,928
Open Pit Average Mill Head Grade	% Li <sub>2</sub> O	1.33
Open Pit Design Mining Rate (ore only)	k tonnes/year	1,050
Underground Resource Mined	M tonnes	8,666
Underground Average Mill Head Grade	% Li <sub>2</sub> O	1.21
Underground Design Mining Rate (ore only)	k tonnes/year	1,250
Mine Life	years	33
Average Process Recovery	%	86.1
Concentrate Grade	% Li <sub>2</sub> O	6.25
Total Concentrate Production	k tonnes	6,570
Concentrate Sold	k tonnes	368
Concentrate Processed at Electrochemical Plant	k tonnes	6,201
Total LiOH-H <sub>2</sub> O Production – Mine Concentrate	k tonnes	1,032.7
Total LiOH-H <sub>2</sub> O Production – Other Sources	k tonnes	64.1
Average Mining Costs	(\$/tonne processed)	24.48
Average Mill Processing Costs	(\$/tonne processed)	21.21
Average Water Management and Tailings Haulage Costs	(\$/tonne processed)	1.15
Average General and Administration Mine Site Costs	(\$/tonne concentrate)	99.68
Concentrate Transport Costs WHA-SHA	(\$/dmt concentrate)	86.39
Concentrate Transport Costs WHA-SLP	(\$/dmt concentrate)	92.05



Item	Unit	Base Case Value
Royalty Payment	(\$/tonne concentrate)	4.28
Average Electrochemical Processing Costs <sup>1</sup>	(\$/tonne concentrate)	418.51
Average Whabouchi Concentrate Costs	(\$/tonne LHM)	2,709.86
Average Electrochemical Processing Costs <sup>2</sup>	(\$/tonne LHM)	2,513.04
Average Total Costs <sup>2</sup>	(\$/tonne LHM)	5,222.90

<sup>1</sup> Excludes costs associated with other sources.  
<sup>2</sup> Based on the processing of Whabouchi concentrate only.

A reduced production of 503 kt milled in the first production year reflects an April start and a 4-month ramp-up to commercial capacity.

## 22.2 Cash Flow Model and Results

Investment decisions are forward-looking. The issue consists of assessing whether an initial capital expense incurred from today onwards for the purpose of obtaining future benefits is justified. Any related past expenses are irrelevant to the decision. If an ensuing economic analysis shows that the future benefits are greater than the initial capital expense, then this capital expense is justified.

In the case of this Project, the initial capital expense is the expenditure required today to bring the Whabouchi project to the production phase. The resulting benefits are the stream of expected net cash flows generated over the life-of-mine. These consist of all revenues and expenses associated with mine production. Any project-related expenses incurred in the past, generally referred to as “sunk costs”, are irrelevant to the decision today. Sunk costs can be recovered (in part or totally) if a decision to go ahead is made based on a favourable forward-looking economic analysis.

Consequently, this economic assessment ignores sunk costs in the determination of cash flows and economic indicators. However, these costs are considered as opening balances for the purpose of determining tax liabilities.

Figure 22.1 illustrates the after-tax cash flow and cumulative cash flow profiles of the Project for base case conditions. The intersection of the after-tax cumulative cash flow curve with the horizontal dashed line represents the payback period (measured from the start of Year 1, which is not the start of commercial production).

A summary of the base case results is given in Table 22.4. The cash flow statement for the base case is given in Table 22.5.

The summary and cash flow statement indicate that the total pre-production (initial) capital costs were evaluated at \$928.7 M (excludes sunk costs of \$222.6 M at the Whabouchi mine site and \$117.3 M at the Electrochemical plant site). The sustaining capital requirements at the mine site were evaluated at \$296.1 M, which includes underground mine development and equipment, and

\$123.3 M at the electrochemical plant site. Mine closure costs were estimated at \$9.2 M (the entire amount has already been paid).

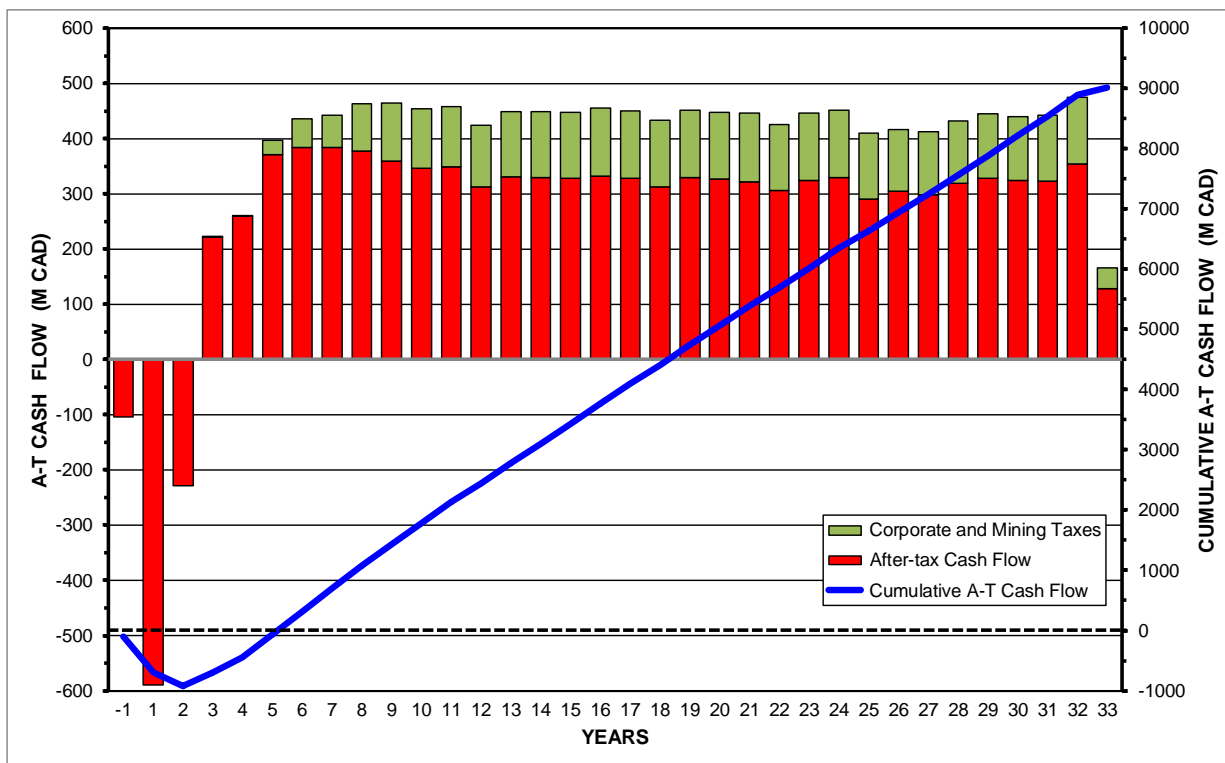
The cash flow statement shows a capital cost breakdown by area and provides an estimated capital spending schedule over the remaining pre-production period of the Project. Working capital requirements were estimated at three (3) months of total annual operating costs. Since operating costs vary annually over the mine life, additional amounts of working capital are injected or withdrawn as required.

The total revenue derived from the sale of concentrate from the mine and the lithium hydroxide product from the Electrochemical plant (LiOH-H<sub>2</sub>O) was estimated at \$20,249.8 M (\$287.2 M from mine concentrate and \$19,962.6 M from the lithium hydroxide) or, on average, \$521/tonne milled (the average excludes the product obtained from the electrochemical processing of material from other sources). The total operating costs (excludes royalty payments but includes the cost of processing the additional material) were estimated at \$6,132.9 M, or on average, \$167.59/tonne milled.

The financial results indicate a pre-tax NPV of \$3,127.6 M at a discount rate of 8.0%. The pre-tax Internal Rate of Return ("IRR") is 30.3% and the payback period is 4.5 years.

The after-tax NPV is \$2,330.3 M at a discount rate of 8.0%. The after-tax IRR is 27.4% and the payback period is 4.6 years.

**Figure 22.1 – After-Tax Cash Flow and Cumulative Cash Flow Profiles**



**Table 22.4 – Project Evaluation Summary – Base Case**

Item	Unit	Value
Concentrate Sales	\$ M	287.2
LiOH-H <sub>2</sub> O Sales – Mine Concentrate	\$ M	18,796.0
LiOH-H <sub>2</sub> O Sales – Other Sources	\$ M	1,166.6
Total Operating Costs (includes royalty payments)	\$ M	6,161.0
Initial Capital Costs (excludes Working Capital and \$330.7 M already spent)	\$ M	928.7
Sustaining Capital Costs	\$ M	419.4
Mine Rehabilitation Trust Fund Payments (excludes \$9.2 M already paid)	\$ M	0
General and Administration Corporate Costs	\$ M	252.2
RDPA Payments (excludes \$4.5 M already paid)	\$ M	383.0
Total Pre-tax Cash Flow	\$ M	12,105.6
Pre-tax NPV @ 6% <sup>1</sup>	\$ M	4,251.0
Pre-tax NPV @ 8%	\$ M	3,127.6
Pre-tax NPV @ 10%	\$ M	2,333.1
Pre-tax IRR	%	30.3
Pre-tax Payback Period <sup>2</sup>	Years	4.5
Total After-tax Cash Flow	\$ M	9,021.0
After-tax NPV @ 6%	\$ M	3,176.0
After-tax NPV @ 8%	\$ M	2,330.3
After-tax NPV @ 10%	\$ M	1,728.4
After-tax IRR	%	27.4
After-tax Payback Period	Years	4.6

<sup>1</sup> NPV calculation based on mid-period convention.

<sup>2</sup> Measured from the start of commercial production.

### Table 22.5 – Cash Flow Statement (Base Case)

[illegible]

## 22.3 Sensitivity Analysis

A sensitivity analysis has been carried out, with the base case described above as a starting point, to assess the impact of changes in total pre-production capital expenditure (“**CAPEX**”), operating costs (“**OPEX**”), product prices (“**PRICE**”) and the USD/CAD exchange rate (“**FX RATE**”) on the Project’s NPV @ 8.0% and IRR. Each variable was examined one-at-a-time (all product prices are varied together). An interval of  $\pm 30\%$  with increments of 10% was used for the first three (3) variables. It is to be noted that the margin of error for cost estimates at the feasibility study level is typically  $\pm 15\%$ . However, the uncertainty in price forecasts usually remains significantly higher, and is a function of price volatility. USD/CAD exchanges rates of 0.70, 0.75, 0.80, 0.85, 0.90, 0.95 and 1.00 (relative variations of -9, -2.5, 4, 10.5, 17, 23.5 and 30%, respectively) were used. Those cost estimates with US content were adjusted accordingly for each exchange rate assumption.

The pre-tax results of the sensitivity analysis, as shown in Figures 22.2 and 22.3, indicate that, within the limits of accuracy of the cost estimates in this Study, the Project’s pre-tax viability does not seem significantly vulnerable to the under-estimation of capital and operating costs, taken one at-a-time. The vertical dashed lines show the typical 15% margin of error associated with the cost estimates. As seen in Figure 22.2, the NPV is more sensitive to variations in Opex than Capex, as shown by the steeper slope of the Opex curve. As expected, the NPV is more sensitive to variations in price (all product prices were varied together) and the USD/CAD exchange rate. The NPV remains significantly positive at the lower limit of the price interval and at the upper limit of the exchange rate interval examined.

**Figure 22.2 – Pre-Tax NPV<sub>8%</sub> – Sensitivity to Capital Expenditure, Operating Costs, Prices and USD/CAD Exchange Rate**

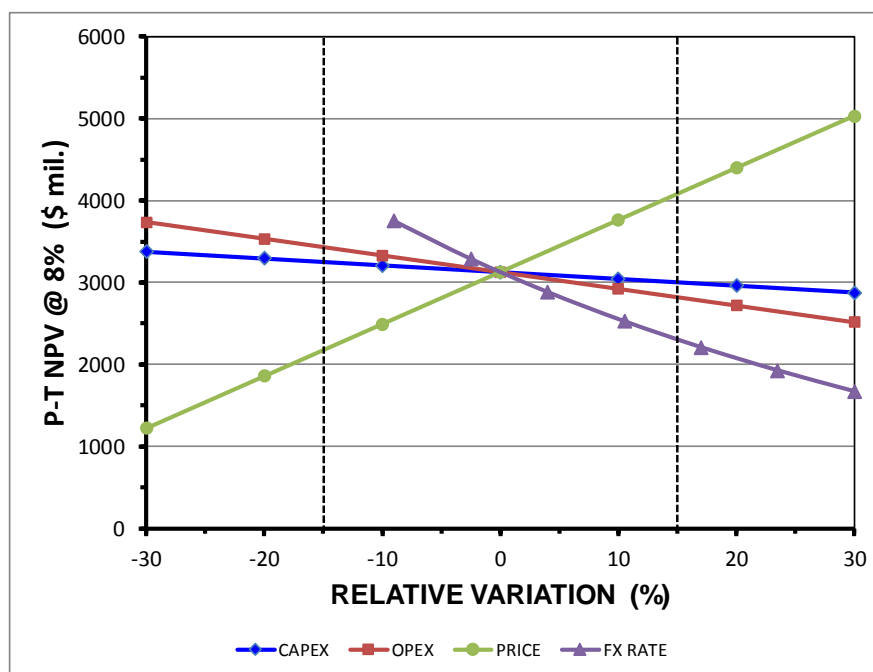
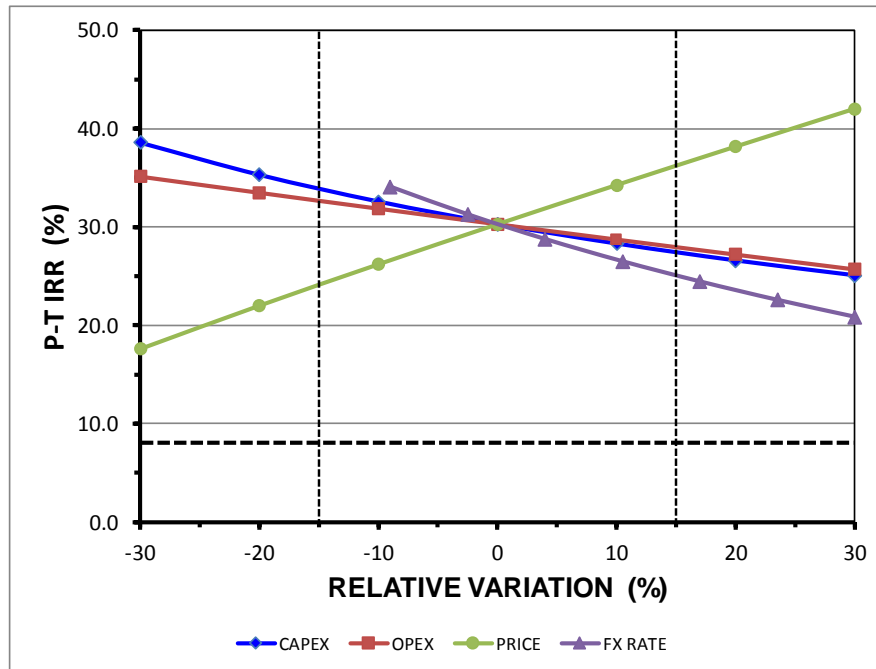


Figure 22.3, showing variations in pre-tax internal rate of return, provides the same conclusions. The horizontal dashed line represents the base case discount rate of 8%. Because of the different timing associated with Capex versus Opex, the IRR is more sensitive to variations in Capex than Opex.

**Figure 22.3 – Pre-Tax IRR – Sensitivity to Capital Expenditure, Operating Costs, Prices and USD/CAD Exchange Rate**



The after-tax results of the sensitivity analysis are shown in Figures 22.4 and 22.5. Figure 22.4 indicates that the Project's after-tax viability is mostly vulnerable to a price forecast reduction and change in the USD/CAD exchange rate, while being less affected by the under-estimation of capital and operating costs.



**Figure 22.4 – After-Tax NPV<sub>8%</sub> – Sensitivity to Capital Expenditure, Operating Costs, Prices and USD/CAD Exchange Rate**

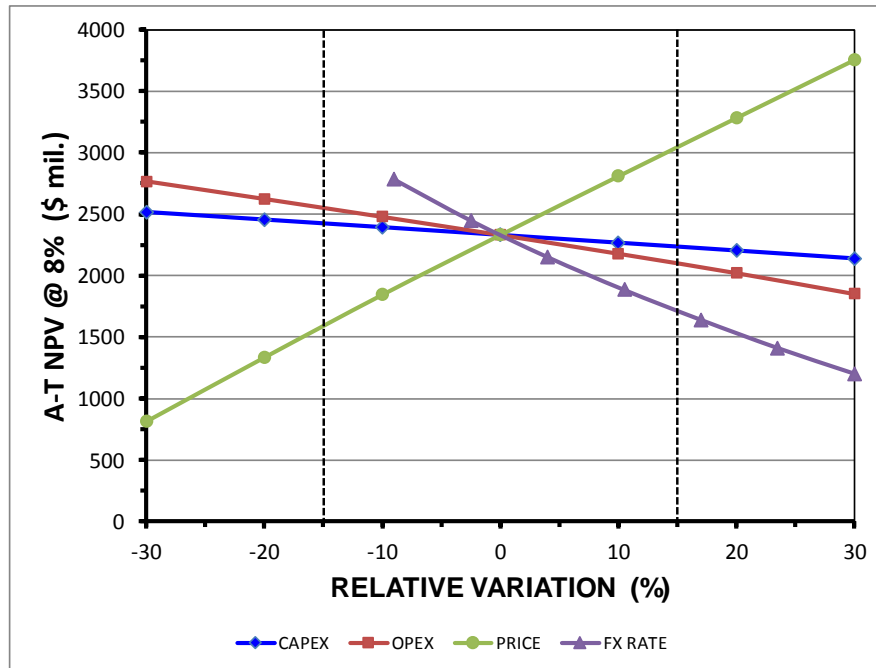
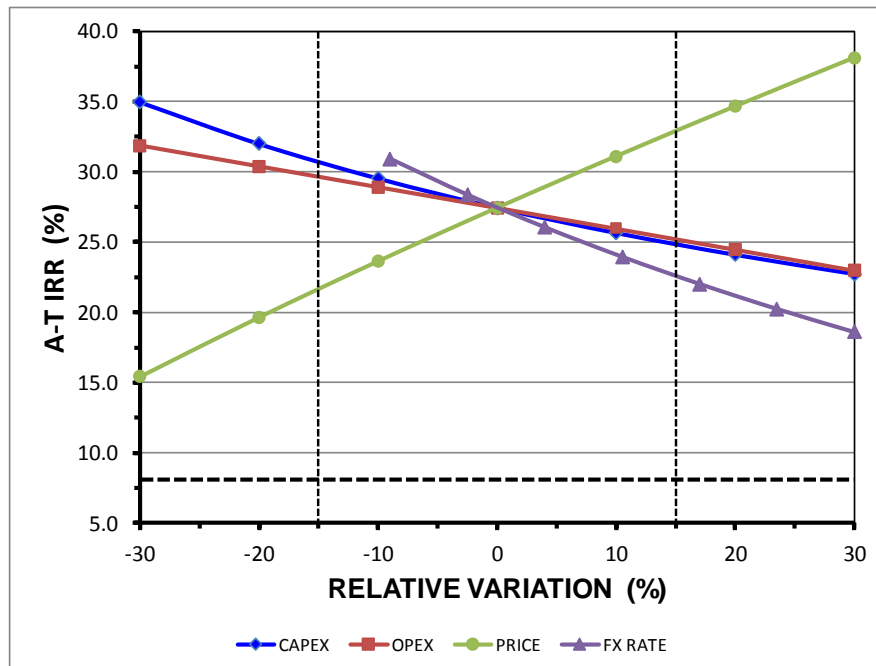


Figure 22.5, showing variations in after-tax internal rate of return, provides the same conclusions.

**Figure 22.5 – After-Tax IRR – Sensitivity to Capital Expenditure, Operating Costs, Prices and USD/CAD Exchange Rate**



## 23 ADJACENT PROPERTIES

Critical Element Corporation (“Critical Element”) holds most of the adjacent properties to the Whabouchi deposit (Figure 23.1). Its most notable property is the Nisk property which hosts the Nisk-1 Ni-Cu-Co-PGE deposit. The other properties located east and west of the Whabouchi Property are early stage projects and show potential for hosting magmatic and volcanogenic sulfides mineralization, as well as spodumene-bearing pegmatites.

Critical Element's Nisk property (owned by Monarques Resources and Nemaska Exploration in the past) hosts the Nisk-1 Ni-Cu-Co-PGE deposit. The deposit is associated with an elongated body of serpentinized ultramafic rocks that intrude paragneiss and amphibolite sequences. The ultramafic rock intrusion is interpreted as a sill composed of at least two (2) distinct ultramafic lithological units: a grey serpentinized peridotite with magnetite veinlets, and a black serpentinized peridotite with chrysotile veinlets hosting the Ni-Cu-Co-PGE sulphide mineralization. The Nisk-1 deposit hosts NI 43 101 compliant mineral resources (December 2009) with measured resource of 1,255,000 tonnes at 1.09% Ni; 0.56% Cu; 0.07% Co; 1.11 g/t Pd and 0.20 g/t Pt; indicated resource of 783,000 tonnes at 1.00% Ni; 0.53% Cu; 0.06% Co; 0.91 g/t Pd and 0.29 g/t Pt and inferred resource: 1,053,000 tonnes at 0.81% Ni; 0.32% Cu; 0.06% Co; 1.06 g/t Pd and 0.50 g/t Pt (Trudel, 2009). The resources are reported without the use of a cut-off grade.

### 23.1 Comparable Projects

Nemaska also published on January 15, 2014 a technical report for the resource estimation of a second lithium property named Sirmac. This property is located 120 km southeast of the Whabouchi Property. The Sirmac deposit comprises 185 kt of measured resources at an average grade of 1.40% Li<sub>2</sub>O, 79 kt of indicated resources at a grade of 1.40% Li<sub>2</sub>O and 40 kt of inferred resources at a grade of 1.10% Li<sub>2</sub>O, using a cut-off grade of 0.50% Li<sub>2</sub>O. A mineral potential for tantalum was also reported for the Sirmac property with 147kt at an average grade of 0.01% Ta<sub>2</sub>O<sub>5</sub> reported using a cut-off grade of 0.005% Ta<sub>2</sub>O<sub>5</sub>.

Other exploration properties also developing spodumene-bearing pegmatites are located in the region surrounding the Whabouchi Property. The Rose property owned by Critical Element Corp. and located 47 km northwest of Whabouchi hosts a NI 43 101 compliant mineral resource. The mineral resources estimate for the Rose Project is dated November 29, 2017 (WSP, 2017). This is the most recent Mineral Resources estimate for the Rose Project and it comprises indicated mineral resources of 31.9 Mt grading 0.93% Li<sub>2</sub>O and 148 ppm Ta<sub>2</sub>O<sub>5</sub> and inferred mineral resources of 2.8 Mt grading 0.82% Li<sub>2</sub>O and 145 ppm Ta<sub>2</sub>O<sub>5</sub>.

A cut-off grade (“NSR”) of \$30/t (for the open pit model) and \$110/t (for the underground model) were used for the Mineral Resource Estimate. The Projects hosts Probable mineral reserves of 26.8 Mt at 0.85% Li<sub>2</sub>O and 133 ppm Ta<sub>2</sub>O<sub>5</sub>. The reserve estimate is based with a constant recovery of 85% Li<sub>2</sub>O. Metal prices are set at \$15,000 USD/t Li<sub>2</sub>O and \$130 US/kg Ta<sub>2</sub>O<sub>5</sub> using an exchange rate of 1.25 CAD:USD.

Metallurgical recoveries are set at constant values of 85% for  $\text{Li}_2\text{O}$  and 64% for  $\text{Ta}_2\text{O}_5$ . The cut-off NSR value is \$29.70 CAD/t. These resources are part of a Feasibility study published by Critical Element in December 2017.

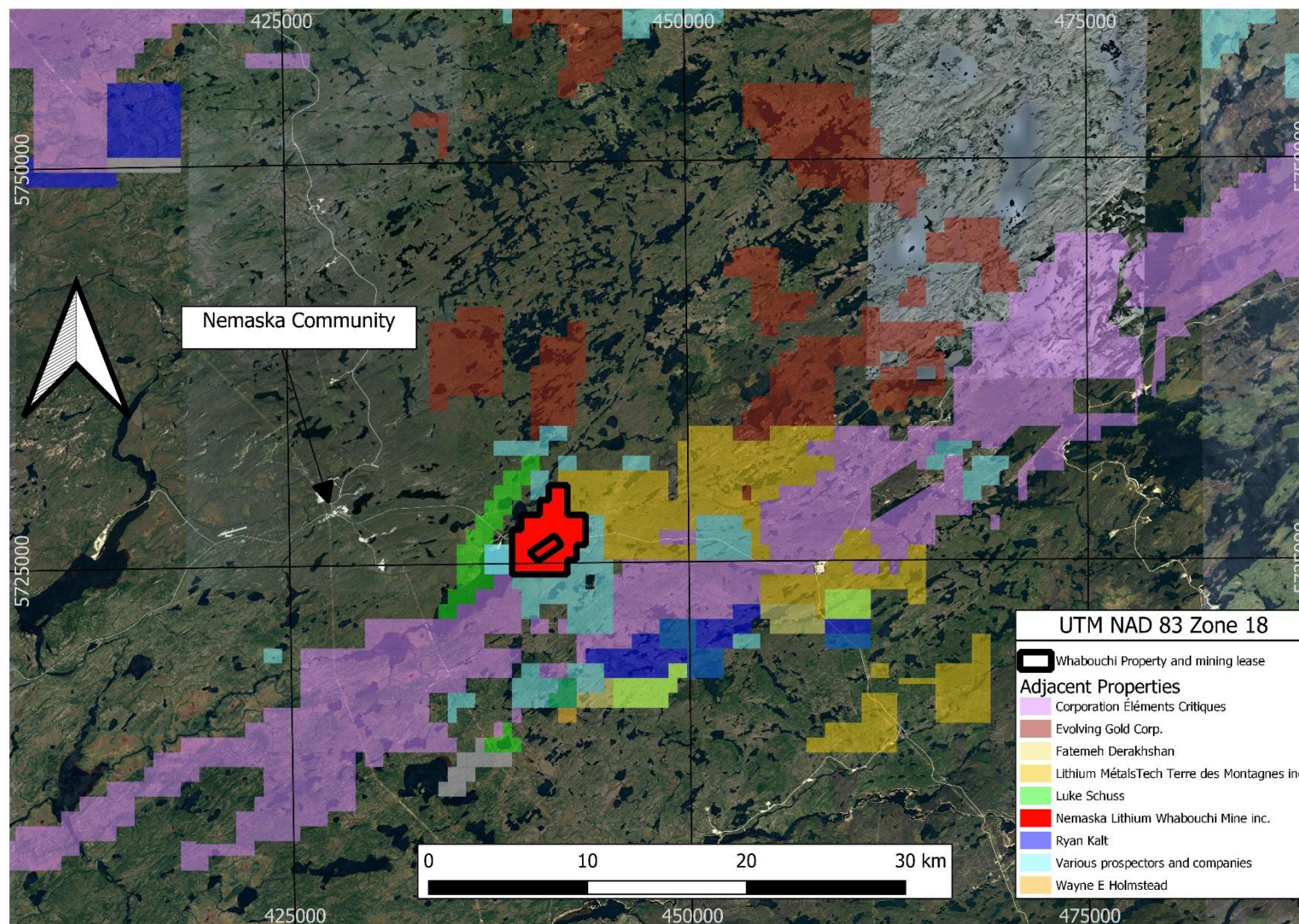
Galaxy Resources Inc. lithium property located 105 km northwest of Whabouchi hosts an NI 43-101 compliant with in-pit mineral resources containing indicated resources of 11.75 Mt grading at 1.30%  $\text{Li}_2\text{O}$  and inferred resources of 10.47 mt grading at 1.20%  $\text{Li}_2\text{O}$ . The mineral resources are reported using a 0.75%  $\text{Li}_2\text{O}$  cut-off grade (SRK – November 2010).

At 125 km southeast of Whabouchi, the Moblan property jointly owned by Perilya Ltd, through Globe Star Mining (60%) and Soquem (40%) hosts an NI 43-101 compliant mineral resources comprising 4.7 Mt grading 1.63%  $\text{Li}_2\text{O}$  in the measured category, 6.8 Mt grading 1.33%  $\text{Li}_2\text{O}$  in the indicated category with an additional 2.8 Mt grading 1.22%  $\text{Li}_2\text{O}$  in the Inferred category, using a cut-off grade of 0.6%  $\text{Li}_2\text{O}$  (Perilya NR – May 2011). The Project is now held by Lithium Guo Ao Ltée, a Canadian subsidiary of Shenzhen Guo Mining Investment Partnership (LP) (Shenzhen, China), with a role to develop the exploitation of lithium deposits in Canada. It is a sister company of Neotec Lithium (Taixing) Ltd., a lithium carbonate producer in Taixing, China

The information is not necessarily indicative of the mineralization on the Property that is the subject of the Technical Report.



**Figure 23.1 – Location Map Showing Adjacent Mineral Properties**



## 24 OTHER RELEVANT DATA AND INFORMATION

### 24.1 Project Schedule

#### 24.1.1 GENERAL

The schedules for the Whabouchi and Shawinigan Projects are dependent on the additional financing required for the completion of the Project. Nemaska has decided to prioritize Whabouchi over Shawinigan. Activities will continue at a slower pace during the summer and early fall months, but are expected to resume full construction activities for the purposes of the Technical Report by November 1, 2019. The following sections describe assumptions for both sites.

The planned production start-up is June 2020 for Whabouchi and November 2021 for Shawinigan.

#### 24.1.2 WHABOUCHI

The schedule for the Whabouchi Area is based on completion of the design activities throughout the summer months and full start of construction in November 2019 with construction completion in June 2020. The pre-construction activities include the following:

- Completion of the design for the water management system plus any geotechnical information required for the design;
- Start and completion of the design of the new crushing, drying and load-out facility including the procurement of the new associated equipment;
- Completion of the piping layouts for the concentrator;
- Completion of the power and automation cable routing for the crushing and processing areas;
- Re-evaluation of all existing contracts and negotiate new contracts with all contractors;
- Procurement of the remaining minor equipment not purchased to date;
- Complete the design for the new warehouse;
- Complete the design for the installation of the truck scale;
- Complete the design for the new fuel storage area;
- Complete the design for the propane tanks for the ore sorting building, the concentrator and the mine workshop;
- Finalise the P&ID's and complete the purchase of instruments not included with the equipment purchases.

Figure 24.1 presents a summary of the Whabouchi Project Schedule.

### 24.1.3 SHAWINIGAN

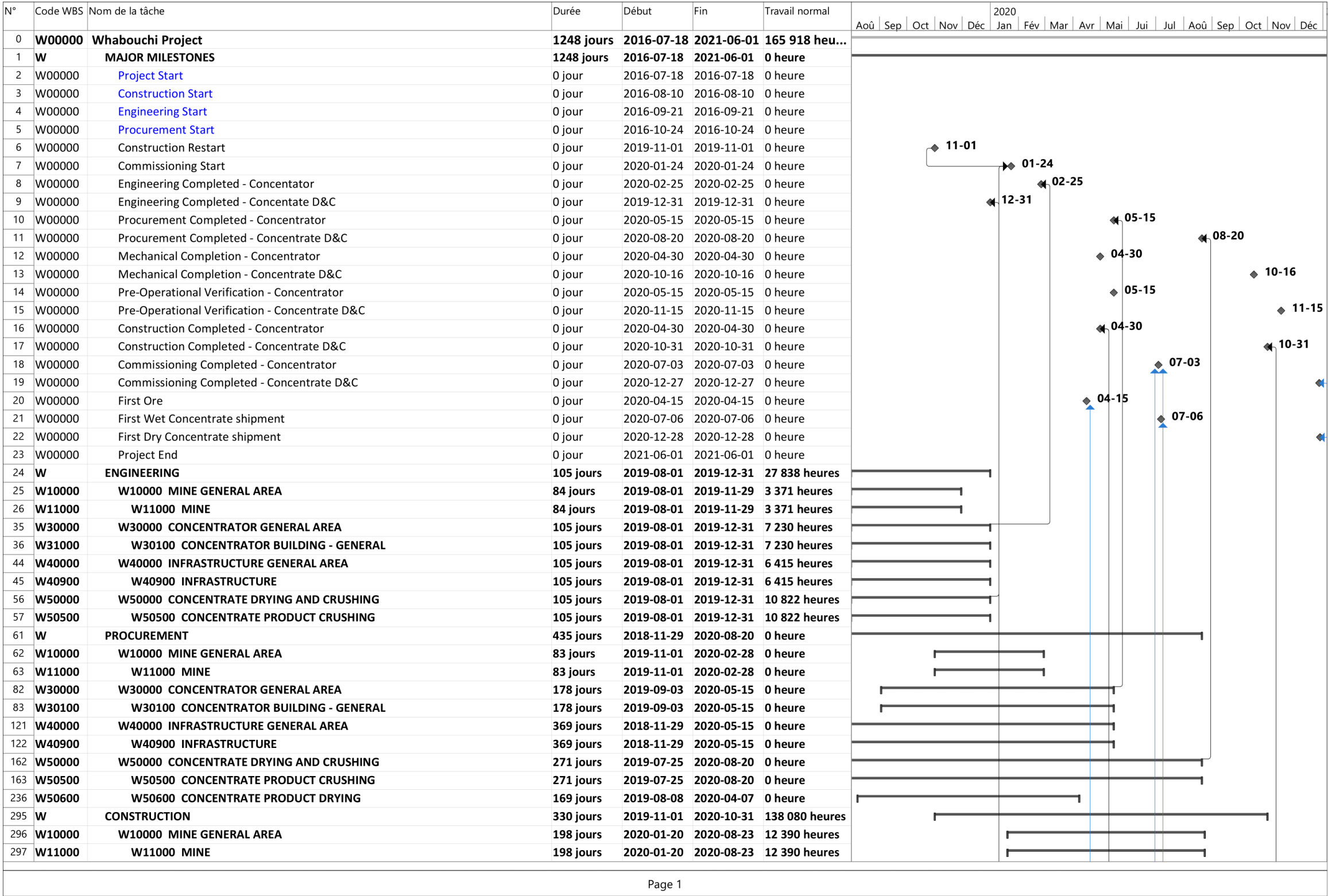
The schedule for Shawinigan was developed with the following assumptions:

- Equipment already purchased will be put on hold until financing is obtained except for the electrolyzers (by NORAM), LHM crystallizer (by Veolia) and SAC (by De Dietrich);
- Construction activities will be stopped, and the site will be closed in an orderly fashion so that the activities can quickly resume upon financing;
- Engineering will continue at a slower pace until the end of October 2019. Focus will be to complete engineering activities and construction documents that will be required to immediately start the construction upon financing;
- The inflexion points to receive Notice to Proceed and start to remobilize procurement, engineering and construction is November 1, 2019.

Figure 24.2 presents a summary of the Shawinigan Project Schedule.



Figure 24.1 – Whabouchi Project Schedule



N°	Code WBS	Nom de la tâche	Durée	Début	Fin	Travail normal	2020											
							Aoû	Sep	Oct	Nov	Déc	Jan	Fév	Mar	Avr	Mai	Jui	Jul
342	W20000	W20000 CRUSHING GENERAL AREA	90 jours	2019-11-01	2020-02-13	36 000 heures												
343	W20100	W20100 ROM CRUSHING AND ORE SORTING	90 jours	2019-11-01	2020-02-13	36 000 heures												
572	W30000	W30000 CONCENTRATOR GENERAL AREA	165 jours	2019-11-01	2020-04-30	64 290 heures												
573	W30100	W30100 CONCENTRATOR BUILDING - GENERAL	165 jours	2019-11-01	2020-04-30	33 230 heures												
1059	W30200	W30200 PRE-CONCENTRATION AND DENSE MEDIA SEPARATION (DMS)	146 jours	2019-11-01	2020-04-09	6 900 heures												
1099	W30300	W30300 MUSCOVITE REMOVAL, GRINDING ANDWET MAGNETIC SEPARATION	97 jours	2020-01-09	2020-04-17	3 340 heures												
1115	W30400	W30400 SPODUMENT FLOTATION	96 jours	2019-12-09	2020-03-28	3 530 heures												
1131	W30500	W30500 DMS CONCENTRATE DRYING & DRY MAGNETIC SEPARATION	59 jours	2020-03-01	2020-04-30	2 400 heures												
1142	W30600	W30600 CONCENTRATE DEWATERING	137 jours	2019-11-01	2020-03-31	5 690 heures												
1167	W30700	W30700 TAILINGS HANDLING	164 jours	2019-11-01	2020-04-29	3 100 heures												
1187	W30800	W30800 REAGENTS & UTILITIES	165 jours	2019-11-01	2020-04-30	6 100 heures												
1220	W40000	W40000 INFRASTRUCTURE GENERAL AREA	224 jours	2019-11-01	2020-06-30	11 500 heures												
1221	W40000	W40300 PROPANE	120 jours	2019-11-01	2020-03-14	210 heures												
1231	W40900	W40900 INFRASTRUCTURE	222 jours	2019-11-01	2020-06-28	6 770 heures												
1262	W40940	W40940 Water Management	224 jours	2019-11-01	2020-06-30	4 520 heures												
1291	W50000	W50000 CONCENTRATE DRYING AND CRUSHING	301 jours	2019-12-01	2020-10-31	13 900 heures												
1292	W50500	W50500 CONCENTRATE PRODUCT CRUSHING	301 jours	2019-12-01	2020-10-31	9 650 heures												
1366	W50600	W50600 CONCENTRATE PRODUCT DRYING	201 jours	2020-01-14	2020-08-20	4 250 heures												
1418	W	COMMISSIONING	456 jours	2020-01-24	2021-06-01	0 heure												
1419	W20000	W20000 CRUSHING GENERAL AREA	75 jours	2020-01-29	2020-04-14	0 heure												
1420	W20100	W20100 ROM CRUSHING AND ORE SORTING	47 jours	2020-01-29	2020-03-15	0 heure												
1438	W20000	ORE COMMISSIONING	30 jours	2020-03-16	2020-04-14	0 heure												
1439	W30000	W30000 CONCENTRATOR GENERAL AREA	437 jours	2020-02-12	2021-06-01	0 heure												
1440	W30100	W30100 CONCENTRATOR BUILDING - GENERAL	16 jours	2020-04-24	2020-05-09	0 heure												
1447	W30200	W30200 PRE-CONCENTRATION AND DENSE MEDIA SEPARATION (DMS)	97 jours	2020-02-12	2020-05-21	0 heure												
1476	W30300	W30300 MUSCOVITE REMOVAL, GRINDING AND WET MAGNETIC SEPARATION	54 jours	2020-03-27	2020-05-22	0 heure												
1492	W30400	W30400 SPODUMENE FLOTATION	45 jours	2020-03-22	2020-05-07	0 heure												
1508	W30500	W30500 DMS CONCENTRATE DRYING & DRY MAGNETIC SEPARATION	26 jours	2020-05-01	2020-05-27	0 heure												
1515	W30600	W30600 CONCENTRATE DEWATERING	57 jours	2020-03-29	2020-05-27	0 heure												
1529	W30700	W30700 TAILINGS HANDLING	78 jours	2020-03-15	2020-06-03	0 heure												
1543	W30800	W30800 REAGENTS & UTILITIES	34 jours	2020-04-14	2020-05-17	0 heure												
1556	W30000	WET COMMISSIONING	30 jours	2020-06-04	2020-07-03	0 heure												
1557	W30000	RAMP UP TO 60%	60 jours	2020-07-04	2020-09-01	0 heure												
1558	W30000	COMMERCIAL PRODUCTION	30 jours	2020-09-02	2020-10-01	0 heure												
1559	W30000	RAMP UP TO 100%	243 jours	2020-10-02	2021-06-01	0 heure												
1560	W40000	W40000 INFRASTRUCTURE GENERAL AREA	210 jours	2020-01-24	2020-09-09	0 heure												
1561	W40900	W40900 INFRASTRUCTURE	210 jours	2020-01-24	2020-09-09	0 heure												
1576	W50000	W50000 CONCENTRATE DRYING AND CRUSHING	153 jours	2020-07-03	2020-12-27	0 heure												
1577	W50500	W50500 CONCENTRATE PRODUCT CRUSHING	26 jours	2020-11-01	2020-11-27	0 heure												
1581	W50600	W50600 CONCENTRATE PRODUCT DRYING	43 jours	2020-07-03	2020-08-28	0 heure												
1588	W50000	ORE COMMISSIONING	30 jours	2020-11-28	2020-12-27	0 heure												

Page 2

### Nemaska - Shawinigan Electrochemical Plant - Execution Schedule





## 24.2 Whabouchi Construction

### 24.2.1 PROJECT STATUS

As of the effective date of writing of this Technical Report, project construction has started and is partially completed. Overall construction advancement stands at approximately 35%.

#### 24.2.1.1 Mine

In 2018, purchase orders for mining equipment were placed. Deliveries and assembly have taken place and pre-production mining activities have begun. Plans are in place to perform the mine production tonnages corresponding to the mine planning requirements.

The support facilities for the mine include the mine garage and wash bay, the tank farm, warehouse, waste rock and tailings co-disposal area and the low grade stockpile.

The mine garage facility is constructed with some enhancements required such as a new concrete floor, addition of offices, equipment, tooling, and hydraulic lift for the service equipment.

The wash bay, warehouse and tank farm have not been designed to date.

SNC has completed preliminary design of the waste rock and tailings co-disposal areas. However, detailed design of the area and purchase of equipment and issuance of construction tender documents have not yet been prepared.

The layout and design of the low grade stockpile has not been prepared to date.

#### 24.2.1.2 Crushing System

The detailed design of the crushing system, comprising the primary crusher, ore sorting building, secondary and tertiary crusher building and the interconnection conveyors, transfer towers and screening towers, is complete. The purchase of the equipment is also essentially complete with only minor equipment remaining to be procured.

The earthworks and foundations for the crushing system facilities is about 85% completed. The primary crusher and incoming hopper are installed as well as the secondary and tertiary crushers. The ore sorting facility is completed, but no equipment has been installed to date. The secondary and tertiary crusher building has not been erected to date.

The crushing system electrical module is in place and fully operational. The module is connected to the main substation via a buried line.

The remaining work focuses on the installation of the equipment in the ore sorting facility, the installation of all interconnecting conveyors, the finalization of the erection of the equipment in the secondary and tertiary crusher as well as the building structure, the completion of the transfer towers and screening tower.

Figure 24.3 shows the construction status of the primary crusher (located to the left of the picture), the electrical room (center) and the secondary and tertiary crusher building (located on the side of the picture). The picture was taken on May 7, 2019.

**Figure 24.3 – View of Primary and Cone Crusher Buildings**



Figure 24.4 shows the screening tower in the foreground and the fine ore storage and concentrator in the background. The construction camp facilities are shown in the background on the top of the hill. This picture was also taken on May 7, 2019.

**Figure 24.4 – View of Screening Tower, and Concentrator**



#### 24.2.1.3 Concentrator

The design of the concentrator is nearing completion. The balance of the design focuses on finalizing the piping layouts, and the completion of the P&ID's. There are only a few equipment or systems that have to be procured. The fire detection system must be re-evaluated and issued for bid.

The fine ore and tailings dome is complete as well as the concentrator building shell and roof. The three (3) electrical modules are installed adjacent to the concentrator. The concentrate dome is also complete but will be dismantled to allow for the construction of the crushing, drying and loadout facility.

The balance of work to be done in the fine ore and tailings facility is the construction of the conveyor foundations, installation of the process equipment and conveyors and power connections.

The work in the concentrator has been ongoing and much of the interior foundation and structural steel work is completed. The design has been sent to the steel supplier for fabrication as well as the pipe supports. The building shell for the process water tank and thickener has not been erected, nor has the steel stairs linking the electrical rooms, laboratories and the concentrator.

Figure 24.5 shows the interior of the concentrator with two operating cranes, some of the erected equipment and installation of cable trays along the south wall. (Taken on May 7, 2019).

**Figure 24.5 – View of Concentrator Interior**





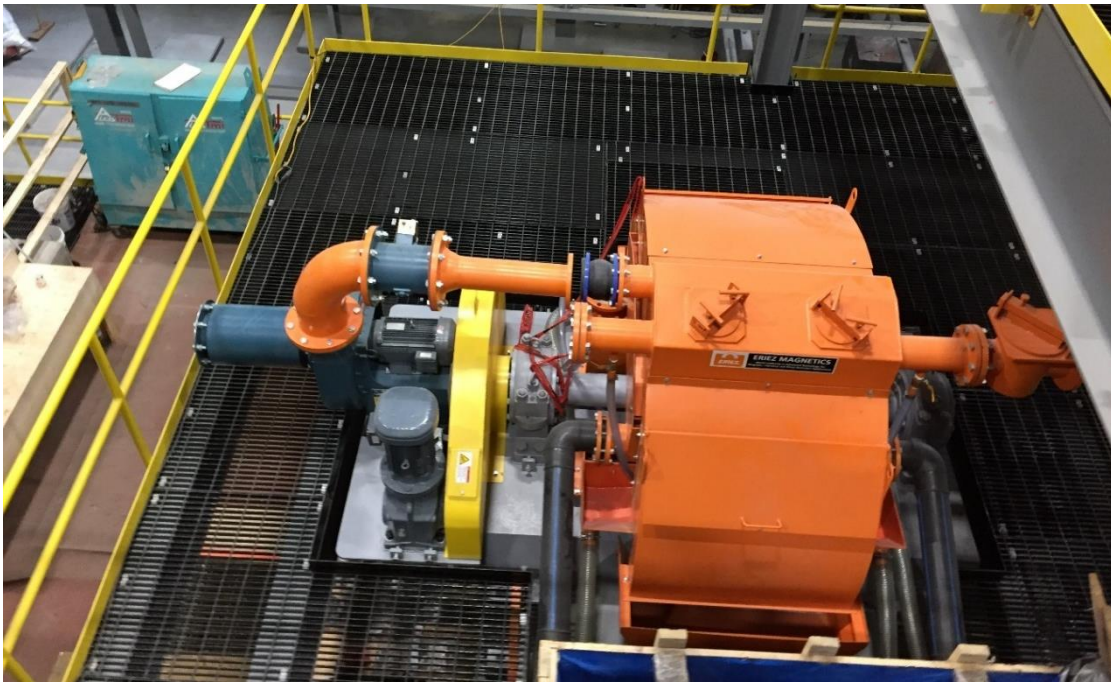
The erection of the equipment is on-going with some equipment installed. Two overhead cranes are in place to assist in the erection of the equipment. Power for the work in the concentrator is provided by the main substation.

The office facilities and control room are enclosed, and a contract has been issued for the completion of the interior features. Figure 24.6 shows the status of the offices and control room. Figure 24.7 to Figure 24.12 show views of the construction as of May 7, 2019 in the concentrator area.

**Figure 24.6 – View of Offices and Control Room**



**Figure 24.7 – View of the Wet High Intensity Magnetic Separator**



**Figure 24.8 – View of the Reagent Area**

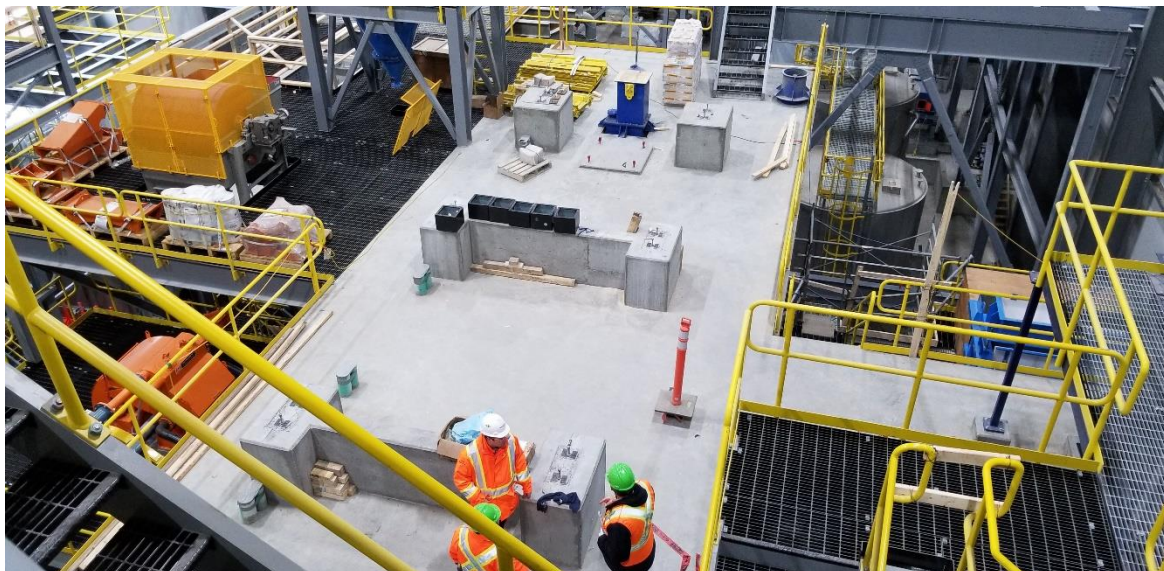


**Figure 24.9 – View of the Process Water Tank and Thickener Area**





**Figure 24.10 – View of the Dryer Foundations**



**Figure 24.11 – View of the Hydrocyclone**



**Figure 24.12 – View of the Hydraulic Separators**



#### 24.2.1.4 Infrastructure

The administration building was completed and is currently occupied by Nemaska field personnel. No further changes to this facility are envisioned.

The laboratories have been procured and the five (5) modules are on site fully furnished. The foundations for the laboratories are complete.

The gate house is fully functional. The truck scale will be relocated from the ore storage building to the gate house area to suit the new crushing, drying and load out facility.

Most of the site work, roads and parking lots have been completed and provision is made for final leveling. A new mine haul road overpass has been included for the mine trucks to have easy access to the co-disposal area.

The fire protection facility is nearing completion as only the fire pumphouse remains to be delivered. Once delivered, it will be installed and connected to the existing system. The underground fire loop is in place.

Work will be required to the *Route du Nord* to repair ditches.



The water management system includes basins and equipment to manage the excess water from the pit and from the general area. Some of the basins have been completed. However, the water management system has to be restudied and re-designed and this process is currently on-going.

The construction camp is a fully functional camp housing both the Nemaska and contractor personnel. The catering and camp services are currently undertaken by a Cree company. Following completion of the construction, Nemaska will upgrade the camp to a “management / operation standard.” The extra camp modules will be dismantled and returned to the camp supplier. The camp is serviced with potable water and sewage treatment. A concrete batch plant and aggregate crushing plant is mobilized to site.

A 169-room camp is already installed at the *Relais Routier Nemiscau* and operated by a Cree company that can accommodate supplemental current Project needs as required.

#### 24.2.2 MOVING FORWARD

Site infrastructure work is well advanced and overall construction advancement stands at approximately 35%.

The required permitting for the construction of all site infrastructure was secured by Nemaska in 2016 and 2017, as outlined in Section 20.0.

The concentrator completion strategy takes into account that detailed engineering is essentially completed; remaining work is centered on electrical and process piping checks.

##### 24.2.2.1 Engineering

The detailed engineering for the concentrator and crushing system is nearing completion and will be completed by the 3<sup>rd</sup> quarter 2019.

##### 24.2.2.2 Long Lead Items

All long lead items have been procured and deliveries are expected by August 2019.

##### 24.2.2.3 Procurement Plan

Procurement of equipment and construction supplies is substantially completed. Remaining procurement will be focussed on electrical and piping components once the associated engineering is completed.

##### 24.2.2.4 Construction

The first priority will be site preparation and temporary installations such as construction management facilities and temporary construction power distribution. Construction activities (mechanical, piping and electrical) will continue until completion in second quarter (Q2) of 2020 including the crushing and screening area. Other work activities not on the critical path will be optimized, based on resources leveling and availability.

Detailed engineering for water management was initiated in the fall of 2016. Actual earthworks and trenches, required for the start-up of operations, started in the fall of 2016 and were pursued in 2017. Final works will be completed in 2020.

#### 24.2.2.5 *Commissioning and Start-Up*

The commissioning activities will be performed by a team comprised of construction managers, contractors, engineers, suppliers' representatives and operation personnel. Commissioning will be managed by operations personnel. A four (4) months commissioning period has been scheduled. The commissioning will start as soon as systems are ready to be handed over. A detailed commissioning schedule will identify process systems that can be commissioned prior to construction completion and turned over to operations. Commissioning will start with individual equipment evaluation followed by a dry run for a short period. Systems will then be flushed and run with water, where possible, to check functionality of controls and equipment. Any discovered deficiencies or leaks will then be repaired. Once all process deficiencies are corrected, systems will be handover to the production personnel to start normal operation.

#### 24.2.3 SCHEDULE CRITICAL PATH

The Project critical path for shipping a wet concentrate is as follows:

- Project funding and remobilization of the engineering and construction teams;
- Electrical and piping detailed engineering completion;
- Procurement of electrical and piping material;
- Completion of electrical and piping works in the concentrator (W30000);
- Mechanical completion of the concentrator (W30000);
- Wet and Ore commissioning;
- Achieving commercial production and shipment of wet concentrate.

##### 24.2.3.1 *Project Constraints and Dependencies*

There are several constraints and dependencies that must be considered in the Project Schedule:

- The completion of water management basins BC11 is required primarily to store water for the first winter of operation and manage major surface water flows particularly during the spring freshet. This basin will not be completed for the spring freshet for 2020 (however, it should be partially functional), and can be completed prior to the end of the summer of 2020 in time to serve as a fresh water basin for winter concentrator operation.
- Winter weather – These conditions may impact the productivity of certain construction activities; and have been considered given the hypothesis of construction remobilization in November 2019. Should the remobilization be delayed, this may impact actual productivities and cost;



- Increase available power from Hydro-Québec from 10 MW to 13 MW – will be required for continuous commercial production. If not available, some heating loads may need to be fueled by propane or diesel, and/or some temporary diesel power generation may be required.

Figure 24.13 depicts the Critical Path for Whabouchi.

## 24.3 Shawinigan Construction

### 24.3.1 PROJECT STATUS

As of the effective date of writing of this Technical Report, project construction has started. Overall construction advancement stands at approximately 5%.

### 24.3.2 SITE INFRASTRUCTURE

All the site infrastructure necessary to resume construction activities are in place:

- The administrative building was completed end of 2018;
- Temporary power necessary to cover construction requirements is available;
- Permanent power will be delivered by Hydro-Québec on time for the start of Pre-Commissioning activities.

### 24.3.3 ELECTROCHEMICAL PLANT

#### 24.3.3.1 *Electrochemical Transformation Plant Implementation Plan*

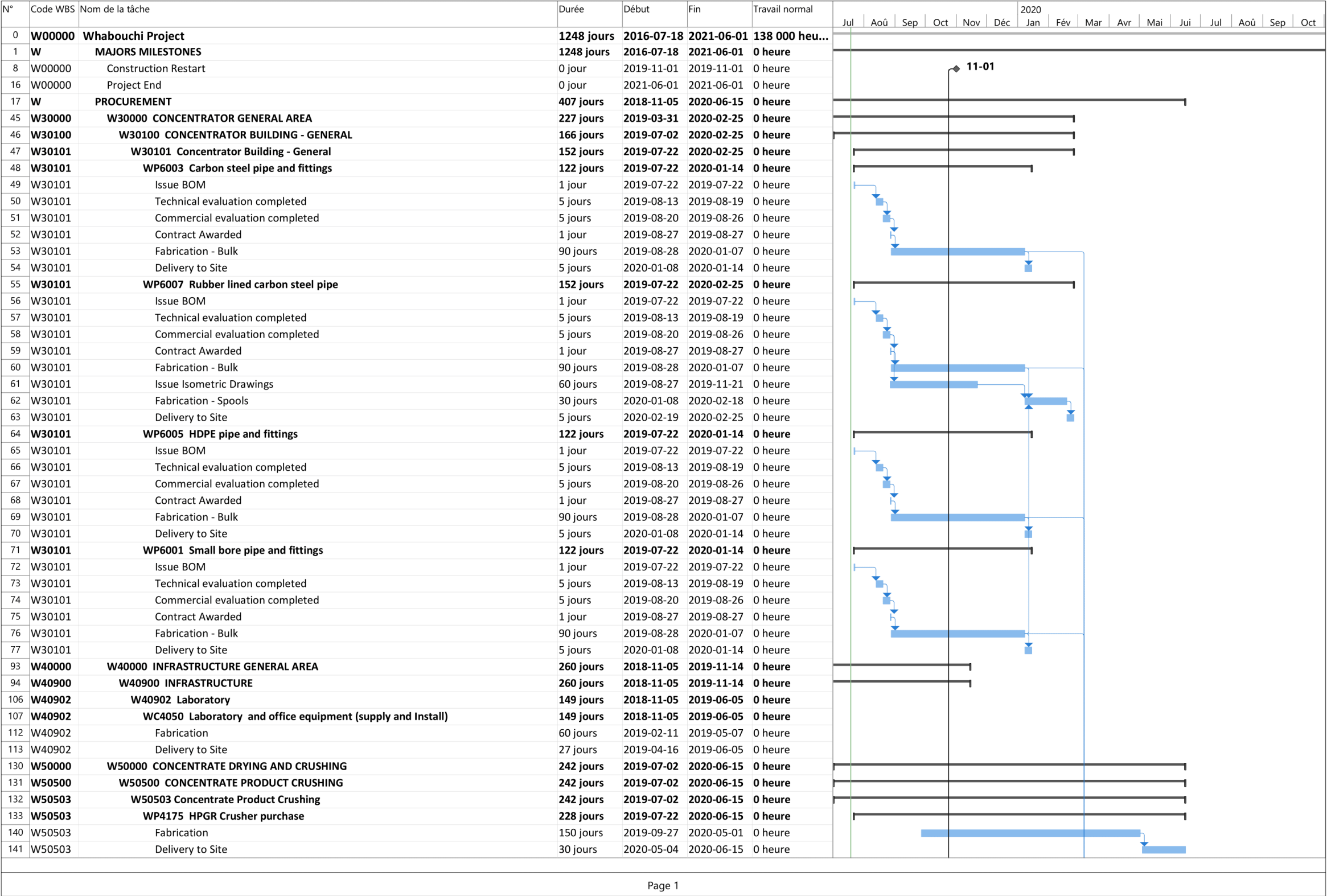
The Electrochemical Transformation Plant implementation strategy assumes that engineering will continue at a slower pace until the end of October 2019 which is the assumed date to obtain financing and full notice to proceed. Upon financing it has been assumed that a period of 6 weeks will be required to reconfirm pricing and schedule for awarded pre-purchased packages and construction contracts. The remaining of the schedule covers the completion of equipment procurement, engineering and construction up the end of plant commissioning. Duration for equipment supply is obtained from vendors. Engineering, construction and pre-commissioning duration are based on level of effort and work schedule.

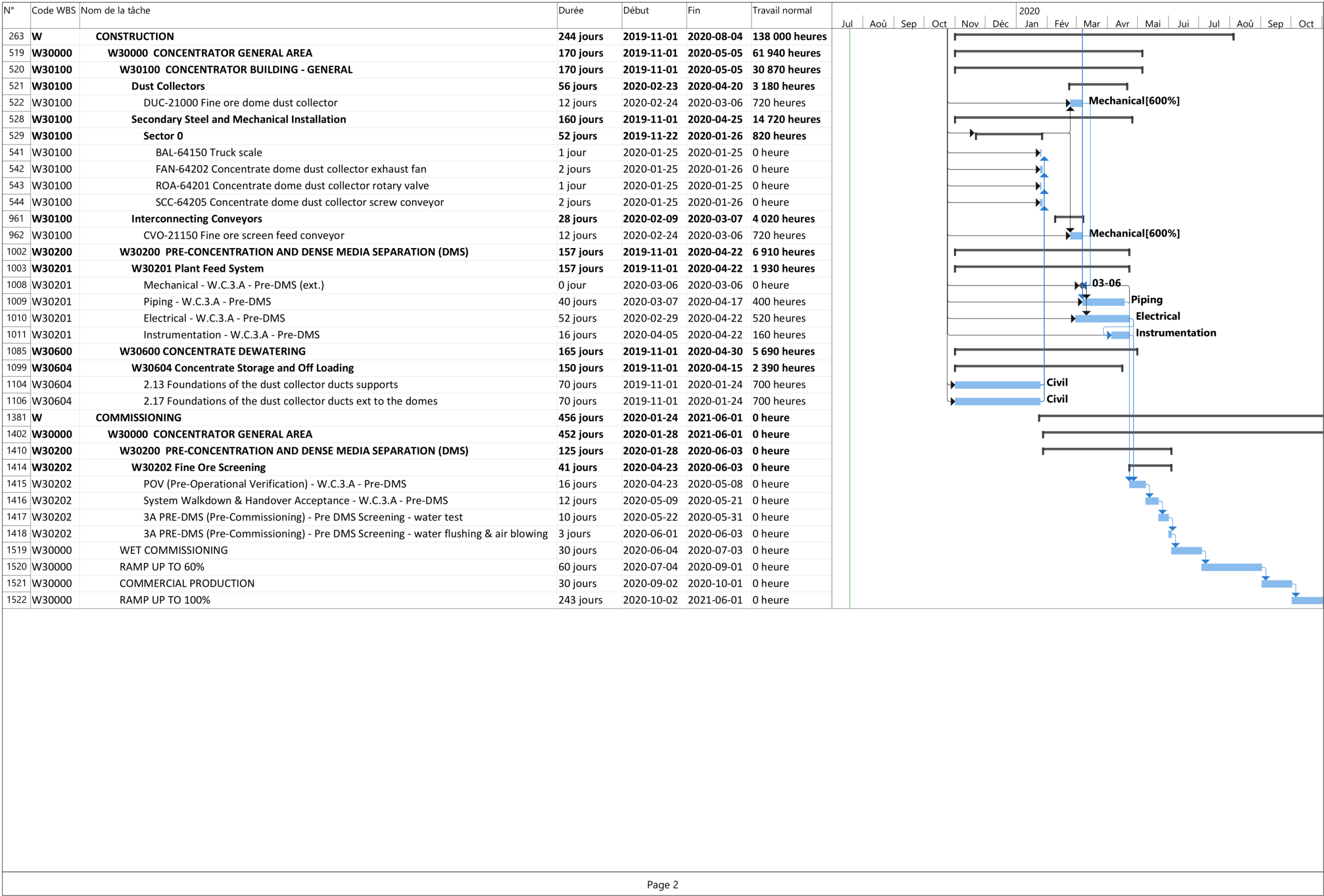
#### 24.3.3.2 *Engineering*

Engineering at the end of May 2019 is approximately 45% completed. Until the end of October, the engineering focus will be to complete engineering activities that can immediately resume upon financing i.e. remaining piling inside Buildings #67 and #80, foundation for Building #67 (column, acid bake kiln) and calciner foundations & structure. Engineering will also progress for all sector with a reduced team. Remaining HAZOP (services) not yet completed will be performed.

Assuming that the team is remobilized early October, the engineering will be mostly completed by the end of Q4 2020.

Figure 24.13 – Whabouchi Critical Path





#### 24.3.3.3 Long Lead Items

All the long lead critical equipment is either awarded or clarification process started.

Critical awarded packages are:

- Calciner;
- Electrolysis;
- LHM & LSM crystallizers;
- SAC;
- Acid bake kiln;
- Acid bake coolers;
- Candle filter;
- Belt filters;
- LHM dryer;
- Filter presses;
- Thickener;
- Transformer.

In the current schedule it is assumed that a six-weeks period will be required to confirm price and schedule upon financing.

Fabrication has also started for some of the key packages (calciner, electrolysis, crystallizers, SAC, acid bake in). Figure 24.14 to Figure 24.17 show fabrication progress on some of the major packages.

**Figure 24.14 – Calciner Cyclones**



**Figure 24.15 – Electrolysis Transformer FAT Test**





**Figure 24.16 – LHM Crystallizer Falling Film Evaporator**



**Figure 24.17 – SAC-Regenerated Acid Storage**



#### 24.3.3.4 Procurement Plan

All the pre-purchased equipment and construction contracts are included in the master schedule.

For the remaining smaller equipment which is not on the critical path, procurement process will resume as soon as financing is obtained.

Construction contract activities will also resume as soon as financing is obtained.

#### 24.3.3.5 Construction

As of the end of May 2019 construction progress is as follows:

- External demolition east of Building #67 is completed;
- Demolition inside Buildings #67 and #80 is essentially completed except for Building #67 B;



- Piling activities are also well advanced for Buildings #67 and #80 and started west of Building #80. All the piling material necessary to complete work is stored at site;
- Concrete activities also started for Buildings #67 and #80 with rebar installation started for pile cap and tanks in Building #67.
- Structural reinforcement of Building #67 is well underway;
- The installation of the girth east and south Building #67 are also well advanced and ready for cladding installation. Cladding material is stored at site;
- Structural contract for the new steel for Buildings #67 and #80 was awarded but fabrication has not yet started.

Figure 24.18 to Figure 24.21 show construction progress in some of the areas.

**Figure 24.18 – Building #67 East Wall Cladding and Structural Reinforcement**



**Figure 24.19 – Building #80 Form Work and Rebar for Tanks Foundations**



**Figure 24.20 – Building 67 Formwork & Rebar for Pile Caps and Tank Foundations**



**Figure 24.21 – Piling West of Building #80**



When construction activities resume in December 2019, the focus will be to complete reinforcement of Building #67 and the cladding on the east wall so that subsequent construction activities can be done inside, protected from the weather. Building #80 is already fully enclosed.

Remaining piling activities will also resume in the proper sequence to complete concrete foundations for tanks to liberate access for the other activities.

Structural contract for Buildings #67 and #80 will also resume. Sequencing will match equipment delivery.

Site preparation for the calciner location will start in January 2020, allowing foundation works to start in the spring of 2020.

Major equipment delivery will span from Q2 2020 to Q1 2021. The equipment installation (mechanical, piping, electrical and instrumentation work) will start from Q2 2020 to Q3 2021. The pre-commissioning activities will start in parallel to the construction activities as soon as systems are ready to be handed over. Other work activities not on the critical path will be further optimized, based on resources leveling.

#### 24.3.3.6 Pre-Commissioning, Commissioning, and Ramp-Up

The pre-commissioning activities will follow the mechanical completion of the systems and will take about eight (8) months to complete.

A preliminary commissioning strategy has been prepared. Ground material from Whabouchi site will be required to start commissioning, therefore grinding system will need to be installed and commissioned at Whabouchi, and an allowance for transport included.

In order to accelerate commissioning and optimize the First Production date, Nemaska intends to commission Line 1 Electrolysis at first.

All systems will be commissioned independently to one another and as soon as they become available. LHM, LSM and high purity acid will be purchased and used to commission the equipment. Certain systems will be run in recirculation mode to debug them. Other systems will be commissioned with beta spodumene but without the addition of acid in order to avoid needing to dispose or store large volumes of lithium containing solutions.

Once all systems have been commissioned independently, acid will be added to the spodumene and the systems will be integrated, marking the First Production Achieved milestone.

Total commissioning activities will take about six (6) months to complete which is in line with industry standards.

The ramp up of production to 60% will take approximately 10 months which is in line with the McNulty 2.5 curve for ramp-up. When this milestone is reached Nemaska will need to maintain production at that level or higher for at least one month. Beyond that date the expenses are no longer capitalised.

A detailed commissioning plan will be prepared in the subsequent project phase. This will include further optimization and levelling of the Pre-Commissioning and Commissioning activities.

#### 24.3.4 CRITICAL PATHS

In the context of this project, Critical Path is defined as the activities having ten (10) days or less of Total Float. As such, the project schedule has 3 critical paths. The first one leads to the *Substantial Completion* Milestone (end of Pre-Commissioning activities / Hand-over to Nemaska), and runs through the Negotiation of the awarded packages, to the Construction works in the Building #80 – Electrolysis and through the *Mechanical Completion* milestone.

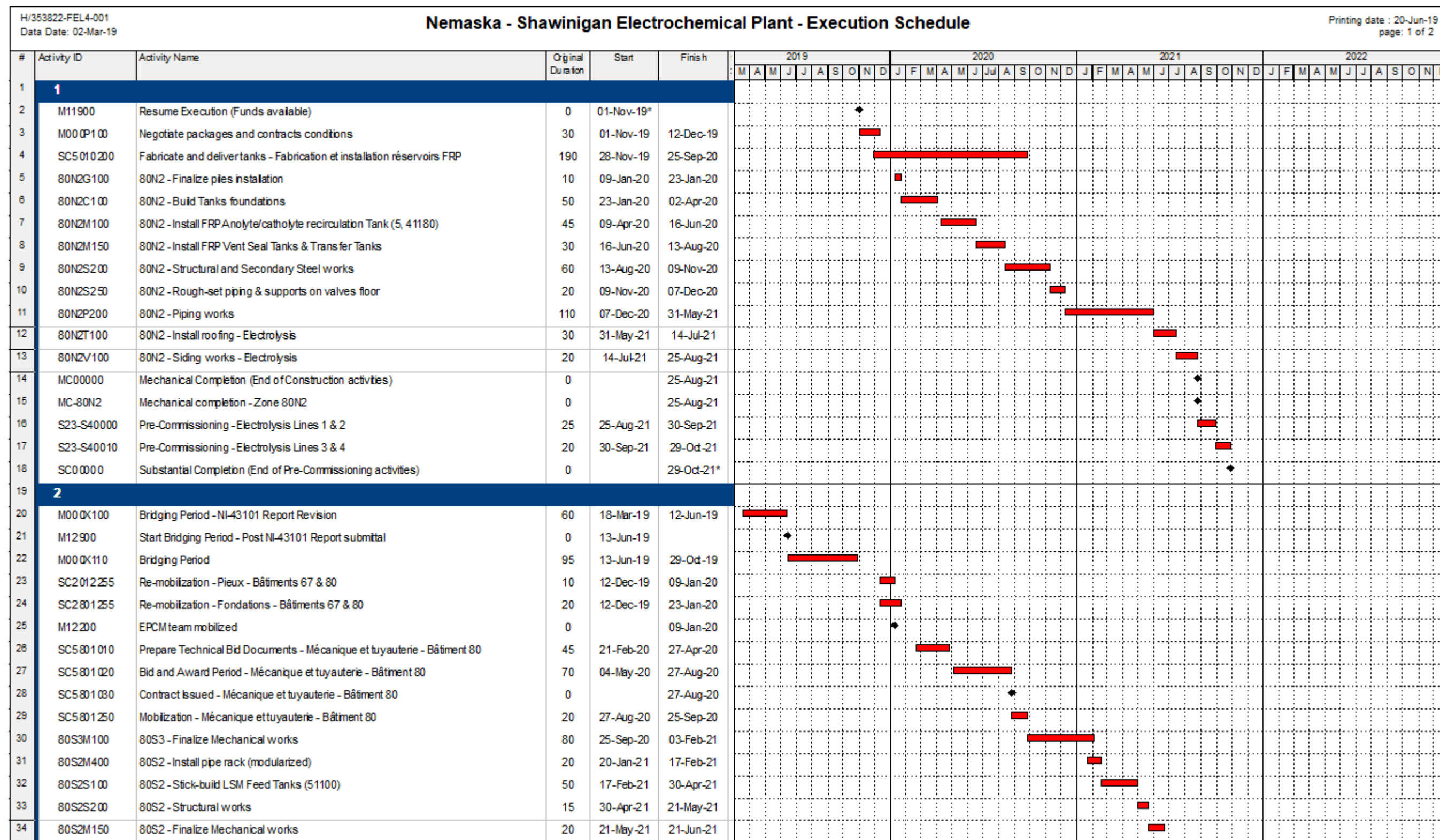
The second critical path leads to the Commercial Production Achieved milestone (by Nemaska) and runs through the Engineering and Procurement activities up to the mechanical and piping works in Building #80 contract award, continues through the Construction activities in Building #80, anolyte and catholyte treatment area, their corresponding Pre-Commissioning and Commissioning activities, and then to the Commissioning - Systems integration up to First Production achieved.



Finally, the third critical path includes activities related to the engineering and contract formation of the mechanical and piping works in Building #67 contract, followed by construction activities in the same area, leading to the Mechanical Completion of Building #67 milestone, continuing through the Pre-Commissioning of the Purification Area and ending with the corresponding Commissioning activity.

Figure 24.22 depicts the Critical Path for Shawinigan.

**Figure 24.22 – Shawinigan Critical Path**











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## 25 INTERPRETATION AND CONCLUSIONS

The Whabouchi Lithium Mine and Electrochemical Plant Project consists of the development of a mine approximately 300 km North of Chibougamau and a lithium hydroxide production complex to be built in Shawinigan.

### 25.1 Conclusions

The mine plan will have to optimize several parameters of the ore feed ( $L_2O$ , dilution, etc.) to meet the planned mill capacity and avoid overloading the ore sorters. Additional blending will be realized by the front-end loader at the primary crusher through the use of ROM buffer piles.

During the 26year life of the open pit mine, a total of 32.4 Mm<sup>3</sup> of waste rock and 14.7 Mm<sup>3</sup> of tailings will be generated for a total of 47.1 Mm<sup>3</sup>. The underground mine will generate an additional 0.4 Mm<sup>3</sup> of waste rock and 4.9 Mm<sup>3</sup> of tailings. In total, the Project will generate 52.4 Mm<sup>3</sup> of waste materials. Four (4) co-disposal storage facilities were designed. All the waste rocks and filtered tailings will be contained in these facilities, except 6 Mm<sup>3</sup> of waste rocks that will be disposed in the open pit mine and could be used as backfill material for the underground operation.

The water management infrastructure is sized based on the required volume of surface runoff to manage. It varies with the catchment area of the co-disposal storage facilities. Through the course of project development, a total of 13 water collection ponds will be required to manage the surface runoff on the Whabouchi mine site.

The final effluent will release water in Nemiscau River with regular monitoring of flow and water quality. If required, a water treatment plant will be implemented to ensure full compliance with all applicable quality criteria. Tests indicate that the ore and waste are non-acid generating and no elements are leachable. The water management system has been designed to allow for sufficient settling time.

Nemaska has developed a novel industrial process for extracting lithium from spodumene to produce lithium hydroxide monohydrate.

Compared to other hard rock lithium extraction processes, Nemaska will not use soda ash (sodium carbonate) and will not generate salt cake (sodium sulfate) that is normally a by-product of lithium extraction from spodumene. It is anticipated that the use of flash calcination will reduce fuel costs compared to the traditional rotary kiln process. Recovery and recycling of sulfuric acid, generated in the electromembrane process, has a significant impact on the operating costs by substantially lowering both the sulfuric acid and lime requirements as well as the by-production of gypsum cake, which must be disposed of. The electromembrane process permits the synthesis of lithium hydroxide directly from lithium sulfate solution, making use of Quebec's advantageous electricity prices. Multiple purification steps will allow the production of high purity final products.

Extensive laboratory and pilot test work have been used to develop the new processing technologies and de-risk the Project.

All required permits for construction and a large proportion of the permits required for operation have already been secured for both sites.

DRA/Met-Chem and the other QPs have examined the technical and economic aspects of the Whabouchi Lithium Mine and Electrochemical Plant Project within the level of precision appropriate for the current status of the Projects. The current Report is an Estimate to Complete for the Whabouchi and Shawinigan Projects with the standards required by NI 43-101 and Form 43 101F1.

A computed cash flow analysis was developed by DRA/Met-Chem from the technical aspects and based on metal price projections made for lithium hydroxide from a reputable market study firm.

Currently, the results of the drilling program show that the Whabouchi Mine contains Mineral Reserves.

Consequently, DRA/Met-Chem concludes that the Whabouchi Lithium Mine and Electrochemical Plant Project is technically feasible as well as economically viable. The authors of this Technical Report consider the Project to be sufficiently robust to warrant pursuing the implementation phase.

## 25.2 Opportunities

### 25.2.1 WHABOUCHI CONCENTRATOR

- The addition of a scavenger ore sorter can increase the lithium recovery with 0.5 to 1%.

## 25.3 Risk Evaluation

Most aspects of the Whabouchi Lithium Mine and Electrochemical Plant Project are well defined. However, some risks remain. In Section 26, the authors have proposed several recommendations that should be followed in the next phase to mitigate these risks.

Approximately 21% of the contained metal at the reported cut-off grades for open pit current Mineral Resource is in the Inferred Mineral Resource classification. The Inferred Resource is based on limited information and although it is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated or Measured Mineral Resources with adequate infill drilling, it is not guaranteed.

The most significant risks identified in the Project were in technology, markets and environment, as explained in the following paragraphs.

### 25.3.1 WHABOUCHI MINE AND CONCENTRATOR

#### 25.3.1.1 Mining

On the mining side, although moderate, a potential risk exists concerning the stability of the pit slopes and underground openings. Mitigation measures include re-evaluation of the final pit walls after a

few years of operation and prepare a detail geotechnical study for the stability of the underground infrastructure and open stopes.

Although considered a small risk, trace amounts of sulphide minerals could be present in the orebody or waste rock and potentially generate acidic drainage waters if unmanaged. Should sulfur bearing mineral species be present in quantities warranting it, a small dedicated storage cell would be constructed in the tailings facility and appropriate water treatment provided, if required.

#### 25.3.1.2 *Process*

The concentrator is designed with a very high internal water recirculation rate. The impact of the accumulation of chemical species cannot be realistically assessed during the design phase. It could potentially be detrimental to the project performance. However, the process was specifically designed to reduce chemicals usage and the only process section that requires reagents is the flotation of spodumene. The other concentration methods are done by physical separation (hydroseparation, DMS and magnetic separation) which will not be impacted significantly, if at all, by any accumulated chemical species present. This risk is therefore limited.

The concentrator design is very flexible and can be adapted during operation to optimize recovery and final product quality. The grade and recoveries projected from individual tests performed by various laboratories and suppliers at bench scale or pilot scale have been used to predict the concentrator performance that is stated in this Report. This has not been specifically demonstrated in a formal pilot plant test in its final flowsheet configuration as it is comprised of a high number of unit operations that are very difficult to size and operate at that scale.

Where feasible, full scale equipment were tested by manufacturers which increased the confidence in the expected performance. There is a risk that the performance recovery or the grade cannot be reached if some unforeseen factor affects the total plant performance. The concentrator should however meet the total spodumene production output considering the design factors used to select equipment.

In the drying, crushing and loadout facility, the High Pressure Grinding Roll (HPGR) equipment will crush DMS concentrate to less than 1 mm. The risk is that the DMS concentrate may still be very warm and the HPGR performance on warm material is unsure. Test work will be required to mitigate this risk. The loadout silo will also be designed to minimize risk of blockage to ensure reliable, rapid and dust managed loading of trucks.

#### 25.3.1.3 *Infrastructure Risk*

As the Whabouchi Site is well advanced in design and construction, there are only a few areas that have not been developed. The major area under development is the water management system. The system is well designed and advanced but requires some geotechnical investigation and final location studies for the catchment basins and interconnecting piping and canals.

The concentrator is located in a remote region with access by road. The concentrator facilities are designed to minimize noise, dust and other emissions to meet regulations. Fuel and reagents must be brought in by road throughout the year. The design of the fuel and reagent storage covers provision for delivery interruptions during inclement weather.

The concentrate will be transported by truck to Matagami. Storage bins above the loading equipment will be designed to ensure sufficient excess capacity to cover delays in truck arrivals or departures due to inclement weather or other delays. However, a prolonged road closure will provoke a slow down or cessation of mill operations.

One (1) main concentrator generator is currently in place and a second will be installed to ensure power to the construction/permanent camp.

#### 25.3.1.4 *Execution Risk*

The balance of the work to be completed assumed to start in November 2019 in this report would be completed in June 2020. This is an ambitious schedule as a large percentage of the work will be done during the winter months, however almost all of the civil works, with the exception of water management infrastructures, has been completed and buildings are enclosed. The major risk is furnishing ample construction personnel to complete the work especially during the winter months.

Almost all of the equipment has been delivered to site or ready to be delivered. With the exception of the new drying and crushing facility, only minimal equipment is yet to be procured. Prior to re-start of construction, it is anticipated that all piping isometric drawings will be completed and issued for bid. The design work on the cable tray layouts and wiring diagrams would also be completed and issued for bid. This work will be constructed within the confines of the concentrator building which is enclosed and heated.

Currently, it is envisioned that the work will continue to follow an EPCM type project and be performed by an EPCM firm with proven track record of this type of facility in Quebec. However, it is possible that Nemaska will manage the Project with assistance from engineering consultants and experts as required.

For the upcoming work, Nemaska will re-negotiate existing contracts with the firms who have or are currently providing service at the site.

#### 25.3.1.5 *Capital Cost Risk*

Capital cost risk has been significantly reduced because:

- The overall engineering advancement is estimated at 75% with engineering of the concentrator and crushing facilities at over 90%;
- The remaining work is well defined and estimated based on the contracts currently awarded;
- The process equipment is purchased and delivered to site or stored in vendor warehouses;



- Nevertheless, the risk of lack of available construction labour forces could be a concern; however, only a relatively small workforce is required.

#### 25.3.1.6 *Schedule Risk*

The planned start and duration for the Whabouchi Project completion is tight and much of the work will be performed during the winter months. Although a significant portion of the work will be performed inside the concentrator, other work such as the completion of the crushing area, the water management system, the warehouse and the new dryer and crushing building will be performed in the elements and will be affected by productivity and work interruptions due to extreme weather conditions. However, these activities can be scheduled in spring 2020 and thus mitigate the impact of winter conditions.

#### 25.3.1.7 *Operating Costs Risk*

Operating cost risks have been reduced due to better definition of:

- Reagent, electricity and natural gas quantities
- Manpower requirements
- Maintenance costs
- Consumables
- General expenses, property taxes and insurance

### 25.3.2 SHAWINIGAN ELECTROCHEMICAL PLANT

Regular risk review sessions have been held since 2017. These risk review sessions tended to focus on process engineering risks, but also touched on general engineering and infrastructure risks. Execution risks (procurement, market, financing, permitting and after sales are the responsibility of Nemaska or other parties.

#### 25.3.2.1 *Process Risk*

Process risk has been significantly reduced by:

- Substantial test work at the laboratory and pilot level.
- Operation of the Phase 1 Demonstration plant
- Advancing the process engineering and performing detailed studies on buffer sizing (dynamic simulation), heat and mass balances, minor impurity impacts, HAZOPs, materials selection, purge requirements, etc.
- Selecting suppliers and advancing the detailed equipment design.
- Allowing space within the design for the addition of equipment should this be necessary.
- Preparing a preliminary hot commissioning plan.

Nevertheless, some process risks remain as described below.



The process of making lithium hydroxide monohydrate from spodumene concentrate has been developed and tested at the lab and pilot scale by Nemaska. Parts of the process, namely acid bake, purification, electrolysis as well as LHM crystallization and drying, have been tested at even larger scales in the Demonstration Plant. The process proposed and deployed by Nemaska will use known industrial unit operations such as flash calciner, pugmill, indirect fired acid bake kiln, chemical reactors, filters, electromembrane cells, crystallizers and acid concentrators which significantly reduces the process risks associated with the project. However, the process of integrating these industrial units into a single flowsheet has not been deployed on a commercial basis and contains the inherent risk related to all new process development, that is to say, there are process and operability unknowns that may be discovered during the plant operation which can affect plant capacity, capital costs or operating costs.

The principal residual process risks are:

- Improper equipment sizing for upset conditions;
- Concentrate grade or concentrate quality deviates from design assumptions;
- Recycle loops in the process may result impurity accumulation in the process;
- Reduced operating efficiency or availability of flash calciner;
- Reduced operating efficiency or availability of the purification circuit;
- Unanticipated corrosion of process components;
- Reduced operating efficiency or availability of acid concentration.

These risks are described in detail below.

a. Improper equipment sizing for upset conditions

It is difficult to predict the complex interplay of different areas of the plant resulting from deviations from the expected operating conditions, upset conditions, planned and unplanned maintenance, and ramp up times, any one of which can lead to reduced production. Existing mitigation measures include dynamic availability analysis, addition of buffers between plant areas, and reserving space in the layout for additional buffers should they be required. Future mitigation measures include updating the dynamic analysis to take into account final designs and operating strategies, detailed analysis of spare requirements, investigating the need for installed standby equipment, detailed maintenance planning, and detailed commissioning and operations planning.

Once the future mitigation strategies are implemented, this risk is estimated to be moderate. During operation, any impact of this risk can be diminished by planning operations to minimize variations and target stable operation as a primary KPI.

b. Concentrate grade or impurity levels deviates from design assumptions

Should the concentrate produced by the Whabouchi concentrator or purchased to make up any shortfall in Whabouchi concentrator production, be significantly different with respect to composition, mineralogy or other properties to that used in the test work, and of the composition specified by Nemaska in the process design criteria, it is possible that certain plant areas will exhibit operating problems or reduced efficiency which could result in capacity or operating costs which materially differ from those estimated in this Report.

Future mitigation measures include maintaining concentrator scope during execution to allow the production of high-quality concentrate, operation of the concentrator along its recovery-grade curve to ensure adequate product grade at all times. Given that the start-up of the concentrator will take place one year prior to the Shawinigan facility, this will allow sufficient time to debug the concentrator and characterizing the concentrate quality prior to needing feed at Shawinigan.

The lithium content in the ore determines the potential production level, while the type and amount of impurities determine the required process and equipment for the purification. Limited data exists on the levels and variability of impurities in the ore over the life of the mine, nor the resulting impurities in the concentrate. Consequently, there is no basis by which a sensitivity analysis can be performed on the potential variability of impurities in the feed to the Electrochemical Plant, nor is there an allowance for higher impurity levels in the design.

Moreover, due to the limited number of concentrate samples produced, there is limited repeatability of impurity level measurements. Finally, several minor impurities have yet to be measured. The type and levels of impurities entering the process dictate flows throughout the process, reactor and filter sizing, equipment performance, materials of construction, and environmental considerations, amongst other. Should the levels of certain impurities be significantly different than the levels specified by Nemaska in the process design criteria, it is possible that certain plant areas will be bottlenecked, exhibit operating problems, or have a reduced efficiency, which could result in capacity, capital or operating costs which materially differ from those estimated in this Report.

Future mitigation measures include re-analysis of DMS and flotation concentrate to confirm the composition specified by Nemaska in the plant design criteria, measurement of the minor impurity levels that have yet to be measured, inclusion of key impurities in the mine plan and estimation of their variability in the concentrate, sensitivity analysis of impurity levels in the concentrate and the impact on the process and equipment sizing, and adequate mine planning to level out peaks in impurity levels (should these exist). It is possible that additional equipment or changes to the process be required following the completion of these mitigation strategies.

This risk is presently considered high pending the completion of future mitigation strategies. Once the future mitigations are implemented, the risk is estimated to be moderate since the impurity profile can be modified through process adjustments in the concentrator.

c. Recycle loops in the process may result in impurity accumulation in the process

Due to several important recycle loops within the process, it is possible that minor impurities build up over time. Key impurities have been measured and addressed, but several minor impurities, of either unknown quantity in the feed, unknown variability in the feed, or of unknown chemical behavior in the process, may build up and cause operating problems. This has historically been an issue with hydro-chemical facilities since it can be difficult to measure very low levels of minor impurities in the feed, and determine if and where they will concentrate, until large scale commercial production commences.

This risk is typically addressed via the operation of an integrated pilot plant, i.e. a pilot plant that includes the key recycle loops and which is operated for sufficient time to observe impurity build up. This has yet to be performed on the Nemaska project since the Demonstration Plant does not include the acid concentration loop, and since its operating setpoints are often somewhat different from the commercial facility due to design constraints. In the absence of this information, several mitigation strategies related to purging solution from the process have been developed and can be implemented as required upon start-up.

Future mitigation strategies include analysis of the DMS and flotation concentrate to investigate the level of minor impurities that have to date not been measured, and to assess the likelihood of build up for each impurity. It is possible that additional equipment or changes to the process be required following this test work.

This risk is estimated to be moderate. It is likely that some impurities will accumulate in the process but their impact, if any, cannot be predicted with any certainty at this stage. The most likely outcome of the accumulation of a deleterious impurity will be occasional purging of the process to control impurity accumulation.

d. Reduced operating efficiency or availability of flash calciner

Flash calciners are used widely in various industries and offer many benefits over the more traditional rotary kiln. The use of flash calciners for the calcination of spodumene will be an industry first and therefore contains inherent risk related to operational performance, notably related to build-up of deposits within the calciner that can hinder operation, as well as due to the relatively short residence times which can result in reduced efficiency of conversion. Multiple pilot runs at two (2) reputable suppliers have been used to evaluate this risk and provide mitigation measures to include in the design. These mitigation measures include increased residence times to allow full conversion, supply of air canons and clean out ports to eliminate build-up should this occur.

Future mitigation strategies include maintaining the focus on the supply of high quality concentrate which is less susceptible to formation of accretion (accretion is believed to be linked to specific low melting point impurities within the concentrate).

The risk for chronic calciner operating issues estimated to be low and manageable, though it may necessitate an adaptation period during commissioning.

e. Reduced operating efficiency or availability of the purification circuit

A significant amount of test work has been performed to determine the acid mixing, acid bake, leach and purification design basis of the commercial facility. Nevertheless, due to budget, time, and feed material constraints, repeat tests have not been performed systematically for all test conditions to ensure their reproducibility under the selected design conditions and for a wide variety of feed material. This is further complicated by the difficulty to produce samples under representative conditions, for example the impact of pumping on particle attrition and the resulting filterability cannot be readily simulated. This results in the possibility of some variability in the exact extraction rates of lithium and impurities and/or filterability of residues, which could ultimately affect plant capacity.

Existing mitigation measures include increased design factors on the leach and purification filters, and reserving space for certain additional impurity removal reactors and filters should they be required. On-going mitigation measures include performing confirmatory test work to validate key reagent consumptions and filter performance criteria with the selected filter vendors. It is possible that additional equipment or changes to the process be required following this test work.

The risk is estimated to be moderate given the large amount of test work performed and the ability to add certain equipment as required. It is expected that process testing and adjustments will be required during commissioning.

f. Unanticipated corrosion of process components

A certain amount of chlorine and fluorine are leached from spodumene concentrate and accumulate within the process. These elements can cause significant corrosion issues. These issues were discovered during Pilot Plant operation and mitigation measures considered in the current design. Existing mitigation strategies include the selection of appropriate materials of construction, and the addition of multiple systems for the control and purge of these elements from the process. Nevertheless, there exists a certain amount of uncertainty as to the amount of chlorine and fluorine that will be present in the concentrate, the variability that can be expected throughout the deposit, the level of extraction to the process, and the efficiency of the control systems.

On-going mitigation strategies include test work to validate the fluorine and chlorine extraction levels to the process and confirm the efficiency of control systems presently in the design, as well analysis of chlorine and fluorine behavior in the Shawinigan Demonstration Plant. It is possible that additional equipment or changes to the process be required following this test work.

Once the future mitigations are implemented, this risk is estimated to be low as the principle corrosive species have been accounted for in the selection of construction materials and the appropriate processes implemented to treat and purge them.

g. Reduced operating efficiency or availability of acid concentration

Acid concentration technologies are well known and extensively used in other industries but will be operated commercially for the first time with acidic solutions containing lithium salts. Laboratory and pilot tests have been performed at multiple suppliers to determine appropriate design parameters. Nevertheless, unforeseen issues related to maintenance or performance could affect production capacity. Nemaska is presently evaluating the need for additional piloting to confirm the selected vendors design.

This risk is considered moderate since although the specific solutions being treated are new and the processing conditions are harsh, the technologies used are well understood and Nemaska is working with experienced equipment vendors.

#### 25.3.2.2 *Electromembrane Process Risk*

In the electromembrane process, membranes degrade over time and must be replaced when their efficiency decreases to an unacceptable performance level. Analogous information from the chlor-alkali industry, 1,000-hour tests, and experience of the technology suppliers have allowed an estimation of the membrane and electrode coatings, life to be in the order of two (2) years, assuming high-quality brine feed. Nevertheless, actual membrane life span remains unknown as no test has been performed of sufficient duration under the required conditions.

In addition, membrane life will be significantly affected by operating methods and electromembrane feed quality. Should membranes degrade more rapidly than expected the operating costs will increase and production may decrease. Existing mitigation measures includes on-going confirmatory laboratory test work at the equipment vendor, specific programs of process and optimization support by the equipment vendor, issuing basic engineering packages to the vendor to advance the engineering, and reserving space in the layout for additional electrolyzers should these be required. Future mitigation strategies include development of detailed operating guidelines, and adequate sparing philosophy so that membranes and associated components are available if required.

#### 25.3.2.3 *Infrastructure Risk*

Infrastructure risk has been significantly reduced by the following:

- Geotechnical investigation has been completed so that piling design and layout of installation is taking advantages of the existing rock profile;
- Inspection of existing buildings has been completed allowing the scope to be confirmed and allowing the existing buildings to be adapted to the new process;
- Sub-station elevation was adjusted for 1-500 years water level;

- A berm for a 1-100 years water level was added to the scope along the road near the St-Maurice river;
- A new road and gate house will be constructed south of the plant that will allow for the segregation of trucks vs operating personal vehicle, Reception of reagent and shipping of aluminum-silicate and gypsum will use that new road;
- Water intake will be from a connection to an existing pipe on the Hydro-Québec water dam which avoid the construction of a new water intake in the St-Maurice river;
- Rail layout was reviewed with key stakeholders and is respecting CN design criteria;
- Demolition inside Buildings #67 and #80 is essentially completed;
- Administrative building is already constructed

The plant is located near a residential area. The design will ensure that noise, dust and other emissions meet regulations. The traffic of truck for reagent, product and most importantly by-products will be significant, but the new road south will allow traffic to use a secondary road that will avoid most of the residential area. Nemaska works in close collaboration with the City of Shawinigan in order to mitigate potential community issues.

Nevertheless, careful monitoring and interface with the community will be required due to the large amount of truck traffic that is expected. To reduce truck traffic, it may in be possible to ship out aluminum silicate by-product by rail (depending on the destination of the aluminum silicate). Considering that the site, until recently, supported industrial activity for over a century, Nemaska regards this risk to be low and manageable through continued community engagement.

Nemaska will need to finalize the negotiation with the city of Shawinigan to obtain the right of way to construct the new road south of the plant and the permanent access road west on the land that was previously owned by Genesee & Wyoming. Should these negotiations not proceed as expected, the project could be delayed, and should they fail, then Nemaska will be constrained to develop an alternate access to the site which could incur capital costs and project delays.

Depending on the rail access line selected, the rail layout will need approval by the rail transport company before construction. Any changes may create schedule delays and Capex impacts.

#### 25.3.2.4 *Execution Risk*

Execution risks are described below.

A preliminary execution strategy has been prepared for the present report. Following the temporary suspension in the Project by Nemaska a detailed strategy has yet to be completed. As a result, some uncertainty remains around the final execution strategy, and changes to the assumptions used in this Report can affect the schedule and project cost. Future mitigation includes development of a detailed execution strategy prior to recommencement of the Project.



The present execution schedule, and the associated capital cost estimate, assume that the execution strategy will follow the typical full EPCM model, and be performed by an EPCM firm with proven track record of this type of facility in Quebec. Changes to the execution model assumed may generate schedule and capital costs risks.

The present project schedule assumes that all permits are obtained as planned. Delays in permitting will increase project schedule and likely project cost.

From a construction point of view the project execution plan will use strategies that will consider the constraints and risks associated with the site and location:

- Careful selection of contractors based on safety performance and experience with similar project and size will be done to qualify them;
- Because of the limited space on site and size of labor force, the project will have an external parking lot for workers and indirect costs include a bus service to transport them;
- Because of limited lay down the project use external warehouse to store equipment that cannot be directly off loaded on site;
- Because the outdoor activities related to civil and concrete are not on the critical path the project will start construction in the spring of 2020;
- Because of the congested work area in Buildings #67 and #80 the contractual strategy is based on larger contracts for mechanical & piping and electrical and automation to minimise interface and coordination between contractors;
- The construction schedule was developed using the commissioning sequence to clearly define the critical path of the project;

Nevertheless, the detailed construction strategy and sequencing has yet to be prepared. A preliminary strategy has been prepared for this report and to develop a realistic schedule. It is possible that when the detailed construction strategy and construction sequence are defined, changes will affect the schedule and project costs. Future mitigation includes development of a detailed construction strategy including a detailed construction sequence.

#### 25.3.2.5 Capital Cost Risk

Capital cost risk has been significantly reduced because:

- The project makes use of the existing Buildings #67 and #80 and a detailed assessment of these buildings has been completed and the scope to reinforce and adapt the building to the new equipment is defined.
- Geotechnical investigation of the Shawinigan site has been completed for all the process area and design is based on the geotechnical report. Only confirmation drilling for the berm design along the east road is required.

- All the critical equipment (calciner, electrolysis, LHM crystallizer and acid concentration system) and key process equipment have been purchased and a large portion of the vendor documents are available to complete the design.
- Demolition of existing infrastructure is essentially complete, and a clear scope for the reinforcement and repair has been developed.
- Piling and concrete contracts for Buildings #67 and #80 have been awarded and construction started. Structural reinforcement of Building #67 7 is also well underway.
- Engineering is approximately 45% complete;

Nevertheless, the following capital cost risks remain:

- The plot plan and layout are frozen for all process plant area. However, Nemaska will need to finalize the negotiation with the city of Shawinigan to obtain the right of way to construct the new road south of the plant and the permanent access road west on the land that was previously owned by Genesee & Wyoming.
- Issues that may arise during price confirmation for awarded packages and firm price received may impact the Capex. These issues include change in market conditions or supplier work load.
- Inflation on the construction labor as per the union agreement has been included in the capital cost estimate, but no provision for material cost increase or unusual market conditions is included.
- The process, execution and schedule risks all have potential negative impact on the capital costs.
- Any process risks described above could negatively affect the capital cost should additional equipment be required.

#### 25.3.2.6 *Schedule Risk*

The current estimate is using assumptions for financing date and full notice to proceed. If these dates are delayed, the schedule will be delayed and additional costs potentially incurred. Currently, the Project has been slowed down until additional financing is completed. The current schedule is based on assumptions as to restart times. Any delays to secure Project financing required to start construction will delay the beginning of production of concentrate at Whabouchi and the commissioning of Shawinigan as well. This may allow a competing project to begin production before Nemaska and therefore reduce the market opportunity that Nemaska is targeting and could impact sales level and Project economics.

The present site and buildings will lead to a physically constrained and congested construction environment and related productivity and safety management issues. Similarly, the commissioning scheduling assumes that there will be concurrent construction and commissioning activities. Risk of schedule delays have been partially mitigated by the consideration of the aforementioned site

specificities in the development of the preliminary schedule, a schedule risk analysis and multiple workshops to develop optimal construction sequences. Further mitigation is planned with the:

- Development of a detailed project execution plan
- Validation and optimisation of the construction sequence via BIM4D construction simulation

The commissioning and ramp up to full capacity may prove difficult due to the risks described herein. Existing mitigation measures include the development of a high-level commissioning strategy, including the addition of temporary and permanent bypasses, equipment and reagents, and the strategic incorporation of surge vessels throughout the process flowsheet which allow a plant area to operate at a different throughput to a neighboring plant area by providing buffering between plant areas.

McNulty curves have been used to estimate a reasonable ramp up time to be used for the financial analysis. Future mitigation strategies include the development of a detailed commissioning and start-up strategy, as well as the implementation of appropriate levels of operational readiness planning. It is possible that during the development of this strategy it is realized that additional equipment must be installed to allow for a rapid ramp up to full production, or that the ramp up time will be longer due to the inability to ramp up multiple sectors in parallel.

#### 25.3.2.7 *Operating Costs Risk*

Operating cost risks have been reduced due to better definition of:

- The performance of electrolysis
- Reagent, electricity and natural gas quantities
- Manpower requirements
- Maintenance costs
- Consumables
- General expenses, property taxes and insurance

Nevertheless, several operating cost risks remain as described below.

Aluminum silicate and Na/K purge solution by-products are produced in large quantities by the Shawinigan Electrochemical facility and could incur significant by-product disposal costs (>20 M CAD) should Nemaska not find end-users capable of accepting the product as is. Mitigation strategies include on-going investigations by Nemaska of potential end users. The anticipated market for the aluminum silicate by-product is as a cementitious additive, similar to fly ash for example.

It is difficult to evaluate the maintenance requirements for a new process such as this one that includes multiple highly abrasive, acidic or caustic chemicals which have the potential, despite diligent materials of construction selection, to require significant maintenance. Maintenance costs have been based on industry benchmarks. A detailed maintenance strategy should be prepared to further mitigate this risk.

No contracts have been signed for the procurement of spodumene concentrate, lithium sulfate, reagents, by-product disposal, electricity or natural gas supply. Some variability in these costs is, therefore, likely. Mitigation strategies include signing contracts. In addition, for by-products, an investigation and qualification of potential disposal sites is necessary to ensure their ability to accept the large amount of aluminum silicate during the first years of operation, as well as gypsum residue which will be sent on an on-going basis.

As mentioned in the process risks section, there is a lack of data on the variability of impurities in the ore over the life of the mine. In addition, confirmatory test work to validate key reagent consumptions and expected residue quantities is presently on-going. Thus, some variability in reagent and residue quantities may occur.

The cost of greenhouse gas (“GHG”) emissions has been calculated and integrated within the financial analysis based on commonly used methods, various assumptions and following guidelines from the Quebec Ministry of the Environment. Should GHG credits change, the market cost of CO<sub>2</sub> vary unexpectedly, or future maximum costs exceed the assumptions made, then significant costs could be incurred.

### 25.3.3 OVERALL PROJECT RISK

Lithium is considered as an industrial mineral and the sales prices for the different lithium compounds are not public. Sales agreements are negotiated on an individual and private basis with each different end-user. Therefore, it is possible that the sales prices used in the financial analysis be different than the actual market when Nemaska is in fact in a position to sell lithium compounds. In addition, there are a limited number of producers of lithium compounds and it is possible that these existing producers try to prevent new comers in the chain of supply by increasing their production capacity and lowering their sales prices. In such cases, the economics of the Project could be affected.

Nemaska intends to produce mainly lithium hydroxide monohydrate to address the increasing demand for that compound favored in the making of cathodes for rechargeable batteries. If cathode manufacturers use less hydroxide than expected or if the demand for rechargeable batteries, mainly in the electric and hybrid vehicles, is less than forecast, it could have an effect on the sales price of that compound and the need for new production.

The estimate includes some provision for cost increase on equipment supply. If there are additional financing delays it may become necessary to renegotiate with suppliers’ costs and delivery times.

## 26 RECOMMENDATIONS

Based on the Project's demonstrated economic, it is recommended to proceed to the implementation phase once the Project is financed.

For the Whabouchi mine site, site work has already been started and engineering is progressed with the available funds that Nemaska already has. It has allowed the various parties involved to develop a clear detailed execution plan that fits the proposed schedule. A total budget of \$224.6 M (excluding sunk costs) is needed to complete construction of the Whabouchi mine and allow Nemaska to produce concentrate to feed the Shawinigan Electrochemical Plant.

For the Electrochemical Plant, detailed engineering is well underway. The revised budget to complete all engineering and construction related activities for the Electrochemical Plant in Shawinigan is \$704.1 M (excluding sunk costs).

Specific elements that need to be monitored or done are listed below.

### 26.1 For Whabouchi Site

The following activities are recommended to mitigate the risks as outlined in Section 25.2.

#### 26.1.1 MINING

- The known mineralization has an opportunity to be extended at depth and along strike on the Property. The possible transfer of the inferred mineral resources within the optimised pit into measured and/or indicated mineral resources is present although it is not guaranteed and additional validations must be done to ascertain the resource category upgrade.

#### 26.1.2 PROCESS

- In order to control the grinding product, Nemaska should consider an automated media feeder. This would ensure near constant ball loading in the grinding circuit and reduce somewhat the slime production.
- Confirm the performance of the HPGR on warm DMS concentrate;
- Confirm the concentrate loadout flow for effective bin design properties;
- Confirm the moisture content of the concentrate through the dryer.

#### 26.1.3 CO-DISPOSAL AND WATER MANAGEMENT SYSTEMS

- Phases 2B and 3 of the co-disposal and the water management strategy will have to be optimized during the detailed engineering phase when detailed deposition plans will be available, i.e. in a timely manner to secure the required environmental authorizations prior to its use, as outlined in Section 20.1.2.

#### 26.1.4 EXECUTION

- Complete the design and contract documents for the co-disposal and water management areas;
- Complete the design of the drying and crushing facility. Go for tender for long lead equipment and place orders;
- Finalize the piping Isometric drawings and P&ID's
- Finalize specifications for piping materials and instruments and issue purchase orders / contracts. Start fabrication of instruments and materials to meet scheduled dates;
- Perform trade-off studies for the infrastructure such as the locations for the mine dry facility, laboratories, warehouse facility and complete design engineering;
- Complete the cable tray and wiring arrangements for the concentrator and issue for construction;
- Finalize outstanding equipment specification and place orders;
- Negotiate with Hydro-Québec on increased power requirements;
- Ensure that the construction management team is in place prior to start of construction;
- Perform a detailed inspection of the site to determine the optimal methodology of proceeding with completing partially completed work and associated new construction;
- Minimize outside work during the winter months if schedule permits.

#### 26.1.5 CAPITAL COST

- Re-negotiate existing contracts to be ready for construction start in November;
- Put in place a strong cost management team to manage costs, deliveries and schedules.

#### 26.1.6 OPERATION COST

- Drying the flotation concentrate will reduce the energy costs at the Shawinigan operation.

### 26.2 For Electrochemical Plant

#### 26.2.1 PROCESS

- Monitor the development of the concentrator to ensure that the quality of the concentrate is maintained for processing in the electrochemical plant.
- Confirm the composition of the concentrate, including the level of minor impurities, that are in the process design criteria. Re-analyze impurities that have had limited repeat analyses.
- Analyze the concentrate for a range of minor impurities that have yet to be measured. Determine which impurities may build-up (if any) and develop mitigation strategies.
- Investigate quantity, composition and variability of impurities across the deposit. Perform sensitivity analysis of impurity levels in the concentrate and the impact on the electrochemical



process and equipment sizing. If required, develop mitigation plans at the mine, concentrator and/or electrochemical plant.

- Investigate the quantity and quality of spodumene concentrate and lithium sulfate that will be purchased and incorporate physical and compositional differences in the design and/or operating strategy.
- Perform or complete outstanding test work including: lab and pilot scale tests on chlorine and fluorine deportment and control; pilot scale testing to validate key reagent consumptions and for final confirmation of filter sizing by vendor; lab scale testing for optimization of the ion exchange system; lab scale testing by vendor of the water treatment system; and lab scale testing for drying of spodumene and aluminum-silicate.
- Continue operation of the Shawinigan Demonstration Plant, ideally operating with 100% spodumene feed for extended periods of time. Analyze the historical and future performance from the Demonstration Plant.
- Consider adding the acid concentration loop to the Shawinigan Demonstration Plant in order to gain practical experience in the operation of this equipment, gain information on the effect of the use of regenerated acid within the process, and evaluate the potential of impurity build up. If such an integrated pilot cannot be performed, consider batch, semi-pilot or pilot acid concentration test work at the selected vendor to confirm the design and gain operating insight.
- Update the dynamic simulation to incorporate recent flowsheet changes and further refine operating and control strategies
- Develop a detailed commissioning, start-up and operational readiness strategy to meet target ramp up times.
- Document process knowledge to ensure that knowledge is conserved.

#### 26.2.2 ELECTROMEMBRANE PROCESS

- Continue studies of optimization of systems peripheral to the electrochemical cells to reduce capital cost;
- Continue studies of membrane and coating lifetimes as a function of impurity profile and other process variables.

#### 26.2.3 EXECUTION

- Continue to expedite permitting according to key schedule date;
- Issue the documentation and letter to the government to officialise the opening of the construction site as a major project (required when resource peak higher than 500 workers);
- Finalize the qualification process for mechanical & piping and electrical and instrumentation contractors;
- Continue to engage with the key stakeholders external to the project (government, city of Shawinigan) to mitigate the risk of social issues during construction and operation;

- Confirm the detailed project organization with key position identified;
- Develop a detailed commissioning plan

#### 26.2.4 CAPITAL COST

- Revise the execution plan to include detailed strategies for all groups (engineering, procurement, project control, construction, POV, OR);
- Finalize negotiation with CN and the City of Shawinigan to obtain servitude for the access road;

#### 26.2.5 OPERATING COST

- Pursue work on aluminum-silicate and Na/K purge solution by-product characteristics and value to confirm their attractiveness for potential clients;
- Complete confirmatory test work on reagent consumptions;
- Confirm spodumene concentrate, lithium sulfate, reagent, residue disposal, electricity and natural gas costs and sign contracts and agreement with main suppliers;
- Develop a detailed maintenance strategy;

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## 28 LIST OF ABBREVIATIONS

The following abbreviations may be used in this Report.

Abbreviation	Description
µm	Microns, Micrometre
'	Feet
"	Inch
\$	Dollar Sign
\$/m <sup>2</sup>	Dollar per Square Metre
\$/m <sup>3</sup>	Dollar per Cubic Metre
\$/t	Dollar per Metric Tonne
%	Percent Sign
% w/w	Percent Solid by Weight
¢/kWh	Cent per Kilowatt hour
°	Degree
°C	Degree Celsius
2D	Two-Dimensional
3D	Three-Dimensional
Al	Aluminium
ARD	Acid Rock Drainage
ARO	After Reception of Order
ASL	Above Sea Level
Au	Gold
Be	Beryl/Beryllium
BG	Battery-Grade
BHS	BHS Filtration Inc.
Ca	Calcium
CA	Certificate of Authorization
CAD	Canadian Dollar
CAGR	Compound Annual Growth Rate
Capex	Capital Expenditures
CBHSSJ	Cree Board of Health and Social Services of James Bay
CCDC	Cree Construction and Development Company Ltd.
CDPNQ	<i>Centre de Données sur le Patrimoine Naturel du Québec</i>



Abbreviation	Description
CDWA	Conservation and Development of Wildlife Act
CEAA	Canadian Environmental Assessment Act
CEHQ	<i>Centre d'Expertise Hydrique du Québec</i>
cfm	Cubic Feet per Minute
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
CL	Concentrate Leach
CLA	Community Liaison Agent
cm	Centimetre
CN	Canadian National Railroad
CNG	Cree Nation Government
CoG	Cut-off Grade
COMEX	Review Committee of the JBNQA
COMEV	Evaluation Committee of the JBNQA
Cs	Cesium
Cu	Copper
d	Day
DC	Bicarbonate Decomposition
DEM	Digital Elevation Model
DFO	Department of Fisheries and Oceans
DMS	Dense Media Separation
DTH	Down-the-Hole
EEMP	Environmental Effects Monitoring Program
Electrosynthesis	Electrosynthesis Company
EPCM	Engineering, Procurement and Construction Management
EPS	Enhanced Production Scheduler
EQA	Environmental Quality Act
ESIA	Environmental and Social Impact Assessment
ESS	Energy Storage System
EV	Electric Vehicle

Abbreviation	Description
Fe	Iron
Feeco	Feeco International
FOB	Free on Board
FS	Feasibility Study
ft	Feet
FX Rate	Exchange Rate
g	Grams
G&A	General and Administration
GIS	Geographical Information System
GPS	Global Positioning System
h	Hour
h/d	Hours per Day
h/y	Hour per Year
H <sub>2</sub>	Hydrogen
ha	Hectare
HADD	Harmful Alteration, Disruption or Destruction
HART	Highway Addressable Remote Transducer
HEV	Hybrid Electric Vehicle
HG	High Grade
HIMS	High Intensity Magnetic Separator
HME	Heavy Mobile Equipment
HMI	Human Machine Interface
hp	Horse Power
HQ	Drill Core Size (6.4 cm Diameter)
HVAC	Heating Ventilation and Air Conditioning
I/O	Input / Output
ICP-AES	Inductively Coupled Plasma – Atomic Emission Spectroscopy

Abbreviation	Description
ICP-MS	Inductively Coupled Plasma – Mass Spectroscopy
ICP-OES	Inductively Coupled Plasma – Optical Emission Spectroscopy
INRS	<i>Institut National de la Recherche Scientifique</i>
IRR	Internal Rate of Return
ISAQ	<i>Inventaire des Sites Archéologiques du Québec</i>
ISP	Internet Service Provider
ITSP	Internet Telephone Service Provider
IX	Ion Exchange
JBNQA	James Bay and Northern Quebec Agreement
kg	Kilogram
kg/y	Kilogram per Year
km	Kilometre
kPa	Kilopascal
kW	Kilowatt
kWh	Kilowatt-hour
kWh/t	Kilowatt-hour per Metric Tonne
L	Litre
LC	Lithium Hydroxide Carbonization
LCE	Lithium Carbonate Equivalent
LFP	Lithium-Iron-Phosphate
LG	Low Grade
LG-3D	Lerchs-Grossman – 3D Algorithm
LHM	Lithium Hydroxide Monohydrate
Li	Lithium
LiFePO <sub>4</sub>	Lithium Iron Phosphate
Li <sub>2</sub> CO <sub>3</sub>	Lithium Carbonate
Li <sub>2</sub> O	Lithium Oxide
Li <sub>2</sub> SO <sub>4</sub>	Lithium Sulfate
LiOH	Lithium Hydroxide

Abbreviation	Description
LIMS	Low Intensity Magnetic Separator
LMO	Lithium Manganese Oxide
m	Metre
M	Million
m <sup>2</sup>	Square Metre
m <sup>3</sup>	Cubic Metre
m <sup>3</sup> /d	Cubic Metre per Day
m <sup>3</sup> /s	Cubic Metre per Second
m <sup>3</sup> /y	Cubic Metre per Year
mA	Milliampere
Mb/s	Mega Bits per Second
Mm <sup>3</sup>	Million Cubic Metres
MCC	Motor Control Center
MELCC	<i>Ministère Environnement et Lutte contre les Changements Climatiques</i> (English: Department of Environment and the Fight to Climate Change)
MDDEP	<i>Ministère du Développement Durable, Environnement, Faune et Parcs</i>
ME	Membrane Electrolysis
MERN	<i>Ministère de l'Énergie et des Ressources Naturelles</i> (English: Department of Energy and Natural Resources)
MFFP	<i>Ministère des Forêts, de la Faune et des Parcs</i>
Mg	Magnesium
mm	Millimetre
mm/d	Millimetre per Day
Mm <sup>3</sup>	Million Cubic Metre
Mm <sup>3</sup> /y	Million Cubic Metre per Year
MDMER	Metal and Diamond Mining Effluent Regulation
Mn	Manganese
MSO	Mineable Stope Shape Optimizer
Mt	Million Metric Tonne
Mt/y	Million Metric Tonne per year

Abbreviation	Description
MV	Medium Voltage
MVA	Mega Volt-Ampere
MVR	Mechanical Vapor Recompression
MW	Megawatts
Na	Sodium
Na <sub>2</sub> O	Sodium Oxide
NRCan	Natural Resources Canada
Nb	Niobium
NCA	Nickel-Cobalt-Aluminium
NE	Northeast
Ni	Nickel
NiCd	Nickel-Cadmium
NI	National Instrument
NMC	Noble Metal Cathode
NPV	Net Present Value
NQ	Drill Core Size (4.8 cm diameter)
NSR	Net Smelter Return
OER	<i>Demande d'Objectifs Environnementaux de Rejet</i>
OK	Ordinary Kriging
Opex	Operating Expenditures
P1P	Phase 1 Plant
PEA	Preliminary Economic Assessment
PF	Process Flow
PFS	Pre-Feasibility Study
pH	Potential Hydrogen
PIR	Primary Impurity Removal
PLC	Programmable Logic Controllers
POV	Pre-operational Verification
PP	Pre-Production

Abbreviation	Description
ppm	Part per Million
QA/QC	Quality Assurance/ Quality Control
QC	Province of Quebec
QP	Qualified Person
Rb	Rubidium
RBC	Rotating Biological Contractor
RDPA	Resource Development Partnership Agreement
RFP	Resolute Forest Products
RMB	Renminbi
RO	Reverse Osmosis
ROM	Run-of-Mine
Roskill	Roskill Consulting Group Ltd.
rpm	Revolutions per Minute
RQD	Rock Quality Designation
s	Second
S	Sulfur
S/R	Stripping Ratio
SAC	Spent Acid Concentrator
Sc	Scandium
SDBJ	<i>Société de Développement de la Baie James</i>
SFE	Shake Flask Extraction
SG	Specific Gravity
SGS	SGS – Canada or SGS – Geostat or SGS – Lakefield or SGS – Mineral Services
Si	Silicium
SIR	Secondary Impurity Removal
Sn	Tin
SPLP	Synthetic Precipitation Leaching Procedure



Abbreviation	Description
SPRCSP	Soil Protection and Rehabilitation of Contaminated Site Policy
SQ	<i>Sûreté du Québec</i>
Std. Dev.	Standard Deviation
SW	Southwest
t	Metric Tonne
t/d	Metric Tonne per Day
t/h	Metric Tonne per Hour
t/m <sup>3</sup>	Metric Tonne per Cubic Metre
t/y	Metric Tonne per Year
Ta	Tantalum
TG	Technical-Grade
TIR	Tertiary Impurity Removal
TJMC	<i>Table Jamésienne de Concertation Minière</i>
ton	Short Ton
tonne	Metric Tonne
TSS	Total Suspended Solids
U	Uranium
\$US or USD	United States Dollar
USA	United States of America
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
V	Volt
VFD	Variable Frequency Drive
VLF	Very Low Frequency
W	Watt
WHIMS	Wet High Intensity Magnetic Separation
XRD	X-Ray Diffraction

Abbreviation	Description
XRF	X-Ray Fluorescence
XRT	X-Ray Transmission
y	Year
Y	Yttrium
Zn	Zinc
Zr	Zirconium

## 29 CERTIFICATE OF QUALIFIED PERSON



## CERTIFICATE OF AUTHOR

To accompany the Report titled “NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant” which is effective as of May 31, 2019 and issued on August 9, 2019 (the “Technical Report”) prepared for Nemaska Lithium Inc. (the “Company”).

I, *Maxime Dupéré, P. Geo.*, Quebec, do hereby certify that:

1. I am a geologist with SGS Canada Inc, Geostat, with an office at 10 Boul. de la Seigneurie Est, Suite 203, Blainville Quebec Canada, J7C 3V5;
2. I am a graduate from the *Université de Montréal*, Quebec in 1999 with a B.Sc. in geology.;
3. I am a member in good standing of the Ordre des Géologues du Québec (#501);
4. I have practiced my profession continuously since 2001. I have 18 years of experience in mining exploration in diamonds, gold, silver, base metals, and iron ore. I have prepared and made several mineral resource estimations for different exploration projects including lithium at different stages of exploration. I am aware of the different methods of estimation and the geostatistics applied to metallic, non-metallic and industrial mineral projects.
5. I have read the definition of “qualified person” set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 4, 5 & 5.1, 6 to 12, 14, and 23 and contributed part of Sections 1 and 25 to 27 of the Technical Report;
7. I visited the property site on December 5, 2017 and May 20 and 21, 2019;
8. I have had prior involvement with the property that is the subject of the Technical Report. The nature of my prior involvement is the 2017 resource update.
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;



12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

*"Original Signed and sealed"*

Maxime Dupéré, P. Geo.

Geologist

SGS Canada Inc. – Geostat

## CERTIFICATE OF AUTHOR

To accompany the Report titled "NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant" which is effective as of May 31, 2019 and issued on August 9, 2019 (the "Technical Report") prepared for Nemaska Lithium Inc. (the "Company").

I, *Rock Gagnon, P.Eng.*, Quebec, do hereby certify that:

1. I am a Project Engineer with QSL, a maritime terminal operator and stevedore with an office at 961 Champlain Boulevard, Quebec, Canada;
2. I am a graduate from "Laval University in Quebec City" with Bachelor Degree in Mining Engineering in 1993;
3. I am a registered member of "*Ordre des Ingénieurs du Québec*" (110811);
4. I have worked continuously since 1993 in various positions as mineral processing engineer and operation supervisor, senior process engineer for Met-Chem Canada Inc., as self-employed consultant where I was involved in the design and optimization of multiple mining projects in the minerals industry. I have worked continuously in the minerals industry for the last 26 years;
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 13 and 13.1 and contributed part of Sections 1 and 25 to 27 of the Technical Report;
7. I have visited the property site on May 9, 2017;
8. My prior involvement with the Project is preparing and supporting the Technical Report entitled "NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, Effective Date: November 7, 2017, issued on February 21, 2018". I was the technical leader and project manager of Engineering on the Whabouchi Project"



9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

"Original Signed and sealed"  
Rock Gagnon., P. Eng.  
Senior Process Engineer



## CERTIFICATE OF AUTHOR

To accompany the Report titled "NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant" which is effective as of May 31, 2019 and issued on August 9, 2019 (the "Technical Report") prepared for Nemaska Lithium Inc. (the "Company").

I, James Anson, Eng., do hereby certify that:

1. I am a Process Engineer with Hatch Ltd with an office at 5 Place Ville Marie, Montreal, Quebec, Canada;
2. I am a graduate of McGill University, with a bachelor in metallurgical engineering in 1996 and a doctorate in metallurgical engineering in 2000;
3. I am a member in good standing of the "Ordre des Ingénieurs du Québec" (permit no.: 125105);
4. I have worked within the metallurgical sector as a Process Engineer and Project Manager continuously since my graduation from university; My experience includes heat and mass balances, process design, feasibility studies, evaluation of equipment/plant capacities and utilization, debottlenecking, investigation of new or unusual processes, batch and pilot scale test work, and specification and procurement of major equipment.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I have participated in the preparation of this Technical Report and am responsible for Sections 13.2 to 13.2.7, 13.2.9 to 13.2.12, 13.2.14, 13.2.15, 13.2.17, 13.2.18, 17.2, 21.4 and contributed part of Sections 1 and 25 to 27 of the Technical Report
7. I have not visited the Whabouchi site. I have visited the Shawinigan plant site on multiple occasions since February 2017;
8. My prior involvement with the Project is preparing and supporting the Technical Report entitled "NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, Effective Date: November 7, 2017, issue on February 21, 2018."
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;

13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

This 9<sup>th</sup> day of August 2019.

*"Original Signed and sealed"*

James Anson, Ph.D., Eng.  
Process Engineer  
Hatch Ltd



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## CERTIFICATE OF AUTHOR

To accompany the Report titled “NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant” which is effective as of May 31, 2019 and issued on August 9, 2019 (the “Technical Report”) prepared for Nemaska Lithium Inc. (the “Company”).

I, *David Anthony (Tony) Boyd, PhD, P. Eng.*, do hereby certify that:

1. I am President of NORAM Engineering and Constructors Ltd., with an office at 200 Granville Street, Suite 1800, Vancouver, BC, V6C 1S4, Canada;
2. I am a graduate from University of British Columbia with B.A.Sc. in Chemical Engineering (1990) and Ph.D. in Chemical Engineering (2006);
3. I am registered as a Professional Engineer in British Columbia (APEGBC registration #24424);
4. I have worked as a process engineer at NORAM since 1990. I have over 20 years of experience in industrial process plant design and the commercialization of new processes, including electrochemical processes.
5. I have read the definition of “qualified person” set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 13.2.8, 13.2.13, 13.2.16, 13.2.19 and contributed part of Sections 1 and 25 to 27 of the Technical Report;
7. I have not visited the Whabouchi site; I have visited the Shawinigan site a number of times over the past 2½ years, including: Sept. 29-30, 2016; May 1, 2017; Sept. 7, 2017; Jan. 25-26, 2018.
8. My prior involvement with the Project is preparing and supporting the Technical Reports entitled:
  - NI 43 101 Technical Report, Feasibility Study on the Whabouchi Lithium Deposit and Hydromet Plant, Effective Date of May 13, 2014, issue on June 26, 2014 and revised on January 22, 2016;
  - NI 43-101 Technical Report - Feasibility Study Update on the Whabouchi Lithium



Deposit and Hydromet Plant which is effective as of April 4, 2016, issue on May 19, 2016 and revised on June 8, 2016;

- NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, Effective Date: November 7, 2017, issue on February 21, 2018.
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
  10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc., or any associated or affiliated entities;
  11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
  12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
  13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019.

*"Original Signed and sealed"*

*David Anthony (Tony) Boyd, PhD, P.Eng.  
President  
NORAM Engineering and Constructors Ltd.*

## CERTIFICATE OF AUTHOR

To accompany the Report titled “NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant” which is effective as of May 31, 2019 and issued on August 9, 2019 (the “Technical Report”) prepared for Nemaska Lithium Inc. (the “Company”).

I, *Jeffrey Cassoff, P.Eng.*, Quebec, do hereby certify that:

1. I am a Senior Mining Engineer and Team Leader with BBA Inc. located at 2020 Robert-Bourassa Blvd., Suite 300, Montreal, Quebec, H3A 2A5;
2. I am a graduate of McGill University in Montréal with a Bachelor’s in Mining Engineering obtained in 1999;
3. I am a member in good standing of the “*Ordre des Ingénieurs du Québec*” (# 5002252);
4. I have practiced my profession continuously since my graduation in 1999. My relevant experience includes mine planning and mine operations. As a consultant, I have worked on many NI 43-101 studies including lithium projects.
5. I have read the definition of “qualified person” set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 15.1 to 15.3 as well as 16.1 to 16.4 and contributed part of Sections 1, 21, and 25 to 27 of the Technical Report;
7. I visited the property site on May 20 and 21, 2019.
8. I have had prior involvement with the Project as the Qualified Person for the Open Pit Mineral Reserves for the report titled, “Feasibility Study on the Whabouchi Lithium Deposit and Hydromet Plant” with an effective date of May 13, 2014.
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;



10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

“Original Signed and sealed”  
Jeffrey Cassoff, P.Eng.

## CERTIFICATE OF AUTHOR

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I, *André-François Gravel, P. Eng., PMP.*, Quebec, do hereby certify that:

1. I am Senior Mining Engineer with Met-Chem, a division of DRA Americas Inc. with an office at suite 600, 555 René-Lévesque Blvd. West, Montreal, Quebec, Canada;
2. I am a graduate from "*École Polytechnique de Montréal*" with Bachelor Degree in Mining Engineering in 2000;
3. I am a registered member of "*Ordre des Ingénieurs du Québec*" (# 125135);
4. I have practiced my profession continuously since 2000. I have 19 years' experience in mining exploration in diamonds, gold, silver, base metals, and iron ore projects across Canada and worldwide. I have participated and supervised several mineral resource estimates for different exploration projects at various stages of exploration.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I have participated in the preparation of this Technical Report and I am responsible for Sections 15.4 and 16.5 and parts of Sections 1, 21, and 25 to 27 of the Technical Report;
7. I have not visited the Whabouchi mine site;
8. I have no prior involvement with the Project.
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;

10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Sections I was involved in (as listed in point 6) in the Technical Report in compliance with NI 43-101 and Form 43-101F1; these Sections were prepared in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

*"Original Signed and sealed"*

André-François Gravel, P. Eng., PMP  
Senior Mining Engineer

## CERTIFICATE OF AUTHOR

To accompany the Report titled "NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant" which is effective as of May 31, 2019 and issued on August 9, 2019 (the "Technical Report") prepared for Nemaska Lithium Inc. (the "Company").

I, *Ewald Pengel, M.Sc., P.Eng.*, Quebec, do hereby certify that:

1. I am a Senior Process Engineer with Met-Chem, a division of DRA Americas Inc, with an office at 555 Rene-Levesque Blvd. West, 6th Floor, Montreal, Canada;
2. I am a graduate from Queen's University, Kingston, Ontario with a B.Sc. in Metallurgical Engineering in 1982 and the University of Pittsburgh, Pittsburgh, Pennsylvania (USA) with a M.Sc. in Mining Engineering in 1985;
3. I am a registered member of Professional Engineers Ontario (90520297) and I am a member of the Canadian Institute of Mining Metallurgy and Petroleum;
4. I have worked for 30 years in the mineral industry since graduation;
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 17 and 17.1 and contributed part of Sections 1, 21, and 25 to 27 of the Technical Report;
7. I have not visited the property site;
8. My prior involvement with the Project is preparing and supporting the Technical Reports entitled:

*"NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Deposit and Hydromet Plant, Effective Date of May 13, 2014, issue on June 26, 2014 and revised on January 22, 2016";*

*“NI 43-101 Technical Report - Feasibility Study Update on the Whabouchi Lithium Deposit and Hydromet Plant which is effective as of April 4, 2016, issue on May 19, 2016 and revised on June 8, 2016”;*

9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

*“Original Signed and sealed”*

*Ewald Pengel, M.Sc., P.Eng.  
Senior Process Engineer*



## CERTIFICATE OF AUTHOR

To accompany the Report titled "NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant" which is effective as of May 31, 2019 and issued on August 9, 2019 (the "Technical Report") prepared for Nemaska Lithium Inc. (the "Company").

I, Pierre Girard, Eng., do hereby certify that:

1. I am a Project Manager with Hatch Ltd with an office at 5 Place Ville Marie, Montreal, Quebec, Canada;
2. I am a graduate from Sherbrooke University, Sherbrooke with a bachelor in mechanical engineering in 1987;
3. I am a member in good standing of the "Ordre des Ingénieurs du Québec" (permit no.: 45933);
4. I have worked within the metallurgical sector as an Engineer, Engineering Manager and Project Manager continuously since my graduation from university. My experience includes in project management, engineering management, construction management and commissioning of major equipment for small to large projects. My expertise also includes plant retrofitting and design tools.
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I have participated in the preparation of this Technical Report and am responsible Sections 5.2, 18.2, 21.2, 24.1.3, 24.3 and contributed part of Sections 1 and 25 to 27 of the Technical Report;
7. I have not visited the Whabouchi site. I have visited the Shawinigan plant site on multiple occasions since February 2017;
8. My prior involvement with the Project is preparing and supporting the Technical Report entitled "NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, Effective Date: November 7, 2017, issue on February 21, 2018."
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;
10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;



13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

This 9<sup>th</sup> day of August 2019.

*"Original Signed and sealed"*

Pierre Girard, B. Eng.  
Project Manager  
Hatch Ltd



## **CERTIFICATE OF AUTHOR**

To accompany the Report titled “NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant” which is effective as of May 31, 2019 and issued on August 9, 2019 (the “Technical Report”) prepared for Nemaska Lithium Inc. (the “Company”).

I, Dominic Tremblay, P. Eng., M.A.Sc., do hereby certify that:

- 1) I am an Engineer, Director of Mining Environment employed at SNC-Lavalin with an office at 5500 des Galeries Blvd., Quebec City (Quebec), G2K 2E2, Canada;
- 2) I am a graduate of “École Polytechnique de Montréal” with B.Eng. in Mining Engineering in 2002 and a Master in Applied Science (M.A.Sc.) in Mineral Engineering in 2006.
- 3) I am a registered member of “Ordre des Ingénieurs du Québec” (133511);
- 4) I have practiced my profession continuously since my graduation from university. I have gained direct experience on projects similar to the Nemaska Lithium Project as a Mining Engineer and Mining Environment specialist (tailings and mine waste management) in Canada;
- 5) I have read the definition of “qualified person” set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
- 6) I have participated in the preparation of this Technical Report and am responsible for Sections 18.1.2, 20.1.1.3, 20.1.4, 20.1.5, and 21.1.7 and parts of Sections 1 and 25 to 27;
- 7) I have visited the Whabouchi site on May 16, 2017; I have not visited the Hydromet plant site;
- 8) My prior involvement with the Project is preparing and supporting the Technical Report entitled “NI 43-101 Technical Report, Feasibility Study on the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant, Effective Date: November 7, 2017, issue on February 21, 2018.”
- 9) I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;





- 10) Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
- 11) Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
- 12) Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
- 13) I have read NI 43-101 and Form 43-101F1 and have prepared the Sections I was involved in (as listed in point 6) in the Technical Report in compliance with NI 43-101 and Form 43-101F1; these Sections were prepared in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

This 9<sup>th</sup> day of August 2019,

*“Original signed and sealed”*

**Dominic Tremblay, P.Eng., M.A.Sc.**

**Director - Mining Environment**

Sustainable Mining

SNC-Lavalin Inc.

5500, boulevard des Galeries, bureau 200

Québec (Québec) G2K 2E2

[dominic.tremblay@snclavalin.com](mailto:dominic.tremblay@snclavalin.com)



## CERTIFICATE OF AUTHOR

To accompany the Report titled "NI 43-101 Technical Report – Report on the Estimate to Complete for the Whabouchi Lithium Mine and Shawinigan Electrochemical Plant" which is effective as of May 31, 2019 and issued on August 9, 2019 (the "Technical Report") prepared for Nemaska Lithium Inc. (the "Company").

I, *Daniel Maguran, P. Eng.*, Quebec, do hereby certify that:

1. I am a Project Manager with Met-Chem, a division of DRA Americas Inc. with an office at suite 600, 555 René-Lévesque Blvd. West, Montreal, Quebec, Canada;
2. I am a graduate from the *Universit  Polytechnique Timisoara*, Timisoara, Romania in 2000 with a Bachelor Degree in Mechanical Engineering;
3. I am a registered member the "*Ordre des Ing nieurs du Qu bec*" (#5001920);
4. I have worked continuously since 2000 in various positions mechanical engineer, area manager, project manager, senior project manager for a total of 20 years continuously since my graduation, with relevant experience gained in the mining industry. I am the Project Manager of engineering on the Whabouchi Project;
5. I have read the definition of "qualified person" set out in the National Instrument 43-101 and certify that by reason of my education, affiliation with a professional association and past relevant work experience, I fulfil the requirements to be an independent qualified person for the purposes of NI 43-101;
6. I am responsible for the Sections 2, 3, 18 and 18.1 (except for 18.1.2), 19, 20 and 20.1 (except for 20.1.1.3, 20.1.4, 20.1.5), 20.2, 21.1 (except for 21.1.7), 21.3 and 21.5, 22, 24.1 to 24.1.2, 24.2 and part of Sections 1 and 25 to 27 of the Technical Report;
7. I visited the property site on May 7, 2019.
8. I have no prior involvement with the property that is the subject of the Technical Report.
9. I have no personal knowledge as of the date of this certificate of any material fact or change, which is not reflected in this Report;

10. Neither I, nor any affiliated entity of mine, is at present, under an agreement, arrangement or understanding or expects to become, an insider, associate, affiliated entity or employee of Nemaska Lithium Inc, or any associated or affiliated entities;
11. Neither I, nor any affiliated entity of mine, own, directly or indirectly, nor expect to receive, any interest in the properties or securities of Nemaska Lithium Inc., or any associated or affiliated companies;
12. Neither I, nor any affiliated entity of mine, have earned the majority of our income during the preceding three (3) years from Nemaska Lithium Inc., or any associated or affiliated companies;
13. I have read NI 43-101 and Form 43-101F1 and have prepared the Technical Report in compliance with NI 43-101 and Form 43-101F1; and have prepared the report in conformity with generally accepted Canadian mining industry practice, and as of the date of the certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make the Technical Report not misleading.

Dated this 9<sup>th</sup> day of August 2019

"Original Signed and sealed"  
*Daniel Maguran, P. Eng.*  
*Project Manager*

## Appendix A – *Mining Lease Letter*

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Gouvernement  
du Québec

Le **MINISTRE DE L'ÉNERGIE ET DES RESSOURCES NATURELLES**, dont le bureau est situé au 5700, 4<sup>e</sup> Avenue Ouest, Québec (Québec) G1H 6R1, dûment autorisé en vertu de la Loi sur les mines (RLRQ, chapitre M-13.1), représenté par M. Roch Gaudreau, directeur du développement et du contrôle de l'activité minière de la Direction générale de la gestion du milieu minier, dûment habilité par l'article 3 de la délégation de l'exercice des pouvoirs attribués au ministre l'Énergie et des Ressources naturelles par la Loi sur les mines, édicté par l'arrêté ministériel numéro 2009-006 publié à la *Gazette officielle du Québec* le 11 mars 2009, en sa qualité de locateur.

ET

**NEMASKA LITHIUM INC.**, société par actions constituée en vertu de la Loi canadienne sur les sociétés par actions (L.R.C. [1985] c. C-44), dont le siège social est situé au 450, rue de la Gare-du-Palais, 1<sup>er</sup> étage, Québec (Québec) G1K 3X2, représentée par M. Guy Bourassa, président et chef de la direction, dûment habilité par une résolution sous seing privé de l'administrateur de la compagnie adoptée le 22 septembre 2017, en sa qualité de locataire.

OBJET ET QUALIFICATION DES DROITS  
NATURE JURIDIQUE DE L'ACTE

Le locateur loue au locataire qui accepte, par bail minier numéro 1022, l'immeuble désigné ci-dessous, aux conditions prévues dans la Loi sur les mines et à celles fixées par règlement.

DÉSIGNATION  
DESCRIPTION DU LIEU OÙ S'EXERCE LE DROIT

Un terrain d'une superficie totale de 138,106 hectares, formé du lot 4 994 037 du cadastre du Québec, circonscription foncière de Lac-Saint-Jean-Ouest.

L'officier de la publicité des droits est requis d'établir au Registre des droits réels d'exploitation des ressources de l'État une fiche immobilière sous un numéro d'ordre puisqu'il s'agit d'une première inscription et vu l'absence de fiche antérieure.

## DROITS DU LOCATAIRE

Le présent bail donne au locataire le droit d'extraire toutes les substances minérales appartenant à l'État dans le terrain ci-dessus désigné, mais il ne donne pas droit aux substances minérales de surface, au pétrole, au gaz naturel, ni à la saumure. Il ne donne pas droit non plus d'aménager ou d'utiliser les réservoirs souterrains qui se trouvent dans le territoire faisant l'objet du bail, pour l'emmagasinement ou l'enfouissement d'une façon définitive d'une substance minérale ou d'un produit industriel.

Le locataire peut transférer à un tiers ses intérêts dans le bail moyennant l'enregistrement au Registre public des droits miniers, réels et immobiliers du Québec d'une copie de l'acte attestant ce transfert et le paiement des frais fixés par règlement. L'acte non inscrit au Registre public des droits miniers, réels et immobiliers du Québec, est sans effet à l'égard de l'État.

## DURÉE

Le présent bail est accordé pour une période de 20 ans à compter de la date de signature du locateur le 26 octobre 2017, et se terminera le 25 octobre 2037.

## CHARGES ET CONDITIONS

1. Le présent bail est consenti moyennant un loyer annuel payable d'avance, établi en vertu de la tarification en vigueur durant la période de validité du bail.

Le taux actuel, à la date de la signature du bail, est de 46,75 \$ l'hectare pour les terres du domaine de l'État, de 22,30 \$ l'hectare pour les terres concédées ou aliénées par l'État à des fins autres que minières et 99,00 \$ l'hectare pour la partie des terres du domaine de l'État utilisée pour entreposer des résidus miniers.

Le locateur se réserve le droit de réviser le taux du loyer suivant la tarification établie par le Règlement sur les substances minérales autres que le pétrole, le gaz naturel et la saumure (RLRQ, chapitre M-13.1, r. 2).

2. Le locataire doit commencer les travaux d'exploitation minière du terrain ci-dessus désigné dans le délai fixé par la Loi sur les mines en vigueur.

3. Le locateur pourra, pour raisons valables, prolonger ce délai, conformément aux dispositions de la Loi sur les mines en vigueur.
4. Le locataire a les droits et obligations d'un propriétaire, mais il a le droit d'utiliser la surface du terrain qu'à des fins minières.
5. Le locataire doit payer toutes les taxes, cotisations et redevances municipales ou autres qui peuvent être légalement imposées pendant la durée du présent bail.
6. Le locataire doit se conformer à la Loi sur les mines et aux règlements en vigueur durant la période de validité du présent bail. Il doit également, dans l'exercice de son droit minier, se conformer à toute autre loi et tout règlement en vigueur au Québec.

#### ORIGINE DU DROIT DE PROPRIÉTÉ

Le ministre de l'Énergie et des Ressources naturelles ne se fonde sur aucun titre publié.

SIGNÉ par les parties en cinq exemplaires :

Le 22 septembre 2017, à Québec

Par représentation, en qualité de locataire,

Nemaka Lithium inc.



Le 26 octobre 2017, à Québec

LE MINISTRE DE L'ÉNERGIE ET DES RESSOURCES NATURELLES

Par délégation, le directeur du développement et du contrôle de l'activité minière, en qualité de locateur,



Roch Gaudreau

## DÉCLARATION DES TÉMOINS

Nous, soussignés(es) SIMON THIBAUT,  
attestons ce qui suit :

1. Nous avons vérifié l'identité, la qualité et la capacité du locataire au bail.
2. Le bail traduit la volonté exprimée par le locataire.
3. Le locataire a signé le présent bail devant nous.

Attesté à Québec, QC,

le 22 septembre 2017

Nom : SIMON THIBAUT      Nom : ETIENNE DESSAGNÉ

Qualité : 1<sup>er</sup> témoin

Qualité : 2<sup>e</sup> témoin

Adresse :

Adresse :

415-205, 57<sup>e</sup> rue O.

62 Rue Bocher

Québec (QC) G1H7N6

SAINT-APOLLINAIRE, QC.

\_\_\_\_\_

G0S 2E0



Signature du 1<sup>er</sup> témoin



Signature du 2<sup>e</sup> témoin

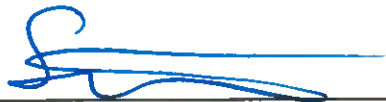
**DÉCLARATION SOUS SERMENT DE L'UN DES TÉMOINS**

Je, soussigné(e), SIMON THIBALLET, BIOLOGUE  
(prénom et nom, métier), domicilié(e) et résidant au  
415 5<sup>e</sup> rue D. app. 205, Québec (QC)  
G1H 7N6, déclare solennellement ce qui suit :

1. Je suis l'un des témoins dans la déclaration des témoins ci-dessus.
2. Toutes les déclarations ci-dessus sont vraies.

Et j'ai signé à Québec, QC (ville et province),

le 22 septembre 2017



Signature du témoin

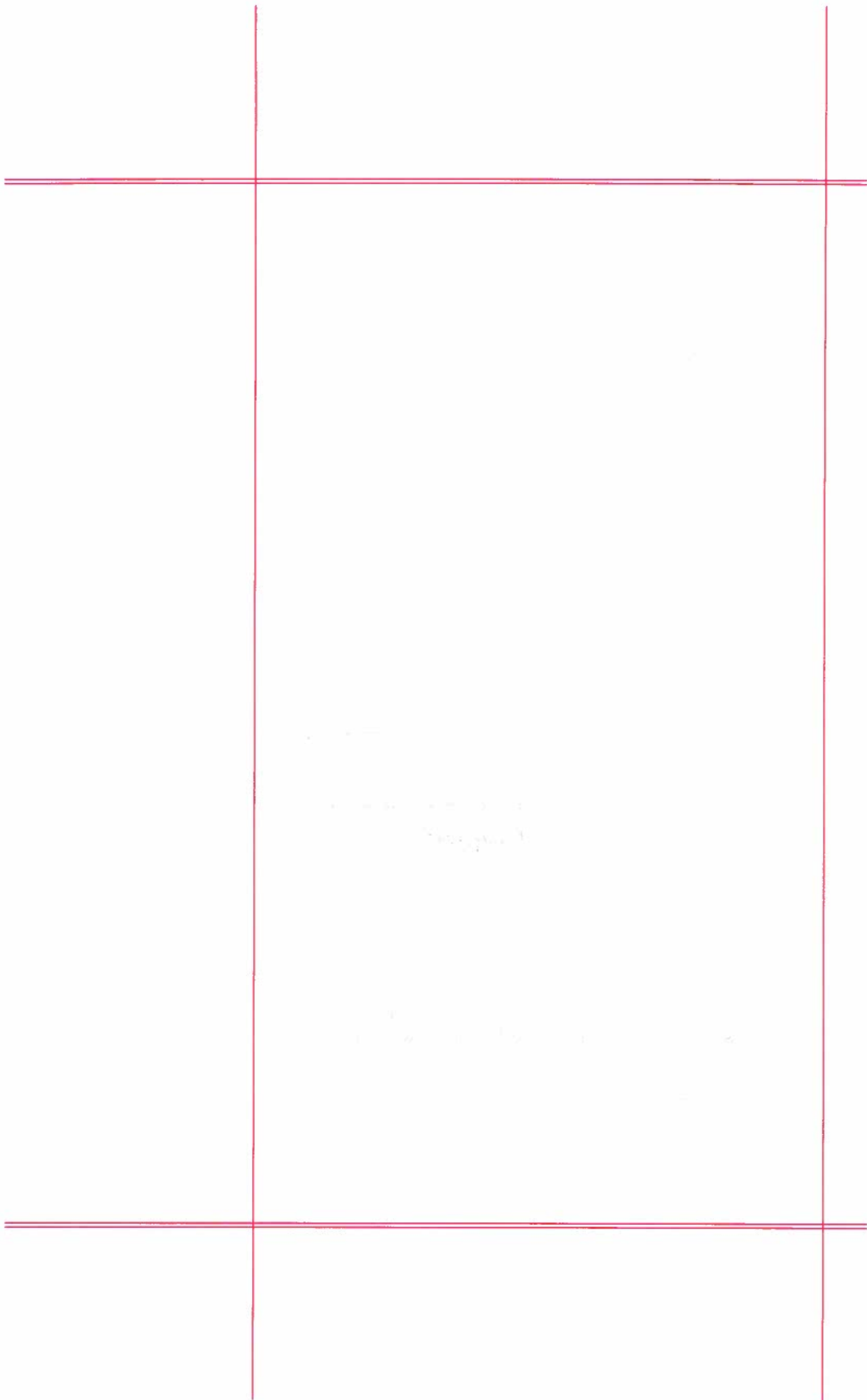
DÉCLARÉ DEVANT MOI À Québec,

CE 22 septembre 2017

  
COMMISSAIRE À LA PRESTATION DE SERMENT POUR

LE DISTRICT DE Québec







## DÉCLARATION D'ATTESTATION

### Nature de la réquisition

Bail minier numéro **1022** conclu entre le ministre de l'Énergie et des Ressources naturelles et Nemaska Lithium inc., signé par le ministre de l'Énergie et des Ressources naturelles, le 26 octobre 2017 à Québec, et par M. Guy Bourassa, le 22 septembre 2017 à Québec.

Je, soussignée, Hélène Giroux, avocate, atteste ce qui suit :

1. J'ai vérifié l'identité, la qualité et la capacité des parties au bail minier numéro **1022**, signé par le ministre de l'Énergie et des Ressources naturelles, le 26 octobre 2017 à Québec, et par M. Guy Bourassa, le 22 septembre 2017 à Québec.
2. Le document est valide quant à sa forme.
3. Le document traduit la volonté exprimée par les parties.

Attesté à Québec, le 26 octobre 2017

M<sup>e</sup> Hélène Giroux, avocate  
Ministère de l'Énergie et des Ressources naturelles  
5700, 4<sup>e</sup> Avenue Ouest, local C-320  
Québec (Québec) G1H 6R1

  
Hélène Giroux, avocate

