PN4.37 Responses to the request for additional information

PROJECT NO.: 201-12362-00

JAMES BAY LITHIUM MINE PROJECT

RESPONSES TO THE REQUEST FOR ADDITIONAL INFORMATION RECEIVED FROM THE MELCC AS PART OF THE PROJECT ENVIRONMENTAL ASSESSMENT

SEPTEMBER 2022

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GALAXY LITHIUM (CANADA) INC.

PROJECT NO.: 201-12362-00
DATE: SEPTEMBER 2022

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Reference to be cited:

WSP. 2022. *JAMES BAY LITHIUM MINE PROJECT. RESPONSES TO THE REQUEST FOR ADDITIONAL INFORMATION RECEIVED FROM THE MELCC AS PART OF THE PROJECT ENVIRONMENTAL ASSESSMENT*. REPORT PREPARED FOR GALAXY LITHIUM (CANADA) INC. 17 PAGES AND APPENDICES.

FOREWORD

As part of the analysis of the Environmental Impact Assessment (EIA) for the James Bay lithium mine project, the *Ministère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC) submitted a list of questions and comments on April 18, 2019. A second list of questions and comments was received from MELCC in December 2019, a third in September 2020, and a fourth on January 21, 2022, following the filing of the second version of the EIA in July 2021. Finally, a request for additional information was received from MELCC in August 2022.

The purpose of this document is to respond to the MELCC's request for additional information. It is the eleventh addendum to the Project EIA, the first having been filed with the CEA Agency as part of the concordance phase (in February 2019), the second with the MELCC in July 2019, the third with the CEA Agency in response to the first round of formal questions (in September 2019), the fourth and fifth to the IAAC (in December 2019 and February 2020, respectively) to provide clarification of the responses provided in the third addendum, the sixth to MELCC in response to the second set of questions and comments (in May 2020), the seventh to the IAAC in response to the second information request (Part 1) in June 2020, the eighth to the IAAC in response to the August 16, 2021, request for additional information, the ninth to the IAAC (in January 2022) in response to the third request for information, and then the tenth (March 2022) to respond to the MELCC's fourth request for information.

In this document, MELCC's requests for additional information are presented in their entirety within a box and in bold type to easily distinguish them in the text from the responses that are provided.

NOTE TO THE READER

This document was translated from the original French version. Therefore, the French version constitutes the official version. In case of conflict of interpretation between the English and French versions, the French version prevails.

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1 PROJECT DESCRIPTION

1.1 FEASIBILITY STUDY

INFORMATION REQUEST 1: TECHNICO-ECONOMIC STUDY

As early as the first round of questions (COMEX, April 2019), the proponent was asked about the possibilities of processing spodumene concentrate in the territory of Eeyou Istchee James Bay and elsewhere in Quebec. In the document Responses to the 4th request for information received from the "Ministère de l'Environnement et de la Lutte contre les changements climatiques" in the context of the project environmental assessment (WSP, 2022), the proponent indicates that a preliminary technico-economic study is being prepared to evaluate the possibility of transforming spodumene concentrate into lithium sulphate in Matagami. Galaxy Lithium (Canada) Inc. planned to file the study in July 2022.

The proponent must file this preliminary techno-economic study as soon as possible as part of this environmental assessment. If the study indicates that the processing of the ore will not take place in Quebec, the proponent must explain why.

Response to Information Request 1:

Contrary to the section heading, Galaxy will be filing a techno-economic study (not a feasibility study) on Friday, September 2 (Appendix A - Confidential). This study was conducted in accordance with MERN's "Guide de rédaction d'une étude d'opportunité économique et de marché pour la transformation au Québec (2018)" and recommends proceeding to the next step, the pre-feasibility study.

Galaxy is a subsidiary of Allkem, a company listed on the financial markets in Australia (ASX) and Canada (TSX), and therefore cannot publicly disclose the results of such a study. The report contains strategic elements that cannot be disclosed. The report must remain strictly confidential, and its contents cannot be published, either in writing or verbally. It will be submitted separately to the Minister of Natural Resources as provided for in the Mining Act (section 101).

1.2 ACCUMULATION AREAS

INFORMATION REQUEST 2: ACCUMULATION AREAS

The proponent points out in the response to question QC4-8 that the additional work and testing mentioned in the Golder (2021) Tailing, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design document had been proposed at the preliminary economic assessment stage of the project. The proponent added that since the preparation of this document, certain aspects have been revised, integrated or abandoned. The proponent also indicated that several issues raised by Golder would be addressed at the detailed engineering stage and had not been addressed in the documentation filed during the environmental assessment process.

The proponent has also included a response to each of the points raised by Golder but has not sufficiently addressed the impacts that the results of the additional work and testing requested by Golder could have on the project. The proponent must therefore complete the information presented in the response to QC4-8 by discussing the anticipated impacts of the results of the additional work and testing on the project as a whole and more specifically on the accumulation areas.

Response to Information Request 2:

Additional Results

The additional results have all been presented and added to Appendix QC4-8-1. No new results are available.

It should be noted that at the time of producing the "Tailing, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design" report, Golder, the designer, had not obtained the information collected during and following the Phase 2 and 3 geotechnical investigation campaign conducted in the summer/fall of 2020 and winter of 2021. Subsequently, Golder completed the feasibility study (Tailing, Waste Rock, Overburden and Water Management Facility Front End Engineering Design, October 2021). At this time, Golder had in hand the draft investigation report to confirm the information already available, particularly for the stratigraphic layers under the piles and collection basins.

The design is currently proceeding to detailed engineering. Between Golder's preliminary study and the current detailed engineering, the analyses carried out have confirmed the infrastructure configuration by making adjustments/optimizations more in line with the information gathered, while meeting the regulatory requirements and specific needs of the project. The current design is robust and its progress to detailed engineering does not diverge from previous engineering stages. It should be noted that further optimizations could be considered during operations, based on observations and measurements taken in the field (e.g., piezometric level readings, material grading in production, new technologies, etc.) to ensure that the system is optimal and well adapted to the conditions observed at the site.

To supplement the information presented in the response to QC4-8, we repeat here the points raised by Golder in its report "Tailing, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design":

- *In-situ permeability tests of the overburden soils and bedrock beneath the WRTSFs to conform compliance with Quebec Directive 19 and water management plan assumptions*
  - Results: The tests were conducted by SNC-Lavalin in the winter of 2021. The results were used as input to the hydrogeological model performed by WSP in 2021, as indicated in the response QC4-8.
  - Impact: The modeling results demonstrated compliance with Directive 019, as presented in the Environmental Impact Statement, version 2 (WSP, July 2021).
- *Develop a groundwater model to evaluate potential impacts of the WRTSFs on the local environment*
  - The modeling report is presented in Appendix J of the Environmental Impact Statement, Version 2 (WSP, July 2021). No additional information is required.

- *Tailings laboratory testing to determine the filterability (dewatering) and geotechnical characteristics*
  - Results/Additional Information: Following the preliminary engineering design, Golder has refined the tailings co-deposition model that features different gradation layers of material to encapsulate the fine tailings. Golder has proposed a conservative and practical approach that is appropriate for managing the deposition of tailings and waste rock. It should be noted that the waste rock and tailings piles are dry piles and the tailings will be transported and placed at different elevations with nominal compaction. The periphery is constructed with waste rock. The separation between the various overlying benches provides stability and drainage for the facility. The waste rock and coarse tailings provide adequate drainage of excess water, if any, and diversion of precipitation water. Additional testing of similar tailings from Allkem's lithium spodumene mine in Australia (i.e., Mount Cattlin) is about to be initiated to further evaluate the properties of the fine tailings. In the meantime, Wood is using conservative properties similar to materials of similar particle size.
  - Impact: The stability and configuration of the waste rock and tailings piles are not expected to change at the end of the laboratory tests. The results are expected to provide a better assessment of the properties and behavior of the fine tailings. The results are expected to be primarily useful in better defining the procedure for placing the fine tailings in the piles, which may include additional compaction, drainage, deposition sequencing, etc. The overall structure configuration will remain the same.
- *Additional tailings and waste rock geochemical characterization to determine acid generation potential and metal leaching in accordance with Quebec Directive 19*
  - Results: No new information. The geochemical characterization results presented in the EIA (WSP, 2021) are considered complete.
  - Impact: The hydrogeological model shows that the vertical seepage rate under the waste rock and tailings piles is in compliance with Directive 019 (i.e., 3.3 L/m^2/day).
- *Optimization and further evaluation of the proposed WRTSFs and construction staging based on the findings of the geotechnical site investigations*
  - Results: The geotechnical investigation carried out by SNC-Lavalin confirmed the presence and properties of the different soil layers under the structures.
  - Impact or additional information: No inconsistencies between the preliminary engineering design and the current detailed engineering design were observed. Only the optimization of the storage facilities and collection ponds is underway to better align the facility boundaries with the surrounding infrastructure (e.g., haul roads and access roads). The location is not changing, the deposition sequence is being developed and the facility boundaries are being better integrated into the overall project. The concept remains the same with flexibility for deposition in multiple locations once the foundation is properly prepared.
- *Further refinement of the site wide water balance*
  - Additional information: Engineering work is currently progressing with Wood and Golder at the detailed engineering stage to fully incorporate the latest site optimizations, particularly the implementation of the water treatment plant (WTP), which will take place during the construction phase. At each stage of the design since the preliminary study, the water balance model has been refined to fully incorporate the latest design variations of the structures. The water balance model has also been used to test variations in precipitation conditions and to evaluate the configuration and expected performance of the hydraulic infrastructure.
  - Impact: The initial stages of refinement of the current model at the detailed engineering level do not indicate significant changes since the previous engineering phases.

— *Optimize the locations and designs of the WMPs*
  – Additional Information: Ongoing activity as part of Wood's detailed engineering. Geotechnical evaluation confirms the configuration of the north water management pond (WMP) with minor design adjustments to allow for proper connection to the existing topography. A water management study of the WMPs is underway with minor design adjustments to ensure a wide range of precipitation events are contained, protective layers are adequately designed, and water levels are properly assessed.
  – Impact: There is no indication that the configuration of the North and East water management ponds will be changed from that proposed in the Golder preliminary study. It is only an optimization to ensure integration with the surrounding works while ensuring compliance with regulatory requirements.
— *Hazard assessment to determine the Consequence Classification of the WRTSF slopes and WMP dykes in accordance with CDA guidelines*
  – Additional information: The classification was made during the preliminary engineering study and has never changed since.
— *A dam breach and inundation study to support the WMP dam classification*
  – Additional information: Wood was commissioned to do this study.
— *Water treatment requirements for effluent discharge from the NWMP*
  – The answer provided to QC4-8 is complete. No additional information is required.

INFORMATION REQUEST 3: RESIDUE MANAGEMENT BY CO-DISPOSITION

The proponent stated that tailings management will be achieved through the co-disposition of dewatered tailings and waste rock. In the 4th series of responses, the proponent specified various information concerning, in particular, the height and slope of the berms for the accumulation areas and the method of disposing of the tailings and waste rock. It referred to the impact study but did not present all the elements requested in question QC4-9.

Since mine tailings are leachable, the proponent must provide all the elements requested in question QC4-9, i.e., the details of the management method that will be chosen with the related conceptual elements, at least the anticipated flow regime of infiltration water, the anticipated degree of water saturation, the anticipated circulation of oxygen, etc. It should be noted that these missing elements were requested from the proponent in the document Questions and comments for the James Bay lithium mine project (COMEX, April 2019) in question QC-28.

Response to Information Request 3:

Concept and Management Method

The design of the waste rock and tailing storage facilities (WRTSFs) is such that no water accumulation is possible. The water saturation in the WRTSFs should therefore be low.

The design was thought to direct the majority of the water from the precipitation to the pit. The analysis of the modeling results (reference WSP, 2021 – JAMES-BAY LITHIUM MINE - HYDROGEOLOGY SPECIALIZED STUDY UPDATE - JULY 2021) shows that for the Northeast WRTSF, 85% of the precipitation will be captured by the drainage ditches; For the West WRTSF, 95% will be captured by the drainage ditches; for the Southwest WRTSF, 89% will be captured by the drainage ditches; for the East WRTSF, 87% will be captured by the drainage ditches. For the South-West and East WRTSFs, the water that reaches the environment will percolate towards the pit (100% for the South-West WRTSF and 84% for the East WRTSF) and will therefore be recovered and treated.

Precipitation that is not captured by the pits (between 5% and 15%) will infiltrate into the environment. Transport modelling (arsenic and copper) (reference WSP, 2021 - JAMES-BAY LITHIUM MINE - HYDROGEOLOGY SPECIALIZED STUDY UPDATE - JULY 2021) was performed to determine the impact of this percolation on the natural environment. These modeling studies have shown that arsenic concentrations are always below the RES criterion and even below the estimated background level of 2018. For copper, concentrations are above the RES criterion in the northeast area, but do not exceed the maximum concentration measured in groundwater. For surface streams, only stream CE2 would be impacted. The results show that even with base flows, the simulated arsenic and copper concentrations at stream CE2 from infrastructure are below the most restrictive surface water criterion for each parameter. Because the transport simulations did not include a delayed degradation or adsorption condition, the projected dissolved metal concentrations in stream CE2 from groundwater were estimated from the leaching results. Even considering the base flow, no exceedances of the various criteria are expected in stream CE2.

It is important to consider that the transport simulations performed are conservative. Indeed, the leaching tests showed that leaching was observed only for 16 weeks maximum and in the model, the concentration was left for 52 weeks. In addition, no adsorption parameters were considered in order to remain conservative even though clay (highly adsorptive) is present at the site.

A groundwater quality monitoring program will be implemented throughout the site and will allow corrective measures to be taken in the event of contamination by the infrastructures.

Anticipated Degree of Saturation

In the hydrogeological model, the saturation of the WRTSFs varies between 0.05 (residual saturation) and 0.15.

Anticipated Circulation of Oxygen

Concerning oxygen in the WRTSFs, during the work, no measures will be put in place to reduce the oxygen content in the stockpiles, so we can expect an oxygen content similar to that of the natural environment. During the remediation period, it is not planned to make the stockpiles completely impermeable, but to revegetate to reduce oxygen, without making the stockpiles anoxic.

Since the waste rock and tailings are not considered leachable in the long term, then no specific mitigation or management measures are required for the restoration of the WRTSFs (i.e., no watertight cover, water catchment) to achieve environmentally satisfactory condition. Achieving satisfactory condition for this infrastructure will instead require adequate revegetation of the stockpiles. Thus, the evaluation of possible remediation techniques will consist more of a choice of revegetation method.

For waste rock in the pit below the maximum water level, flooding the pit will make the environment anoxic, so there will be no leaching. For waste rock above the maximum water level, the same approach described in the previous paragraph applies.

1.3 WATER MANAGEMENT

INFORMATION REQUEST 4: WATER MANAGEMENT - LITHIUM

In the 4th round of responses, the proponent committed to installing a mine water treatment plant equipped with the Best Available Technology Economically Achievable (BATEA)] at the start of mine operations.

The proponent did not provide sufficient detail regarding the mine water treatment plant in this response document but did provide the Administrator with a memorandum Response to question requesting water treatment plant details (G Mining Services, 2022) in May 2022, which outlines the water treatment that will be used during construction and operation of the mine.

In the highlights of the geochemical column tests presented in section 3.3.1 of Appendix 1 of the memorandum (GCM, 2022), it is stated: "Lithium concentrations above the effluent toxicity limit ("VAFe") of 1.8 mg/l were measured on two occasions for unsaturated waste rock. However, since the concentrations are very close to the limit, and waste rock leachate water is not the only source of water directed to the effluent, it is likely that treatment of this contaminant will not be required during the construction phase."

Based on this information, GCM indicates that lithium was not considered as a design criterion for the treatment plant, even though concentrations above the toxicity criterion were measured during the column tests, since water from areas of the site where no contaminants are expected will be mixed with the wastewater.

Such an approach is contrary to section 2.1.5 of the Mining Industry Directive 019 which states that "no dilution of mine wastewater is permitted".

Thus, lithium, as well as all contaminants potentially present in the contact water that could lead to an exceedance of EDOs, must be considered by the proponent in the calculation assumptions for the design of the mine water treatment plant.

The proponent must indicate whether the treatment proposed in the May 24, 2022, Supplemental Information Document is capable of treating the lithium content of the leachate and moving towards the EDO of lithium, which is 0.44 mg/L. If the proposed treatment is not sufficiently effective in reducing lithium concentrations to that of the EDO, the proponent must indicate what type of treatment will be in place to address lithium at the outset of operations in order to avoid lithium toxicity in the effluent and to move towards compliance with the EDO.

Response to Information Request 4:

Here is some additional information regarding the issue of lithium concentrations identified above EDO:

- First, the results mentioned are from laboratory tests conducted in a controlled environment that simulates specific conditions, but the reality will not be identical and could lead to different results.
- Furthermore, as mentioned, only 2 weeks out of the 50 weeks analyzed were high enough to raise questions. In reality, the tailings "piles" will not be isolated from each other, and climatic conditions will vary so that water runoff will not reflect conditions as accurately from one week to the next.
- It should also be noted that the piles will be used to deposit tailings and waste rock (co-disposition). As a result, it will not be possible to separate waste rock runoff from tailings runoff. It is therefore not expected that the water from the piles will have concentrations identical to those obtained in the column tests, where each sample analyzed represented a particular rock type for particular conditions (saturated or unsaturated).
- A study is being prepared to assess the water treatment requirements after Year 3. As part of this study, a scenario with lithium treatment is being considered.

- Initial conversations with technology providers suggest that treatment technologies that would lower lithium concentrations to EDO levels are available (metals removal by coagulation + ultrafiltration or ultrafiltration + reverse osmosis).

In general, for all contaminants, it is expected that the majority of metals will be reduced prior to discharge to the effluent. Water treatment with an Actiflo will be implemented in the year of construction. This treatment technology was selected because it will meet the discharge standards. The plant has been sized based on conservative modeling scenarios and the standards (D019 and MDMER) will be met. It is difficult to guarantee the expected concentrations for all the compounds present in the water, but ballasted coagulation and lamellar decantation will reduce the concentrations of most metals. A follow-up of the water quality at the effluent is planned and the process will be optimized according to the real conditions of the site.

INFORMATION REQUEST 5: WATER MANAGEMENT DURING CONSTRUCTION AND OPERATION - ARSENIC

The proponent is proposing to take an adaptive management approach to mine water treatment, as the contaminants of potential concern and expected flows are different for each phase of the project. An initial treatment system will be built during the construction phase. The performance of the various contaminants treatment will influence the design of the system that will be installed for the operation phase of the mine. COMEX concerns regarding mine water treatment were presented to the proponent on this issue in Round 2 in December 2019.

The proponent plans to use an Actiflo treatment system during the construction phase. The treatment plant would be expanded for the operation phase to treat a larger volume of water and contaminants. In addition, a pH adjustment stage will be added downstream of the treatment process for this phase.

The proponent presented modeling results of expected contaminant levels in raw water and compared them with EDOs (Golder, 2021). Based on these results, exceedances of EDOs in final effluent could occur for arsenic, silver, cadmium, mercury and uranium. The proponent has committed to designing the water treatment plant to strive for compliance with EDOs. In this context, and since arsenic is the contaminant with the highest apparent exceedances, the proponent must indicate how it will reduce the concentrations of this contaminant that could reach several times the EDO based on the results presented by the proponent.

Response to Information Request 5:

Arsenic will be reduced by adsorption on iron. This technique is well documented in the literature. The technology selected to perform this reaction is Actiflo (Veolia), which combines ballasted flocculation and lamellar clarification. In addition, a pH adjustment reactor is planned upstream to control and optimize the reaction. The coagulant and polymer dosages will capture arsenic (and other metals) and generate large flocs that can settle and allow for quality treated water. The last treatment step is a second pH adjustment before discharge to the effluent. This technology generally achieves at least 1 log (x10) removal. It is therefore expected that the effluent will be in compliance with the EDO for arsenic (and therefore with other standards). It is also expected that this technology will reduce the concentration of other metals and compounds present in the water to be treated, even though the design and operation parameters are optimized for arsenic removal.

INFORMATION REQUEST 6: POST-CLOSURE WATER MANAGEMENT - ARSENIC

In the Restoration Plan (WSP, March 2022), the proponent presents an assessment of expected arsenic concentrations in pit water after mine closure. The proponent indicates that during pit filling, arsenic levels would remain above the Directive 019 criterion (0.2 mg/l), as well as the standard (0.1 mg/l) of Metal and Diamond Mining Effluent Regulations (MDMER) until year 59 post-closure. Thereafter, arsenic levels in the pit water are expected to be between the Directive 019 criterion (0.2 mg/L) and the MDMER standard (0.1 mg/L) until the pit is full. In the Water Treatment Requirements for Effluent Discharge From the NWMP (Golder, October 2021), it is stated that arsenic levels when the pit is full are expected to be 1.68 mg/L which meets the Guideline 019 criterion (0.2 mg/L), but exceeds the MDMER standard (see figure below).

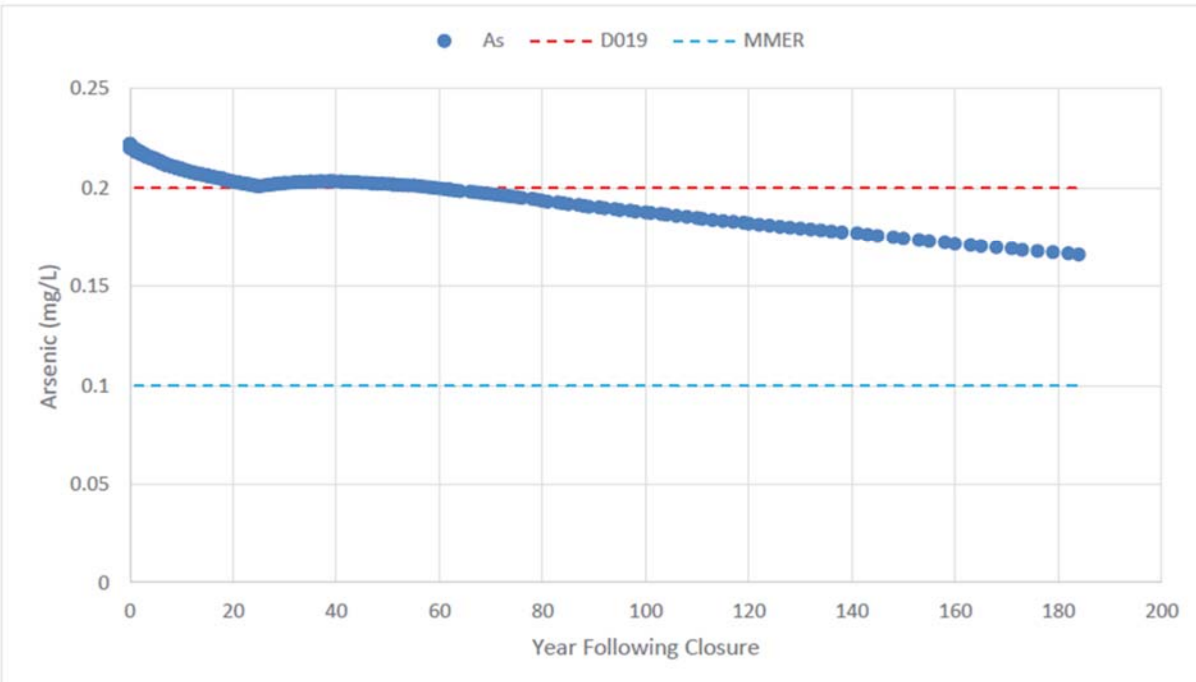

Figure 2 : Arsenic Evolution Over Pit Lake Filling Time

Figure - From Water Treatment Requirements for Effluent Discharge From the NWMP (Golder, October 2021)

Although the proponent does not compare this result to the EDO, it should be noted that the EDO for arsenic concentration in the effluent is 0.021 mg/l, which corresponds to the contamination prevention criterion (aquatic organisms only). In summary, the effluent leaving the pit will not meet the MDMER standard or the EDO even after 180 years following mine closure.

The proponent's restoration plan does not include any concrete measures to ensure that the quality of the water that will accumulate in the pit is restored to its original level before being released to the natural environment. It is only stated that a solution will be investigated in the short term to ensure that arsenic concentrations meet the MDMER criterion before the water from the pit is released to the natural environment. The proponent must present concrete measures to reduce the arsenic load in the pit water so that water released to the environment following mine closure will meet the criteria of Directive 019, the MDMER standards and move towards compliance with EDOs, particularly for arsenic.

Response to Information Request 6:

Correction: Based on modeling results, arsenic concentrations when the pit is full are expected to be 0.168 mg/l (not 1.68 mg/l as stated in the RFI) which meets the Directive 019 criterion (0.2 mg/l), but exceeds the MDMER standard (0.1 mg/l) and EDO for discharges to CE2 (2021; 0.021 mg/L - note that EDOs for CE3, which will be the final effluent discharge point from the pit following its filling, have not been determined). As previously mentioned, the proponent is committed to investigating a solution to ensure that the arsenic concentrations that will be released into the environment are below the applicable standards.

It is important to note that the exceedances that are currently anticipated by the modeling are not significantly higher than the MDMER standard (less than two times the standard).

Currently, there are treatments available that would lower the arsenic concentrations in the pit water prior to its release into the environment, including iron adsorption and precipitation. This practical method would be based on the same principles as the technology proposed for the WTP during the operation phase with the difference that the pit would then serve as a rudimentary tank instead of a designed tank like Actiflo and, considering the residence time as well as the volume of water in the pit, there would be no lamellar clarification required. The reagent used would be selected to optimize the reaction according to the specific environmental conditions of the pit. The sludge would then accumulate at the bottom of the pit where it would remain in perpetuity. Given the depth of the pit and the pH predictions, it is unlikely that the precipitated metals would be released and therefore would not pose a risk to aquatic life in the pit.

Galaxy is committed to conducting additional modeling as soon as the mine begins operations. This modeling will provide more realistic results to refine the closure plan and provide concrete measures to reduce the arsenic (and other metals, if applicable) load in the pit water so that the water discharged to the environment following mine closure will meet the criteria of Directive 019, the MDMER standards, and move towards compliance with EDOs. The best available technology economically achievable (BATEA) will then be considered if the results of monitoring and modeling during the operational phase demonstrate that treatment is required to ensure compliance with applicable standards and move towards EDO compliance prior to discharge to the CE3.

Finally, the closure scenario will be adjusted with the new modeling and monitoring results available. The restoration plan will be updated to take into account the changes made. The restoration plan will in any case have to be updated every 5 years to meet the requirements of the Mining Act.

2 BIOPHYSICAL ISSUES

2.1 AIR QUALITY

INFORMATION REQUEST 7: AIR QUALITY – PERIOD OF APPLICABILITY OF CERTAIN CRITERIA

In its modeling of the atmospheric dispersion of contaminants, the proponent allocated the maximum daily tonnage to the two crushers (11,109 t/d), over a 10-hour period of use, in order to take into account shutdowns, restarts and occasional equipment malfunctions. Thus, an hourly tonnage of 555.5 t/h was assigned to each crusher.

In an update to the modeling, an operating efficiency factor of 1.3 was applied to the crusher operating hours, resulting in an efficient work period of 7.7 hours per day, which produced a feed rate to each crusher of 725 t/h.

The use of the 555.5 t/h feed rate is acceptable for evaluating standards and criteria with a period of applicability equal to or greater than 24 hours. However, since the feed rate to each crusher could be as high as 725 t/hr during the period of use, this maximum rate must be used in the modeling to verify compliance with standards and criteria having a period of applicability equal to or less than one hour, including the nitrogen dioxide (NO_2) standard and the hourly criterion for crystalline silica. The same applies to blasting. Blasting-related emissions must be included for each day modeled (daily blasting) to verify compliance with standards and criteria that have a period of applicability equal to or less than 24 hours.

Therefore, the proponent shall revise the modeling to include the maximum crusher feed rate for standards and criteria with a period of applicability equal to or less than one hour, as well as daily blasting for standards and criteria with a period of applicability equal to or less than 24 hours.

Response to Information Request 7:

The modeling has been revised to consider all of the requested elements (Appendix B). The response is included in the Stantec memo titled *Updated Air Quality Model Results - James Bay Lithium Pegmatite Project* with reference number 121416913. In Section 2 of the report, the first and 6th bullet points answer the question addressed. Below is the text for reference:

"Blasting Emissions: For the 1-hour and 24-hour averaging periods, the model inputs were revised to include one blast event per day (all 365 days). For calculating annual average concentrations, 3 blast events are considered per week. The same methodology is applied as described in Section 4.1.6 and 4.2.5 of Stantec (2021).

Mobile Crushing Emissions: Mobile crushing is used during the Project construction phase (not operations). A feed rate of 555 t/h for each of the two construction mobile crushers to calculate emissions assuming 10 hours of operation per day. This 24-hour averaged emission rate is selected rather than a 1-hour peak rate as the crusher is a source of only particulate matter emissions and there are only 24-hour air quality standards and criteria (no 1-hour standards or criteria). Metal concentration predictions (such as crystalline silica) which may have a 1-hour standard or criteria are not evaluated for the Project construction scenario (only operations). Mobile crushing operations are also not a source of combustion gas emissions such as NOX. The same methodology is applied as described in Section 4.1.4 of Stantec (2021)."

INFORMATION REQUEST 8: AIR QUALITY – DRY PARTICLE DEPOSITION

In its response to question QC4-30, the proponent indicates having used the option of dry deposition of particles for all emission sources, considering that more than 10% of the particles emitted had a diameter greater than 10 µm, except for those originating from diesel-powered mining equipment engines and propane combustion sources (heating and ventilation). For the latter sources, he considered an option that is not recommended for dry deposition ("Method 2" in the AERMOD model), as most particles emitted from these are fine particles (PM2.5). Considering that the deposition of PM2.5 is very low or even negligible, the modeling must consider that PM2.5 remain suspended in the ambient air.

The proponent must demonstrate that ambient PM2.5 concentrations meet the air quality standard of the Clean Air Regulation without considering the dry deposition of PM2.5 emitted from diesel mining equipment engines and propane combustion sources.

Response to Information Request 8:

The modeling has been revised to consider all of the requested elements (Appendix B). The response is included in the Stantec memo titled *Updated Air Quality Model Results - James Bay Lithium Pegmatite Project* with reference number 121416913. In Section 2 of the report, the 8th bullet point answers the question addressed. Below is the text for reference:

"Fine Particulate and Metal Concentrations: Consistent with Stantec (2021), as a conservative assumption, deposition is not applied in the AERMOD model runs to predict PM2.5, PM10 and metal concentrations. No removal of plume mass is assumed to occur."

INFORMATION REQUEST 9: AIR QUALITY – CRYSTALLINE SILICA CONCENTRATIONS

As provided for in section 4.3 of the Mining Projects Guidance Manual, the acceptability of the project in relation to air emissions is assessed based on modelled concentrations to sensitive receptors. Exchanges concerning crystalline silica have taken place with the proponent since the first round of questions. Several adjustments to the project and the modeling have been made since the first exchanges. There are still adjustments to be made to the modeling in order to be able to make a decision on the acceptability of the project.

The initial annual concentration for crystalline silica (SiO_2) used in the dispersion study (0.04 µg/m³) is conservative for the environment where the Galaxy Lithium (Canada) Inc. mining project is located. As a matter of fact, by considering a more representative initial concentration of 0.01 µg/m³, the modeled ambient air concentrations for SiO_2 at the location of a traditional activity site, located less than 300 meters from the mine, as well as at the truck stop at kilometer 381 of the Billy-Diamond Road, would meet the annual criterion. Thus, the proponent can use an initial concentration of 0.01 µg/m³ for modeling SiO_2 concentrations.

In its response to question QC4-32, the proponent states that it has revised the fraction of SiO_2 in the emissions of particles smaller than 10 µm (PM10) and 4 µm (PM4) at 10%. He alleges that this assumption would be more representative than using the measured quartz content in the ore or waste rock, which are 26% and 30%, respectively. The latter were used in the latest modeling submitted by the proponent in July 2021.

Considering that there are few data and studies available concerning the crystalline silica content in fine particles and that it varies according to the rock and the source of the particles (blasting, drilling, wind erosion, road, etc.), it is difficult to establish a precise content for a particle size. Thus, in order to have a conservative model, it is recommended to the proponent that the percentage used to establish the crystalline silica content in PM10 and PM4 be 13%, or 44% of the maximum percentage of 30% measured in the waste rock.

This percentage (13%) was proposed to the proponent on June 10, 2022, to complete an air quality modeling update. On July 27, 2022, the proponent submitted the preliminary results of the air quality modeling update to MELCC. The proponent used different percentages than those proposed.

As a reminder, as stated in Appendix H of the Clean Air Regulation, the modeling scenarios must be able to reproduce the worst-case contaminant concentrations expected based on the time period of application of the limit value. In Round 4, the proponent was asked to repeat the modeling scenarios and show that they considered the maximum concentrations of contaminants emitted based on the time period of application. At first sight, the rates used in the preliminary results do not comply with the guidance in Appendix H of the Clean Air Regulation or with the request made by COMEX in Round 4.

The proponent shall review and submit new modeling using the 13% to establish the crystalline silica content in PM10 and PM4, which is 44% of the maximum 30% measured in the waste rock.

Response to Information Request 9:

Galaxy presents in Appendix B a new modeling using the prescribed percentages. The information is in the Stantec memo titled Updated *Air Quality Model Results - James Bay Lithium Pegmatite Project* with reference number 121416913. This modeling allows for all air quality criteria to be met.

In response to the question raised at the August 26 meeting as to whether year 14 remains the worst-case scenario, yes, year 14 is the worst-case year in that the deposition schedule on the piles is adjusted so that no year has a tonnage deposited to the stockpile greater than the mitigation scenario presents.

Finally, the modelling that will be carried out during project operations with the field data will allow to validate the theoretical data used during this modelling and to validate the proposed mitigation measures. Adjustments to operations can then be made as needed to ensure compliance with air quality criteria.

2.2 SURFACE WATER

INFORMATION REQUEST 10: SURFACE WATER

COMEX's concerns about the discharge of mining effluent were presented to the proponent at the beginning of the project analysis. In the 4th series of responses, the proponent presents a map showing the position of the project relative to the Eastmain River. The mining effluent will be discharged into the CE2 stream, which flows 53 km further into the Eastmain River. The proponent indicates that there will be no significant change in the water quality of stream CE2. However, it seems unlikely that the effluent will have no measurable effect on the water quality of the receiving stream and streams downstream from it (e.g., increase in conductivity, physicochemical changes, etc.).

The proponent must therefore submit an assessment of the extent of the impact of the mining effluent discharge on the receiving aquatic environment and map it.

Response to Information Request 10:

In terms of water quality, the proponent has undertaken to comply with the various criteria (D019, MDMER and EDOs) for the parameters indicated, so that the quality of the water in the receiving stream (CE2) is not affected. It should be remembered that the EDO calculation is based on a zero flow in the CE2, which cannot contribute to a dilution effect, even though flows were measured as part of the sectoral studies in the impact study. The EDOs are therefore very conservative criteria that serve as a basis for the design of the treatment plant (WTP) to ensure that the effluent water will not affect living organisms in the CE2, let alone in the Eastmain River, located 53 km downstream and with a very significant flow. The proponent is therefore confident that the treated water from the mine effluent will be of sufficient quality to have no significant negative impact on the aquatic environment.

This being said, since the effluent that will be discharged into the CE2 will not have the same properties (i.e., the concentrations of physico-chemical parameters, nutrients, ions, metals, etc., will be different), changes to the properties of the water in the CE2 will certainly be observed. These changes will be most noticeable in proximity of the effluent discharge point and will decrease going away downstream from the discharge point. A calculation of the ratio of the average effluent discharge rate to the stream flow (Table 1) was thus performed to determine the input of the downstream inflow of water from other streams to better understand the extent of the changes (Figure 1). In the CE2 (point 1 identified in Figure 1), the average effluent flow represents 40% of the average flow in the CE2. After the junction with the CE6 (point 2 in Figure 1), the average effluent flow represents 27% of the average flow of the CE6 while after the junction with the CE1, the average effluent flow represents 16% of the average flow of the CE1. Seven kilometers downstream of the junction with the CE1 (point 4 on Figure 1), the average effluent flow corresponds to 6% of the average stream flow. Finally, at the junction with the Miskimatao River (about 25 km upstream from the Eastmain River), the percentage is reduced to 0.9%. It is obvious thus that at the junction with the Miskimatao River, and even further upstream, the effect of the effluent will no longer be noticeable.

Table 1 Calculation of the Ratio of Average Effluent Flow to Average Stream Flow

Point	Watershed nder Projected Conditions	Area (km²)	Average Annual Flow (L/s)	Average Effluent Flow Ratio / Average Stream Flow
1	CE2 (without counting the surface of the mine)	7.64	210	40 %
2	After junction with CE6	11.29	310	27 %
3	After junction with CE1	18.93	520	16 %
4	7 km downstream of the junction with CE1	51.15	1406	6 %
5	After junction with Miskimatao River	349.90	9619	0,9 %

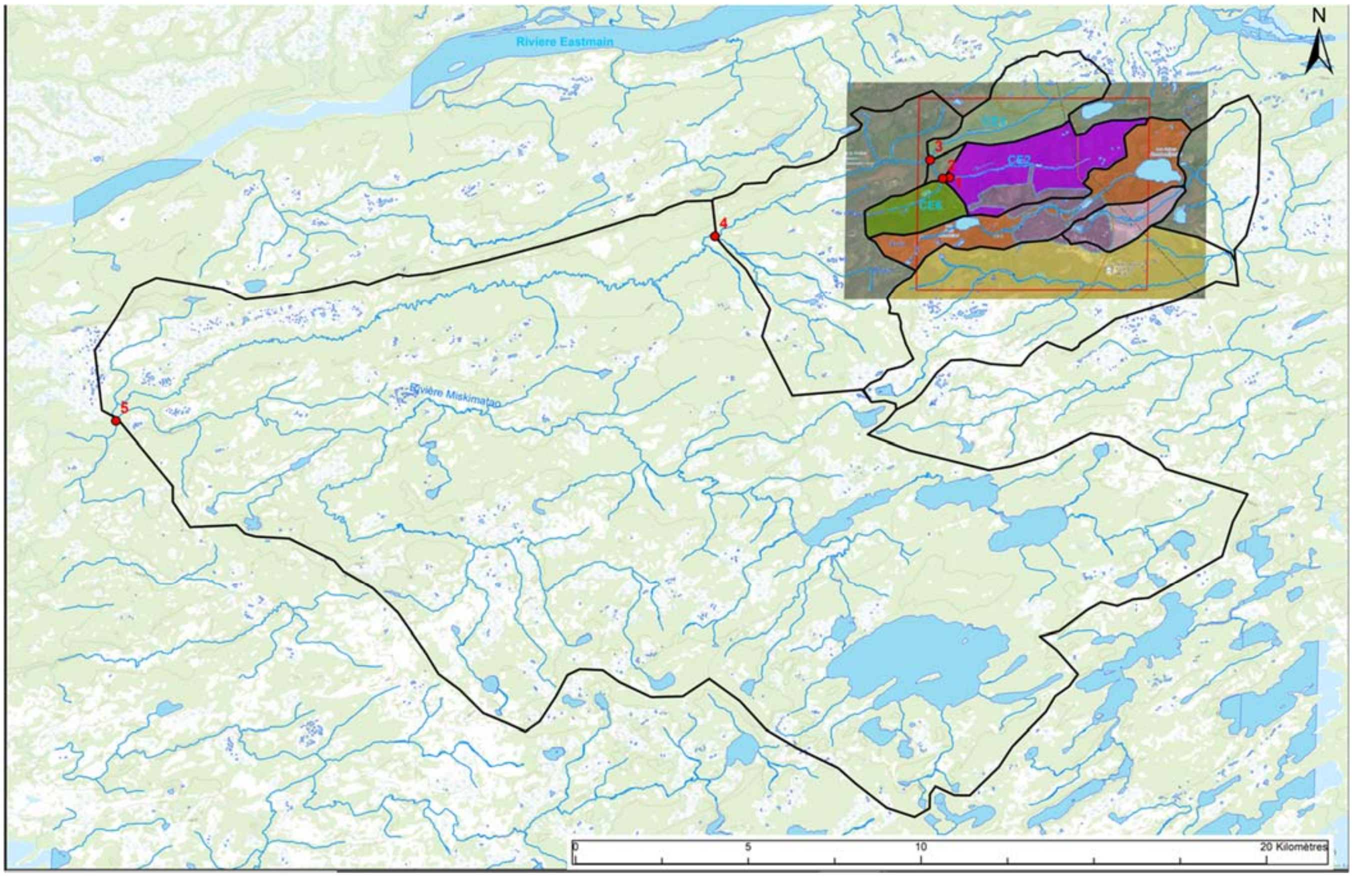

Figure 1 Watersheds and Junction Points Where Ratio Calculations were Made

2.3 FAUNA AND FLORA

INFORMATION REQUEST 11: IMPACT ON AQUATIC FAUNA

In the fourth series of responses, the proponent proposes to conduct an environmental DNA test in order to validate the allopatry of yellow perch in Kapisikama Lake. However, he does not undertake to carry out a diagnosis of the lake and the yellow perch population as requested in the fourth series of questions, in question QC4-62. The latter mentions that the diagnosis must be carried out in order to have a reference state of the environment that will be disturbed and to adequately describe the impact of the project on the fish habitat as well as on the fish population that this lake shelters.

The proponent must therefore conduct a diagnose of the Kapisikama Lake according to the "Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures Tome I - Acquisition de données". It is important to determine whether the yellow perch population is allopatric and, if so, to establish a genetic and phenotypic portrait, i.e. a comparison with local populations or populations further south. An initial request to characterize this yellow perch population had already been submitted to the proponent in the document Questions and comments for the James Bay lithium mine project (COMEX, April 2019) under question QC-100.

Since the filing of the 4th series of responses, the proponent has conducted a diagnose of Kapisikama Lake and the yellow perch population but has not filed the results. The proponent must file, as a minimum and as soon as possible, the preliminary results of the Kapisikama Lake diagnosis as well as the complete results of all the fishing campaigns conducted on Kapisikama Lake. The information provided must allow a decision to be made on the genetic status of this yellow perch population.

Response to Information Request 11:

The field work for the Kapisikama Lake survey has been completed. A technical note was written to report on the objectives, methodology and results of the survey including the fisheries that were conducted (Appendix C). It also includes the results of fisheries conducted in this water body prior to 2022 as part of the project.

However, age structure and environmental DNA results are not yet available. Therefore, this technical memorandum is provided in draft form. A final version that includes full results will be transmitted as soon as it is finalized (early October 2022).

Although the diagnostic results are incomplete, it is important to keep in mind that the information presented is a worst-case scenario, i.e., unless the environmental DNA results show that there are other species present in the lake, the yellow perch population is, for the moment, considered allopatric.

REFERENCES

- GOLDER. 2021. *Tailing, Waste Rock, Overburden and Water Management Facility Preliminary Engineering Design. James Bay Lithium Mine Project, Quebec.* Report prepared for Galaxy Lithium (Canada) Inc. 12 pages.
- MERN. 2018. *Guide de rédaction d'une étude d'opportunité économique et de marché pour la transformation au Québec*. Consulted online : https://mern.gouv.qc.ca/wp-content/uploads/guide-redaction-etude-economique-marche-transformation.pdf.
- WSP. 2021. *Mine de lithium Baie-James - Mise à jour de l'étude spécialisée sur l'hydrogéologie - Juillet 2021*. Report produced for Galaxy lithium (Canada) Inc.
- WSP. 2021. Mine de lithium Baie-James. *Étude d'impact sur l'environnement. Juillet 2021 (version 2).* Report produced for Galaxy lithium (Canada) Inc.

APPENDIX

A

TECHNICAL REPORT, ECONOMICAL OPPORTUNITY ASSESSMENT OF THE SPODUMENE CONVERSION PLANT IN MATAGAMI, QUÉBEC. (ANDEBURG CONSULTING SERVICES, 2022) (CONFIDENTIAL)

APPENDIX

B

UPDATED AIR QUALITY MODEL RESULTS – JAMES BAY LITHIUM PEGMATITE PROJECT (STANTEC, 2022)

Memo

To:	Denis Couture Galaxy Lithium 720 2000 Peel St., Montreal, QC	From:	Reid Person Stantec Consulting Ltd. 200-325 25 St SE, Calgary, AB
Project/File:	121416913	Date:	August 26, 2022

Reference: Updated Air Quality Model Results – James Bay Lithium Pegmatite Project

Stantec Consulting Ltd. (Stantec) was retained by Galaxy Lithium (Canada) Inc. (Galaxy) to conduct an air quality dispersion modelling assessment for the James Bay Lithium Pegmatite Project (the Project) (Stantec 2021) which was an update to the original air dispersion modelling study prepared in support of the Environmental and Social Impact Assessment (ESIA) (WSP 2018). Since the completion of the 2021 air quality assessment, there have been several methodological changes requested by the Comité d'examen des répercussions sur l'environnement et le milieu social (COMEX) which have been incorporated in the dispersion modelling. This memorandum (memo) summarizes the methodological changes and provides updated dispersion model predictions for the Project. Unless otherwise noted, all other model methods and inputs are the same as described in Stantec 2021 dispersion modelling assessment (Stantec 2021).

1 Methodology

The air contaminants evaluated in the updated modelling include carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), volatile organic compounds (VOCs), and particulate matter (total particulate matter, TPM; particulate matter with an average size of 10 µm, PM_{10}; and particulate matter with an average size of 2.5 µm, $PM_{2.5}$), for both the construction and operation phase, and 19 metals for the operation phase. The emission rates used in the updated air dispersion modelling are based on a combination of Project-specific equipment and activity data and published industry standard emission factors. The dispersion modelling was performed using the AERMOD dispersion modelling system (v21112). The meteorological data is the same 5-year dataset (2011-2015) consistent with previous modelling.

The air quality modelling follows the “Guide de la modélisation de la dispersion atmosphérique” (GMDA) (MELCC 2005) and “Préparation et réalisation d’une modélisation de la dispersion des émissions atmosphériques – Projets miniers” (MELCC 2017). Model predictions are presented at locations at and beyond a defined application boundary as well as at several nearby sensitive receptors representing Cree Camps, traditional activity locations, valued areas, and a local truck stop (km 381).

2 Updated Assumptions

The Project emission inventory has been revised to incorporate several methodological changes requested by the Comité d'examen des répercussions sur l'environnement et le milieu social, minor project changes and to address several errata. The emission inventory was updated for both the construction and operations phases of the Project.

The emission calculations methods are the same as in the 2021 air quality assessment report except as otherwise described in this memorandum. The updates and clarification to the emission inventory and modelling assumptions and methods include:

- Blasting Emissions: For the 1-hour and 24-hour averaging periods, the model inputs were revised to include one blast event per day (all 365 days). For calculating annual average concentrations, 3 blast events are considered per week. The same methodology is applied as described in Section 4.1.6 and 4.2.5 of Stantec (2021).

- Haul Road Fugitive Dust Emissions: During summer months, the dust control efficiency (mitigation) is assumed to be 80% based upon active dust control with water or dust suppressants as appropriate while during winter months it is 85% based upon natural mitigation associated with snow cover and frozen surfaces. The same calculation methodology is applied as described in Section 4.1.2 and 4.2.2 of Stantec (2021).

- Wind Erosion Mitigation: For the 1-hour and 24-hour periods averaging periods, no mitigation associated with precipitation is assumed. For annual averaging periods, a natural mitigation factor of 45% is applied based upon 165.7 days per year with precipitation greater than 0.254 mm based on Climate Normals data from the La Grande Riviere Airport (1991-2020). The aerodynamic factor for $PM_{2.5}$ was revised to 0.075 consistent with Section 3.10.2.5 of the Quebec Modelling Guide.

- Stockpile Emissions: The primary ore stockpile and the final product stockpile will be covered. Emissions from the primary ore stockpile and the final product stockpile sources were removed from the model. The same methodology is applied as described in Section 4.2.8 of Stantec (2021).

- Dozing Emissions: Material dozing emissions were revised assuming a silt content of 9.5%. The same methodology presented in Section 4.1.5 and 4.2.4 of Stantec (2021) is applied assuming a moisture content was 5% and a control efficiency of 50% to represent the intermittent nature of this type of activity.

- Mobile Crushing Emissions: Mobile crushing is used during the Project construction phase (not operations). A feed rate of 555 t/h for each of the two construction mobile crushers to calculate emissions assuming 10 hours of operation per day. This 24-hour averaged emission rate is selected rather than a 1-hour peak rate as the crusher is a source of only particulate matter emissions and there are only 24-hour air quality standards and criteria (no 1-hour standards or criteria). Metal concentration predictions (such as crystalline silica) which may have a 1-hour standard or criteria are not evaluated for the Project construction scenario (only operations). Mobile crushing operations are also not a source of combustion gas emissions such as NO_X. The same methodology is applied as described in Section 4.1.4 of Stantec (2021).

- TSP Deposition: An error was discovered for the model input deposition parameters for modelling TSP concentrations and total particulate deposition rate for the operation scenario. The corrected deposition parameters result in lower predicted TSP concentrations. Note that deposition of particulate matter (PM) is applied only for model runs to predict TSP concentrations and total particulate deposition rates.

- Fine Particulate and Metal Concentrations: Consistent with Stantec (2021), as a conservative assumption, deposition is not applied in the AERMOD model runs to predict $PM_{2.5}$, PM_{10} and metal concentrations. No removal of plume mass is assumed to occur.

- Chromium: Total chromium emissions have been separated into distinct species to separately evaluate chromium VI and Chromium III concentrations relative to their respective ambient air quality criteria.
- Nickel: The 24-hour ambient air quality criterion for Nickel was updated and annual average nickel concentrations are included for comparison with the new annual criteria (2022).
- Crystalline Silica: A site-specific crystalline silica baseline (initial) concentration of 0.01 µg/m³ is adopted for the annual averaging period. Crystalline silica emission rates were updated based upon 26% and 30% measured content in the ore/tailings and waste rock materials, respectfully, combined with the assumption of a 44% ratio of crystalline silica in particulate matter relative to the ore and waste rock content. Ratios are based upon Richards et al. (2009). The two factors are multiplied to determine the final crystalline silica content in particulate matter for each fugitive dust sources as follows:

Fugitive Dust Source	Crystaline Sillica Content as % of PM Emissions
Drilling	13%
Blasting	13%
Routing (truck traffic on unpaved haul roads)	13%
Material transfer, bulldozing and wind erosion (ore)	12%
Material transfer, bulldozing and wind erosion (waste rock)	13%
Material transfer, bulldozing and wind erosion (tailings)	12%
Dust collectors	12%

3 Model Results

The model predicted concentrations for the construction and operation phases of the Project are added to the initial concentrations for comparison against the respective ambient air quality limits. The applicable limits include standards and criteria set by MELCC (2022) in the Quebec standards and criteria for the quality of the atmosphere/Normes et critères québécois de qualité de l'atmosphère, NAAQS/CAAQS set out by the CCME (2022), and WHO (2005) guidelines.

3.1 Construction Scenario

A summary of the air dispersion modelling maximum concentration results for the construction phase in the modelling domain outside of the application boundary limit are presented in Table 1, and the maximum concentrations at locations of sensitive receptors in Table 2. Particulate deposition results are presented in Table 3 and Table 4, for the maximum in the application domain (outside of the application boundary limit) and the maximum at sensitive receptors, respectively.

The model predicted air quality concentrations for all species assessed for the construction phase were lower than their applicable ambient air quality limits except the 1-hour NO_2 (CAAQS). The model predicted 1-hour NO_2 concentrations were greater than the CAAQS at locations near the application boundary limit and at the traditional activity sensitive receptors. The maximum predicted 1-hour NO_2 concentrations occurs on the south side of the application boundary limit (maximum concentration of 218 $\mu g/m^3$ or 193% of the 2020 CAAQS and 276% of the 2025 CAAQS).

There is no applicable limit for TPM deposition. Formerly, there was a 30-day standard of 7.5 g/m^2 set out in section 6 of the Regulation on Air Purification/*règlement sur l'assainissement de l'atmosphère* (Quebec 2019), which was revoked in 2011. Predicted 30-day deposition in the modelled domain, including at locations of sensitive receptors, met the former standard.

Table 1 Model Predicted Air Quality in the Application Domain for Construction

Substance	CAS No.	Averaging Period	Statistical	Limit (µg/m^3)	Type of Limit	Authority	Initial Concentration (µg/m^3)	Modeled Concentration (µg/m^3) Maximum per Meteorological Year						Concentration Total[1] (µg/m^3)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Y1	Y2	Y3	Y4	Y5	Max.			
Total Suspended Particulate (TPM)	N/A-1	24 hours	1st Maximum	120	Standard	MELCC	40	36.2	31.9	38.4	29.9	35.0	38.4	78.4	49%	65%
Particulate Matter < 10 µm (PM_{10})	N/A-2	24 hours	99th Percentile	50	Guideline	WHO	21.8	16.6	16.6	15.8	12.7	14.4	16.6	38.4	43%	77%
		Annual	1st Maximum	20	Guideline	WHO	5.5	1.67	1.61	1.60	1.64	1.79	1.79	7.29	25%	36%
Fine particulate matter ($PM_{2.5}$)	N/A-3	24 hours	1st Maximum	30	Standard	MELCC	15	4.77	3.95	4.31	2.78	3.66	4.77	19.8	24%	66%
		24 hours	98th Percentile[4]	27	CAAQS	CCME	15	1.79	1.77	1.85	1.55	1.62	1.85	16.9	11%	62%
		Annual	1st Maximum[5]	8.8	CAAQS	CCME	4.5	0.510	0.477	0.479	0.470	0.533	0.533	5.03	11%	57%
Nitrogen dioxide (NO_2) (from OLM)	10102-44-0	1 hour	98th Percentile[6]	113 (2020) / 79 (2025)	CAAQS	CCME	50	168	158	148	156	166	168	**218**	77%	**193% (2020)/ 276% (2025)**
		1 hour	1st Maximum	414	Standard	MELCC	50	249	269	276	238	350	350	400	87%	97%
		24 hours	1st Maximum	207	Standard	MELCC	30	32.4	37.1	39.6	28.6	38.3	39.6	69.6	57%	34%
		Annual	1st Maximum	103	Standard	MELCC	10	3.83	3.52	3.51	3.32	3.86	3.86	13.9	28%	13%
		Annual	1st Maximum[7]	32 (2020) / 23 (2025)	CAAQS	CCME	10	3.83	3.52	3.51	3.32	3.86	3.86	13.9	28%	43% (2020) / 60% (2025)
Sulphur dioxide (SO_2)	7446-09-5	4 min	1st Maximum[8]	1,310	Standard	MELCC	40	52.1	55.4	85.4	43.9	50.5	85.4	125.4	68%	10%
		4 min	99.5th Percentile[8]	1,050	Standard	MELCC	40	3.80	4.41	3.30	3.28	2.88	4.41	44.4	10%	4%
		1 hour	99th percentile[9]	183 (2020) / 170 (2025)	CAAQS	CCME	21	14.1	12.2	13.2	14.1	12.4	14.1	35.1	40%	19% (2020) / 21% (2025)
		24 hours	1st Maximum	288	Standard	MELCC	10	1.14	1.21	1.87	1.00	1.11	1.87	11.9	16%	4%
		Annual	1st Maximum	52	Standard	MELCC	2	0.028	0.022	0.017	0.018	0.017	0.028	2.03	1%	4%
		Annual	1st Maximum[10]	13 (2020) / 10 (2025)	CAAQS	CCME	2	0.028	0.022	0.017	0.018	0.017	0.028	2.03	1%	16% (2020) / 20% (2025)
Carbon monoxide (CO)	630-08-0	1 hour	1st Maximum	34,000	Standard	MELCC	600	11,823	13,603	14,222	10,880	15,002	15,002	15,602	96%	46%
		8 hours	1st Maximum	12,700	Standard	MELCC	400	1,480	1,702	1,779	1,361	1,878	1,878	2,278	82%	18%

Notes:
[1]The modeled total concentration is the sum of the modeled maximum concentration and the initial concentration.
[2]The project contribution is the maximum modeled concentration divided by the total concentration, as a percentage.
[3]The percentage of the limit value is the total concentration divided by the limit value, as a percentage.
[4]The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
[5]The 3-year average of the annual average concentrations
[6]The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[7]The arithmetic average over single calendar year of all 1-hour NO_2 concentrations
[8]Based on the initial 4-minute concentration converted for a period of 1 hour using the conversion formula ($C(T) = C_{MAX\text{-}H} \times 0.97\ T^{-0.25}$)
[9]The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[10]The arithmetic average over single calendar year of all 1-hour SO_2 concentrations

Table 2 Model Predicted Air Quality at Sensitive Receptors for Construction

Substance	CAS No.	Averaging Period	Statistical	Limit (µg/m^3)	Type of Limit	Authority	Initial Concentration (µg/m^3)	Model Predicted Concentration (µg/m^3) – Maximum per Category					Concentration Total[1] (µg/m^3)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Road Relay km 381	Cree Camp	Valued Area	Traditional Activity	Max			
Total Suspended Particulate (TPM)	N/A-1	24 hours	1st Maximum	120	Standard	MELCC	40	15.4	1.91	10.0	16.5	16.5	56.5	29%	47%
Particulate Matter < 10 µm (PM_{10})	N/A-2	24 hours	99th Percentile	50	Guideline	WHO	21.8	6.43	0.66	4.29	6.57	6.57	28.4	23%	57%
		Annual	1st Maximum	20	Guideline	WHO	5.5	0.535	0.055	0.281	0.826	0.826	6.33	13%	32%
Fine particulate matter ($PM_{2.5}$)	N/A-3	24 hours	1st Maximum	30	Standard	MELCC	15	1.81	0.32	1.34	2.36	2.36	17.4	14%	58%
		24 hours	98th Percentile[4]	27	CAAQS	CCME	15	0.785	0.079	0.374	0.838	0.838	15.8	5%	59%
		Annual	1st Maximum[5]	8.8	CAAQS	CCME	4.5	0.118	0.010	0.047	0.255	0.255	4.76	5%	54%
Nitrogen dioxide (NO_2) (from OLM)	10102-44-0	1 hour	98th Percentile[6]	113 (2020) / 79 (2025)	CAAQS	CCME	50	86.2	7.27	53.4	119	119	**169**	70%	**149% (2020) / 214% (2025)**
		1 hour	1st Maximum	414	Standard	MELCC	50	151	67.0	132	186	186	236	79%	57%
		24 hours	1st Maximum	207	Standard	MELCC	30	15.7	2.81	6.74	18.1	18.1	48.1	38%	23%
		Annual	1st Maximum	103	Standard	MELCC	10	0.863	0.072	0.377	2.30	2.30	12.3	19%	12%
		Annual	1st Maximum[7]	32 (2020) / 23 (2025)	CAAQS	CCME	10	0.863	0.072	0.377	2.30	2.30	12.3	19%	38% (2020) / 53% (2025)
Sulphur dioxide (SO_2)	7446-09-5	4 min	1st Maximum[8]	1,310	Standard	MELCC	40	10.6	2.91	7.9	21.1	21.1	61.1	35%	5%
		4 min	99.5th Percentile[8]	1,050	Standard	MELCC	40	0.590	0.047	0.542	1.38	1.38	41.4	3%	4%
		1 hour	99th percentile[9]	183 (2020) / 170 (2025)	CAAQS	CCME	21	1.41	0.094	1.07	3.84	3.84	24.8	15%	14% (2020) / 15% (2025)
		24 hours	1st Maximum	288	Standard	MELCC	10	0.238	0.066	0.181	0.464	0.464	10.5	4%	4%
		Annual	1st Maximum	52	Standard	MELCC	2	0.005	0.0003	0.003	0.010	0.010	2.01	0.5%	4%
		Annual	1st Maximum[10]	13 (2020) / 10 (2025)	CAAQS	CCME	2	0.005	0.0003	0.003	0.010	0.010	2.0	0.5%	15% (2020) / 20% (2025)
Carbon monoxide (CO)	630-08-0	1 hour	1st Maximum	34,000	Standard	MELCC	600	3,134	311	1,434	6,268	6,268	6,868	91%	20%
		8 hours	1st Maximum	12,700	Standard	MELCC	400	392	38.9	180	784	784	1,184	66%	9%

Notes:
[1]The modeled total concentration is the sum of the modeled maximum concentration and the initial concentration.
[2]The project contribution is the maximum modeled concentration divided by the total concentration, as a percentage.
[3]The percentage of the limit value is the total concentration divided by the limit value, as a percentage.
[4]The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
[5]The 3-year average of the annual average concentrations
[6]The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[7]The arithmetic average over single calendar year of all 1-hour NO_2 concentrations
[8]Based on the initial 4-minute concentration converted for a period of 1 hour using the conversion formula ($C(T) = C_{MAX\text{-}H} \times 0.97\ T^{-0.25}$)
[9]The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[10]The arithmetic average over single calendar year of all 1-hour SO_2 concentrations

Table 3 Model Predicted Particulate Deposition Results in the Application Domain for Construction

Substance	CAS No.	Averaging Period	Statistical	Threshold (g/m²)	Deposition Initial (g/m²)	Authorization	Modeled Deposition Results (Domain Application) (g/m²) – Maximum per Meteorological Year						Total Modeled Deposition[1] (g/m²)	Contribution of Project[2] (%)	Percentage of the Limit[3] (%)
							Y1	Y2	Y3	Y4	Y5	Max			
Total Particulate Deposition	N/A-4	Annual	1st Maximum	-	0	CEAA	13.1	13.8	13.1	13.9	14.9	14.9	14.9	100%	-
Total Particulate Deposition	N/A-4	Monthly	1st Maximum	-	0	CEEA	3.25	2.82	2.72	3.22	3.04	3.25	3.25	100%	-

Notes:
[1]The modeled total deposition is the sum of the modeled maximum deposition and the initial deposition.
[2]The project contribution is the maximum modeled deposition divided by the total deposition, as a percentage.
[3]The percentage of the limit value is the total deposition divided by the limit value, as a percentage.

Table 4 Model Predicted Particulate Deposition Results at Sensitive Receptors for Construction

Substance	CAS No.	Averaging Period	Statistical	Threshold (g/m²)	Deposition Initial (g/m²)	Authorization	Modeled Deposition Results (Sensitive Receptors) (g/m²) – Maximum per Category					Total Modeled Deposition[1] (g/m²)	Contribution of Project[2] (%)	Percentage of the Limit[3] (%)
							Road Relay km 381	Cree Camp	Valued Area	Traditional Activity	Max.			
Total Particulate Deposition	N/A-4	Annual	1st Maximum	-	0	CEAA	3.09	0.277	1.44	5.46	5.46	5.46	100%	-
Total Particulate Deposition	N/A-4	Monthly	1st Maximum	-	0	CEEA	0.646	0.062	0.379	1.14	1.14	1.14	100%	-

Notes:
[1]The modeled total deposition is the sum of the modeled maximum deposition and the initial deposition.
[2]The project contribution is the maximum modeled deposition divided by the total deposition, as a percentage.
[3]The percentage of the limit value is the total deposition divided by the limit value, as a percentage.

3.2 Operations Scenario

A summary of the air dispersion modelling maximum concentration results in the operational phase in the application domain outside of the application boundary limit are presented in Table 5, and the maximum concentrations at locations of sensitive receptors in Table 6. For substances that are predicted to exceed a limit, the value and percent of limit are bolded. Particulate matter deposition results are presented in Table 7 and Table 8, for the maximum in the application domain outside of the application boundary limit and the maximum at sensitive receptors, respectively.

The model predicted maximum 1-hour NO_2 (CAAQS) concentration was greater than the CAAQS at locations near the application boundary limit and at traditional activity sensitive receptors. The location at which the maximum predicted maximum 1-hour NO_2 (CAAQS) was greater than the standard is at the east side of the application boundary limit (maximum concentration of 264 µg/m^3 that is 233% of the 2020 CAAQS and 334% of the 2025 CAAQS).

The model maximum annual arsenic concentrations are greater than its applicable ambient air quality standards. The model predicted maximum annual average arsenic concentration 0.00322 µg/m^3 is greater than (107%) the standard, however, maximum concentrations are less than the standard at the all sensitive receptors.

The model predicted 1-hour and annual crystalline silica concentrations are greater than its applicable ambient air quality standards. The model predicted maximum 1-hour crystalline silica concentrations were greater than the standard at locations outside of the application boundary limit (maximum concentration of 24.3 µg/m^3, 106% of the standard); however, the maximum predicted 1-hour concentration at nearest sensitive receptor is less than the standard (61%).

The model predicted maximum annual crystalline silica concentration was greater than the standard (0.213 µg/m^3; 305% of the standard) along the application boundary limit. The maximum annual crystalline silica concentration is greater than the standard at three sensitive receptors including the kilometer 381 truck stop and at traditional activity receptors TRC1 and TRC2 (Table 15 and Figure B1-2 in Stantec 2021). Traditional activity receptors TRC1 and TRC2 are located within or immediately adjacent to the Project boundary. During Project operations, the presence of traditional activity users at these locations would be expected to be infrequent and for limited duration. The maximum predicted annual crystalline silica concentration at the kilometers 381 truck stop is 0.105 µg/m^3 (150% of the standard).

There is no applicable limit for TPM deposition. Formerly, there was a 30-day standard of 7.5 g/m^2 set out in section 6 of the Regulation on Air Purification/*règlement sur l'assainissement de l'atmosphère* (Quebec 2019), which was revoked in 2011. Predicted 30-day deposition in the modelled domain, including at locations of sensitive receptors, met the former standard.

Table 5 Modeled Results in the Application Domain during Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (µg/m³)	Type of Threshold	Authorization	Initial Conc. (µg/m³)	Model Predicted Concentration (µg/m³) Maximum per Meteorological Year						Concentration Total[1] (µg/m³)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Y1	Y2	Y3	Y4	Y5	Max.			
Total Suspended Particulate (TPM)	N/A-1	24 hours	1st Maximum	120	Standard	MELCC	40	41.9	40.1	46.9	36.8	40.9	46.9	86.9	54%	72%
Particulate Matter < 10 µm (PM_{10})	N/A-2	24 hours	99th Percentile	50	Guideline	WHO	21.8	14.0	15.4	15.0	13.6	13.9	15.4	37.2	41%	74%
		Annual	1st Maximum	20	Guideline	WHO	5.5	3.40	3.30	3.30	3.24	3.61	3.61	9.11	40%	46%
Fine particulate matter ($PM_{2.5}$)	N/A-3	24 hours	1st Maximum	30	Standard	MELCC	15	8.20	6.62	7.86	6.15	10.08	10.08	25.1	40%	84%
		24 hours	98th Percentile[4]	27	CAAQS	CCME	15	3.95	4.04	3.50	3.67	3.70	4.04	19.0	21%	71%
		Annual	1st Maximum[5]	8.8	CAAQS	CCME	4.5	1.18	1.16	1.18	1.07	1.23	1.23	5.73	21%	65%
Nitrogen dioxide (NO_2) (from OLM)	10102-44-0	1 hour	98th Percentile[6]	113 (2020) / 79 (2025)	CAAQS	CCME	50	185	214	159	168	181	214	**264**	81%	**233% (2020) / 334% (2025)**
		1 hour	1st Maximum	414	Standard	MELCC	50	324	351	332	335	342	351	401	88%	97%
		24 hours	1st Maximum	207	Standard	MELCC	30	64.8	71.3	72.9	56.6	64.2	72.9	103	71%	50%
		Annual	1st Maximum	103	Standard	MELCC	10	9.22	9.12	9.54	7.92	9.68	9.68	19.7	49%	19%
		Annual	1st Maximum[7]	32 (2020) / 23 (2025)	CAAQS	CCME	10	9.22	9.12	9.54	7.92	9.68	9.68	19.7	49%	61% (2020) / 85% (2025)
Sulphur dioxide (SO_2)	7446-09-5	4 min	1st Maximum[8]	1,310	Standard	MELCC	40	12.3	12.3	12.1	18.9	11.4	18.9	58.9	32%	4%
		4 min	99.5th Percentile[8]	1,050	Standard	MELCC	40	1.08	1.10	1.09	0.97	1.05	1.10	41.1	3%	4%
		1 hour	99th percentile[9]	183 (2020) / 170 (2025)	CAAQS	CCME	21	3.81	3.97	3.42	4.63	3.32	4.63	25.6	18%	14% (2020) / 15% (2025)
		24 hours	1st Maximum	288	Standard	MELCC	10	0.299	0.326	0.335	0.437	0.298	0.437	10.4	4%	4%
		Annual	1st Maximum	52	Standard	MELCC	2	0.040	0.039	0.041	0.033	0.042	0.042	2.04	2%	4%
		Annual	1st Maximum[10]	13 (2020) / 10 (2025)	CAAQS	CCME	2	0.040	0.039	0.041	0.033	0.042	0.042	2.04	2%	16% (2020) / 20% (2025)
Carbon monoxide (CO)	630-08-0	1 hour	1st Maximum	34,000	Standard	MELCC	600	3,323	3,640	3,170	3,601	3,374	3,640	4,240	86%	12%
		8 hours	1st Maximum	12,700	Standard	MELCC	400	419	458	398	453	425	458	858	53%	7%
Antimony (Sb)	7440-36-0	Annual	1st Maximum	0.17	Standard	MELCC	0.001	0.0000114	0.0000111	0.0000107	0.0000103	0.0000123	0.0000123	0.00101	1%	1%
Silver (Ag)	7440-22-4	Annual	1st Maximum	0.23	Standard	MELCC	0.005	0.0000171	0.0000166	0.0000161	0.0000155	0.0000184	0.0000184	0.00502	0.4%	2%
Arsenic (As)	7440-38-2	Annual	1st Maximum	0.003	Standard	MELCC	0.002	0.00113	0.00110	0.00107	0.00103	0.00122	0.00122	**0.00322**	38%	**107%**
Barium (Ba)	7440-39-3	Annual	1st Maximum	0.05	Standard	MELCC	0.02	0.00763	0.00744	0.00718	0.00690	0.00823	0.00823	0.0282	29%	56%
Beryllium (Be)	7440-41-7	Annual	1st Maximum	0.0004	Standard	MELCC	0	0.000146	0.000142	0.000141	0.000137	0.000157	0.000157	0.000157	100%	39%
Cadmium (Cd)	7440-43-9	Annual	1st Maximum	0.0036	Standard	MELCC	0.0005	0.0000114	0.0000111	0.0000107	0.0000103	0.0000123	0.0000123	0.000512	2%	14%
Total Chromium	7440-47-3	Annual	1st Maximum	0.004	Standard	MELCC	0.01	0.00319	0.00311	0.00301	0.00289	0.00344	0.00344	0.01344	26%	13%
Chromium (trivalent chromium compounds) (Cr III)	16065-83-1	Annual	1st Maximum	0.1	Standard	MELCC	0.01	0.00319	0.00311	0.00301	0.00289	0.00344	0.00344	0.01344	26%	13%

Table 5 Modeled Results in the Application Domain during Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (µg/m^3)	Type of Threshold	Authorization	Initial Conc. (µg/m^3)	Model Predicted Concentration (µg/m^3)						Concentration Total[1] (µg/m^3)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Maximum per Meteorological Year								
								Y1	Y2	Y3	Y4	Y5	Max.			
Chromium (hexavalent chromium compounds) (Cr VI)	18540-29-9	Annual	1st Maximum	0.004	Standard	MELCC	0.002	0.0000000188	0.0000000176	0.0000000191	0.0000000192	0.0000000216	0.0000000216	0.00200	0.001%	50%
Cobalt (Co)	7440-48-4	Annual	1st Maximum	0.1	Criterion	MELCC	0	0.000262	0.000256	0.000247	0.000237	0.000283	0.000283	0.000283	100%	0.3%
Copper (Cu)	7440-50-8	24 hours	1st Maximum	2.5	Standard	MELCC	0.2	0.00398	0.00426	0.00460	0.00351	0.00541	0.00541	0.205	3%	8%
Manganese (Mn)	7439-96-5	Annual	1st Maximum	0.025	Criterion	MELCC	0.005	0.00167	0.00162	0.00158	0.00154	0.00180	0.00180	0.00680	26%	27%
Mercury (Hg)	7439-97-6	Annual	1st Maximum	0.005	Standard	MELCC	0.002	0.0000000395	0.0000000382	0.0000000372	0.0000000362	0.0000000426	0.0000000426	0.00200	0.002%	40%
Nickel (Ni)	7440-02-0	24 hours	1st Maximum	0.014	Standard	MELCC	0.005	0.00156	0.00165	0.00176	0.00138	0.00213	0.00213	0.00713	30%	10%
		Annual	1st Maximum	0.02	Standard	MELCC	0.002	0.000239	0.000233	0.000227	0.000217	0.000259	0.000259	0.00226	11%	11%
Lead (Pb)	7439-92-1	Annual	1st Maximum	0.1	Standard	MELCC	0.004	0.000184	0.000179	0.000173	0.000167	0.000199	0.000199	0.00420	5%	4%
Selenium (Se)	7782-49-2	Annual	1st Maximum	2	Criterion	MELCC	0.15	0.00085	0.00094	0.00106	0.00098	0.00101	0.00106	0.151	1%	8%
Crystalline silica (SiO_2)	14808–60–7	1 hour	1st Maximum	23	Criterion	MELCC	6	14.5	17.7	18.3	17.5	17.2	18.3	**24.3**	75%	**106%**
		Annual	1st Maximum	0.07	Criterion	MELCC	0.01	0.190	0.185	0.181	0.173	0.203	0.203	**0.213**	95%	**305%**
Thallium (Tl)	7440-28-0	Annual	1st Maximum	0.25	Standard	MELCC	0.005	0.00000726	0.00000700	0.00000694	0.00000691	0.00000778	0.00000778	0.00501	0.2%	2%
Titanium (Ti)	7440-32-6	24 hours	1st Maximum	2.5	Criterion	MELCC	0	0.269	0.288	0.311	0.238	0.367	0.367	0.367	100%	15%
Vanadium (V)	7440-62-2	Annual	1st Maximum	1	Standard	MELCC	0.01	0.00135	0.00132	0.00127	0.00122	0.00146	0.00146	0.0115	13%	1%
Zinc (Z)	7440-66-6	24 hours	1st Maximum	2.5	Standard	MELCC	0.1	0.00724	0.00750	0.00818	0.00648	0.00993	0.00993	0.110	9%	4%

Notes:
[1]The modeled total concentration is the sum of the modeled maximum concentration and the initial concentration.
[2]The project contribution is the maximum modeled concentration divided by the total concentration, as a percentage.
[3]The percentage of the limit value is the total concentration divided by the limit value, as a percentage.
[4]The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
[5]The 3-year average of the annual average concentrations
[6]The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[7]The arithmetic average over single calendar year of all 1-hour NO_2 concentrations
[8]Based on the initial 4-minute concentration converted for a period of 1 hour using the conversion formula ($C(T) = C_{MAX-H} x 0.97 T^{-0.25}$)
[9]The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[10]The arithmetic average over single calendar year of all 1-hour SO_2 concentrations

Table 6 Results of Modelling at Sensitive Receptors for Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (µg/m³)	Type of threshold	Authorization	Initial Concentration (µg/m³)	Model Predicted Concentration (µg/m³)					Concentration Total[1] (µg/m³)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Maximum per Category							
								Road Relay km 381	Cree Camp	Valued Area	Traditional Activity	Max			
Total Suspended Particulate (TPM)	N/A-1	24 hours	1st Maximum	120	Standard	MELCC	40	28.7	1.86	7.36	30.1	30.1	70.1	43%	58%
Particulate Matter < 10 µm (PM_{10})	N/A-2	24 hours	99th Percentile	50	Guideline	WHO	21.8	9.85	0.75	2.70	8.35	9.85	31.7	31%	63%
		Annual	1st Maximum	20	Guideline	WHO	5.5	1.76	0.10	0.44	2.10	2.10	7.6	28%	38%
Fine particulate matter ($PM_{2.5}$)	N/A-3	24 hours	1st Maximum	30	Standard	MELCC	15	4.31	0.32	0.69	4.75	4.75	19.7	24%	66%
		24 hours	98th Percentile[4]	27	CAAQS	CCME	15	1.81	0.11	0.43	2.42	2.42	17.4	14%	65%
		Annual	1st Maximum[5]	8.8	CAAQS	CCME	4.5	0.399	0.021	0.092	0.676	0.676	5.18	13%	59%
Nitrogen dioxide (NO_2) (from OLM)	10102-44-0	1 hour	98th Percentile[6]	113 (2020) / 79 (2025)	CAAQS	CCME	50	57.5	11.6	35.4	146	146	**196**	74%	**173% (2020) / 248% (2025)**
		1 hour	1st Maximum	414	Standard	MELCC	50	136	85.2	135	265	265	315	84%	76%
		24 hours	1st Maximum	207	Standard	MELCC	30	19.9	3.80	8.81	57.7	57.7	87.7	66%	42%
		Annual	1st Maximum	103	Standard	MELCC	10	1.97	0.144	0.528	6.87	6.87	16.9	41%	16%
		Annual	1st Maximum[7]	32 (2020) / 23 (2025)	CAAQS	CCME	10	1.97	0.144	0.528	6.87	6.87	16.9	41%	53% (2020) / 73% (2025)
Sulphur dioxide (SO_2)	7446-09-5	4 min	1st Maximum[8]	1,310	Standard	MELCC	40	3.12	1.30	4.49	6.10	6.10	46.1	13%	4%
		4 min	99.5th Percentile[8]	1,050	Standard	MELCC	40	0.340	0.028	0.101	0.91	0.91	40.9	2%	4%
		1 hour	99th percentile[9]	183 (2020) / 170 (2025)	CAAQS	CCME	21	0.732	0.114	0.70	1.09	1.09	22.1	5%	12% (2020) / 13% (2025)
		24 hours	1st Maximum	288	Standard	MELCC	10	0.085	0.029	0.104	0.257	0.257	10.3	3%	4%
		Annual	1st Maximum	52	Standard	MELCC	2	0.007	0.0006	0.002	0.030	0.030	2.03	1%	4%
		Annual	1st Maximum[10]	13 (2020) / 10 (2025)	CAAQS	CCME	2	0.007	0.0006	0.002	0.030	0.030	2.03	1%	16% (2020) / 20% (2025)
Carbon monoxide (CO)	630-08-0	1 hour	1st Maximum	34,000	Standard	MELCC	600	787	377	796	1,801	1,801	2,401	75%	7%
		8 hours	1st Maximum	12,700	Standard	MELCC	400	108	47.2	100	226	226	626	36%	5%
Antimony (Sb)	7440-36-0	Annual	1st Maximum	0.17	Standard	MELCC	0.001	0.00000682	0.00000036	0.00000174	0.00000727	0.00000727	0.00101	1%	1%
Silver (Ag)	7440-22-4	Annual	1st Maximum	0.23	Standard	MELCC	0.005	0.00001023	0.00000054	0.00000260	0.00001091	0.0000109	0.00501	0.2%	2%
Arsenic (As)	7440-38-2	Annual	1st Maximum	0.003	Standard	MELCC	0.002	0.000679	0.000036	0.000173	0.000726	0.000726	0.00273	27%	91%
Barium (Ba)	7440-39-3	Annual	1st Maximum	0.05	Standard	MELCC	0.02	0.00457	0.00024	0.00116	0.00490	0.00490	0.0249	20%	50%
Beryllium (Be)	7440-41-7	Annual	1st Maximum	0.0004	Standard	MELCC	0	0.0000455	0.0000027	0.0000118	0.0000784	0.0000784	0.0000784	100%	20%
Cadmium (Cd)	7440-43-9	Annual	1st Maximum	0.0036	Standard	MELCC	0.0005	0.00000682	0.00000036	0.00000174	0.00000727	0.00000727	0.000507	1%	14%
Total Chromium	7440-47-3	Annual	1st Maximum	0.004	Standard	MELCC	0.01	0.00191	0.00010	0.00049	0.00204	0.00204	0.01204	17%	12%
Chromium (trivalent chromium compounds) (Cr III)	16065-83-1	Annual	1st Maximum	0.1	Standard	MELCC	0.01	0.00191	0.00010	0.00049	0.00204	0.00204	0.01204	17%	12%
Chromium (hexavalent chromium compounds) (Cr VI)	18540-29-9	Annual	1st Maximum	0.004	Standard	MELCC	0.002	0.000000003	0.000000000	0.000000001	0.000000027	0.000000027	0.00200	0.001%	50%
Cobalt (Co)	7440-48-4	Annual	1st Maximum	0.1	Criterion	MELCC	0	0.000157	0.000008	0.000040	0.000168	0.000168	0.000168	100%	0.2%
Copper (Cu)	7440-50-8	24 hours	1st Maximum	2.5	Standard	MELCC	0.2	0.00338	0.00032	0.00075	0.00277	0.00338	0.203	2%	8%
Manganese (Mn)	7439-96-5	Annual	1st Maximum	0.025	Criterion	MELCC	0.005	0.000965	0.000051	0.000243	0.000999	0.00100	0.00600	17%	24%
Mercury (Hg)	7439-97-6	Annual	1st Maximum	0.005	Standard	MELCC	0.002	0.000000024	0.000000001	0.000000006	0.000000025	0.000000025	0.00200	0.001%	40%
Nickel (Ni)	7440-02-0	24 hours	1st Maximum	0.014	Standard	MELCC	0.005	0.00129	0.00012	0.00028	0.00103	0.00129	0.00629	20%	9%
		Annual	1st Maximum	0.02	Standard	MELCC	0.002	0.000139	0.000007	0.000035	0.000145	0.000145	0.00215	7%	11%
Lead (Pb)	7439-92-1	Annual	1st Maximum	0.1	Standard	MELCC	0.004	0.000110	0.000006	0.000028	0.000118	0.000118	0.00412	3%	4%
Selenium (Se)	7782-49-2	Annual	1st Maximum	2	Criterion	MELCC	0.15	0.000345	0.000081	0.000213	0.000419	0.000419	0.150	0.3%	8%
Crystalline silica (SiO_2)	14808–60–7	1 hour	1st Maximum	23	Criterion	MELCC	6	7.9	1.8	4.9	7.5	7.9	13.9	57%	61%
		Annual	1st Maximum	0.07	Criterion	MELCC	0.01	0.095	0.004	0.021	0.087	0.095	**0.105**	90%	**150%**

Table 6 Results of Modelling at Sensitive Receptors for Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (µg/m³)	Type of threshold	Authorization	Initial Concentration (µg/m³)	Model Predicted Concentration (µg/m³) Maximum per Category					Concentration Total[1] (µg/m³)	Contribution of Project[2] (%)	Percentage of Limit[3] (%)
								Road Relay km 381	Cree Camp	Valued Area	Traditional Activity	Max			
Thallium (Tl)	7440-28-0	Annual	1st Maximum	0.25	Standard	MELCC	0.005	0.00000338	0.00000019	0.00000086	0.00000410	0.00000410	0.00500	0.1%	2%
Titanium	7440-32-6	24 hours	1st Maximum	2.5	Criterion	MELCC	0	0.228	0.022	0.051	0.187	0.228	0.228	100%	9%
Vanadium (V)	7440-62-2	Annual	1st Maximum	1	Standard	MELCC	0.01	0.000807	0.000042	0.000205	0.000863	0.000863	0.0109	8%	1%
Zinc (Z)	7440-66-6	24 hours	1st Maximum	2.5	Standard	MELCC	0.1	0.00618	0.00057	0.00132	0.00511	0.00618	0.106	6%	4%

Notes:
[1]The modeled total concentration is the sum of the modeled maximum concentration and the initial concentration.
[2]The project contribution is the maximum modeled concentration divided by the total concentration, as a percentage.
[3]The percentage of the limit value is the total concentration divided by the limit value, as a percentage.
[4]The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations
[5]The 3-year average of the annual average concentrations
[6]The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations
[7]The arithmetic average over single calendar year of all 1-hour NO_2 concentrations
[8]Based on the initial 4-minute concentration converted for a period of 1 hour using the conversion formula ($C(T) = C_{MAX-H} x\ 0.97\ T^{-0.25}$)
[9]The 3-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations
[10]The arithmetic average over single calendar year of all 1-hour SO_2 concentrations

Table 7 Modeled Particulate Deposition Results in the Application Domain during Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (g/m²)	Deposition Initial (g/m²)	Authorization	Model Predicted Deposition (Domain Application) (g/m²) Maximum per Meteorological Year						Total Modeled Deposition[1] (g/m²)	Contribution of Project[2] (%)	Percentage of the Limit[3] (%)
							Y1	Y2	Y3	Y4	Y5	Max			
Total Particulate Deposition	N/A-4	Annual	1st Maximum	-	0	CEAA	18.1	18.1	18.6	19.2	21.3	21.3	21.3	100%	-
Total Particulate Deposition	N/A-4	Monthly	1st Maximum	-	0	CEEA	2.76	3.79	2.64	2.46	2.39	3.79	3.79	100%	-

Notes:
"-"indicates that the value is not available
[1]The modeled total deposition is the sum of the modeled maximum deposition and the initial deposition.
[2]The project contribution is the maximum modeled deposition divided by the total deposition, as a percentage.
[3]The percentage of the limit value is the total deposition divided by the limit value, as a percentage.

Table 8 Modeled Particulate Deposition Results at Sensitive Receptors during Operation

Substance	CAS No.	Averaging Period	Statistical	Threshold (g/m²)	Deposition Initial (g/m²)	Authorization	Model Predicted Deposition (Sensitive Receptors) (g/m²) Maximum per Category					Total Modeled Deposition[1] (g/m²)	Contribution of Project[2] (%)	Percentage of the Limit[3] (%)
							Road Relay km 381	Cree Camp	Valued Area	Traditional Activity	Max.			
Total Particulate Deposition	N/A-4	Annual	1st Maximum	-	0	CEAA	8.85	0.385	2.58	12.4	12.4	12.4	100%	-
Total Particulate Deposition	N/A-4	Monthly	1st Maximum	-	0	CEEA	1.15	0.058	0.432	1.78	1.78	1.78	100%	-

Notes:
[1]The modeled total deposition is the sum of the modeled maximum deposition and the initial deposition.
[2]The project contribution is the maximum modeled deposition divided by the total deposition, as a percentage.
[3]The percentage of the limit value is the total deposition divided by the limit value, as a percentage.

3.3 Mitigation Scenario

As the maximum annual crystalline silica concentration at the kilometers 381 truck stop is predicted to be greater than the standard, a mitigation scenario was developed to identify a contingency operating scenario which results in crystalline silica concentrations less than standard.

A sensitivity analysis was completed to optimally modify selected waste rock disposal locations to identify an operating scenario which reduces maximum predicted annual crystalline silica concentrations. The scenario remains conservatively based upon the material movement log for the peak operational year (year 14); however, waste rock previously assumed to be placed at the east waste rock pile is now assumed to be disposed of at both the east waste rock pile (30% of waste rock material) and at the west waste rock pile (70% of waste rock material). Dozing emissions are similarly modified proportional to the waste rock volume (70% occurring at the waste rock pile and 30% at the east waste rock pile). Haul road emissions associated with waste rock transport were similarly revised. Total Project emissions are unchanged. The mitigation scenario is a redistribution of the location of the emissions within the Project.

Maximum predicted annual average crystalline silica concentration for the mitigation scenario compared to the pre-mitigation scenario at the three sensitive receptors with predicted exceedances are presented in Table 9. Predicted annual average crystalline silica concentrations decreases range from 5.6% to 37% at the three sensitive receptors. The maximum annual crystalline silica concentration is less than standard at the kilometer 381 truck stop (95% of the standard) while remains greater than the standard at traditional activity receptors TRC1 and TRC2. Traditional activity receptors TRC1 and TRC2 are located within or immediately adjacent to the Project boundary where the presence of traditional activity users at these locations is expected to be infrequent and for limited duration.

Table 9 Results of Modelling at Sensitive Receptors for Operation for Annual Crystalline Silica

Scenario	Threshold (μg/m³)	Initial Concentration (μg/m³)	Model Predicted Total Concentration (μg/m³) [1] — Maximum per Receptor: Road Relay km 381	TRC1	TRC2	Percentage of Limit at Road Relay km 381 [2] (%)
Mitigation Scenario	0.07	0.01	0.0662	**0.0911**	**0.0728**	95%
Pre-Mitigation Scenario (Table 6)			**0.105**	**0.0965**	**0.0925**	**150%**
Percent Change (%)			-37.0	-5.6	-21.3	-

Notes:
[1]The modeled total concentration is the sum of the modeled maximum concentration and the initial concentration.
[2]The percentage of the limit value is the total concentration divided by the limit value, as a percentage.

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3.4 Prediction Uncertainty

Air quality models such as AERMOD are tools that are used to link ambient air quality changes and deposition to existing and proposed emissions. Regulatory agencies rely on dispersion model predictions for decision making. The U.S. EPA (2005) indicates that the application of regulatory dispersion models such as AERMOD as a best estimate approach and that this approach should be viewed as acceptable to the decision maker. The modelling community and regulators recognize that prediction uncertainties arise from the uncertainties with the emission source inputs, the model physics, and the random nature of the atmosphere.

A number of conservative assumptions have been incorporated in the assessment. The application of five years of hourly meteorological data includes a wide range of conditions which reduces the level of uncertainty related to meteorology. The emission scenarios evaluated are based upon the expected peak year of mining activity and emission estimation methods adopt many conservative assumptions.

The primary air quality issue related to mining is particulate matter emissions, primary fugitive dust. The United States Environmental Protection Agency's (US EPA) Office of Air Quality Planning and Standards (OAQPS) has published a number of studies concluding that air quality models relying on the application of fugitive dust emission estimates and transport and dispersion models overpredict fugitive dust concentrations by as much as an order of magnitude (Pace 2005). The US EPA notes that the fundamental cause of fugitive dust over-estimates is that the fugitive dust measurements that were used to develop fugitive emission factors were generally taken within 5 m to 10 m of fugitive dust sources (Pace 2005). Two-thirds of the measured dust plume was found to be less than 2 m above ground level. Because the dust plume is turbulent and close to the ground, substantial dust removal processes occur near a fugitive dust source, including impaction on land cover (vegetation and structures) and other processes that enhance deposition on a local scale. These other mechanisms include electrostatic forces, thermophoresis, and particle agglomeration which could enhance gravitational settling. Only a portion of the US EPA methods calculated emission rate is therefore transportable and has potential to impact air quality outside of the boundary of the Project. The use of US EPA fugitive dust emission factors (as applied in the James Bay Project) is a notably conservative assumption.

The Project adopted a natural mitigation control factor (or efficiency) assumption of 85% for Project haul roads during winter conditions that is significantly higher (conservative) than measured values from a study that measured the effectiveness of natural winter mitigation of road dust from two De Beers Canada Inc. diamond mining operations in northern Canada (Golder Associates 2012). This natural wintertime mitigation control factor accounts for the reduction in fugitive dust that occurs during winter conditions due to both immobilization of dust particles bound in the frozen road surfaces and the capping effect of snow cover. Due to snow, ice and sub-zero temperatures, the silt fraction of a road, combined with ice, becomes bound to larger pieces of aggregate in the road and is unavailable for lofting by wheel entrainment. The Golder Associates (2012) study involved measuring particulate concentrations in the plume generated by mine haul trucks using a pickup-truck mounted dust sampling system deployed in chase truck. The study measured the effectiveness of road watering, variations in night and day emissions and differences between summer and winter emissions. One of the conclusions of the study was that the observed 95th percentile values for wintertime road dust emissions were naturally reduced by 94% at the Victor Mine and by 96% at the Snap Lake Mine, compared to uncontrolled summer conditions. The adoption of an 85% winter dust control factor is a notably conservative assumption.

4 Summary and Conclusions

Stantec completed updated dispersion modelling of Galaxy's proposed James Bay lithium mine and processing mill activities to assess the effects on ambient air quality incorporating several updates to the emission inventory and modelling methodology.

The model predicted concentrations for the construction phase are below the applicable ambient air quality limits/standards for all species except for the 1-hour NO_2 (CAAQS). The model predicted 1-hour NO_2 concentrations were greater than the 2020 and 2025 CAAQS.

The model predicted maximum 1-hour NO2 (CAAQS) concentrations for the operations phase are similarly greater than the 2020 and 2025 CAAQS at locations near the application boundary limit and at traditional activity sensitive receptors. The model maximum annual average arsenic concentrations are greater than its applicable ambient air quality standards, however, are less than the standard at all sensitive receptors.

The model predicted 1-hour and annual crystalline silica concentrations for the operations phase are greater than its applicable ambient air quality standards at the location of maximum impact. The maximum predicted 1-hour crystalline silica concentration at nearest sensitive receptor are less than the standard (61%); however, are predicted to exceed the annual average standard at the kilometer 381 truck stop and at traditional activity receptors TRC1 and TRC2. A mitigation scenario was developed based upon varying the distribution of waste rock material to waste rock storage piles. The mitigation scenario results in predicted annual average crystalline silica concentration reductions from 5.6% to 37% at the three sensitive receptors. The maximum annual crystalline silica concentration is less than standard at the kilometer 381 truck stop (95% of the standard) while remains greater than the standard at traditional activity receptors TRC1 and TRC2 for the mitigation scenario. Traditional activity receptors TRC1 and TRC2 are located within or immediately adjacent to the Project boundary where the presence of traditional activity users at these locations is expected to be infrequent and for limited duration.

Galaxy is committed to implementing an ambient air quality monitoring program to assess the impact of mining activities on local air quality to verify assessment predictions and allow for adaptation of mitigation to meet air quality standards. Galaxy will monitor concentrations of TPM, PM_{10}, $PM_{2.5}$, and select metals, including crystalline silica, to determine compliance with applicable ambient air quality limits. Results from the monitoring program will be provided to the MELCC and follow-up actions will be implemented as deemed necessary.

Regards,

STANTEC CONSULTING LTD.

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Attachment: [Attachment]

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APPENDIX

C

DIAGNOSE DU LAC KAPISIKAMA – CARACTÉRISATION DE L'ÉTÉ 2022 – PROJET MINE DE LITHIUM BAIE-JAMES (WSP, 2022) (IN FRENCH ONLY)

NOTE TECHNIQUE

DESTINATAIRES :	M. Denis Couture, Exécutif Canada Mme Caroline Morissette, directrice Environnement et Permis Galaxy Lithium
EXPÉDITEUR :	Mme Marie-Claire Robitaille Mme Christine Martineau Mme Dominique Thiffault WSP Canada Inc.
OBJET :	Diagnose du lac Kapisikama – Caractérisation de l'été 2022 Projet Mine de lithium Baie-James
N^O DE PROJET :	201-12362-00
DATE :	25 août 2022

1. MISE EN CONTEXTE

Galaxy Lithium (Canada) Inc. (Galaxy) projette d'exploiter un gisement de pegmatites à spodumène, un minéral qui contient du lithium. Le site du projet est situé à une dizaine de kilomètres au sud de la rivière Eastmain, à quelque 100 km à l'est de la Baie-James, à proximité du relais routier du km 381 de la route Billy-Diamond (anciennement appelée route de la Baie-James). La propriété se trouve sur des terres de catégorie III selon la Convention de la Baie-James et du Nord québécois (CBJNQ). La réalisation du projet, tel que prévu dans le plan d'aménagement actuel (WSP, 2021), indique qu'un petit lac isolé, le lac Kapisikama, sera vraisemblablement asséché lors du minage de la fosse.

Dans le cadre des études préalables de description du milieu d'insertion du projet, des travaux de caractérisation du lac Kapisikama ont été réalisés en 2012 et 2017. En 2012, une première campagne d'inventaire des communautés de poissons et de leurs habitats s'est déroulée du 25 au 1er juillet. Un filet maillant expérimental (un engin/nuit) et cinq bourolles (cinq engins/nuit) avaient alors permis de capturer de la perchaude uniquement. Le détail des résultats de cette campagne est présenté dans l'étude spécialisée sur la faune aquatique[1].

Une seconde campagne de caractérisation de l'habitat du poisson a été effectuée en 2017 et des pêches expérimentales ont été réalisées entre le 6 et le 14 septembre. Des filets à grandes mailles (quatre engins/nuit) et à petites mailles (deux engins/nuit) ont alors été déployés et ont, à nouveau, permis de capturer seulement des Perchaudes. Le détail de cette campagne est également présenté dans l'étude spécialisée sur la faune aquatique[1].

[1] WSP. 2018. *Mine de lithium Baie-James – Étude spécialisée sur l'habitat aquatique*. Rapport préparé pour Galaxy Lithium (Canada) inc. 64 p. et ann.

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Malgré ces deux campagnes d'inventaire menées dans le lac Kapisikama, le ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), dans le cadre de son analyse du projet, a demandé à ce qu'une diagnose soit réalisée afin d'avoir un état de référence du milieu qui sera impacté et décrire adéquatement l'impact du projet sur l'habitat du poisson ainsi que sur la population de poissons que ce lac abrite. Une campagne terrain a donc été tenue du 9 au 14 juin 2022. Il était demandé que la diagnose soit réalisée selon le Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures Tome I – Acquisition de données[2].

Les objectifs de la campagne terrain étaient de :

1. déterminer la composition ichtyologique du lac Kapisikama;
2. déterminer la structure d'âge de la population;
3. confirmer les résultats de pêche avec des analyses d'ADN environnemental;
4. caractériser les rives du lac afin de définir l'utilisation par la faune aquatique;
5. réaliser la bathymétrie du lac.

La diagnose devait également permettre de statuer sur l'était allopatrique des Perchaudes du lac Kapisikama grâce à des analyses génétiques. Par contre, à la suite d'une demande du MELCC, les échantillons leur ont été envoyés directement sans être analysés. Il est donc impossible pour WSP de se prononcer sur ce sujet. Il était également prévu que des analyses de certains contaminants soient réalisées sur la chair des poissons (mercure, biphényles polychlorés, dioxines et furanes et chlorobenzène). Par contre, après discussion avec le MELCC, il a été décidé que la chair serait récoltée sur le terrain, mais qu'elle serait analysée seulement si des études complémentaires en requièrent le besoin.

2. MÉTHODOLOGIE D'ÉCHANTILLONNAGE ET D'ANALYSE

Préalablement à la réalisation des travaux de terrain, un programme de travail (annexe 1), basé sur le Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures Tome I – Acquisition de données, a été préparé et soumis au MELCC pour validation afin de s'assurer que les activités prévues répondaient bien aux attentes des experts du MELCC. Ce programme a fait l'objet de quelques échanges avec le MELCC et certaines modifications ont été apportées. Ainsi, il a été convenu de :

1. capturer un minimum de 30 poissons au lieu des 15 poissons initialement proposés;
2. ne faire aucune analyse de métaux dans les tissus de poissons;
3. ne faire aucune analyse génétique sur les poissons capturés. Il a plutôt été décidé d'envoyer les 30 échantillons de rayons de nageoire pectorale des perchaudes capturées à la Direction de gestion de la faune du Nord-du-Québec du ministère des Forêts, de la Faune et des Parcs (MFFP), à Chibougamau (la Gestion de la faune).

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2 Service de la faune aquatique, 2011. Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures, Tome I, Acquisition de données, ministère des Ressources naturelles et de la Faune, Québec, 137 p. Microsoft Word - Normalisation_17Fev2011_FINAL.doc (gouv.qc.ca)

Le prélèvement et la conservation des rayons ont été réalisés conformément au document *Prélèvement et conservation d'échantillons de tissus pour les analyses génétiques* de la Direction de l'expertise sur la faune aquatique, daté du 14 juin 2021.

4 faire la lecture d'âge sur les 30 perchaudes sacrifiées.

La diagnose du lac Kapisikama consiste à la récolte de données par cinq méthodes différentes et complémentaires : l'analyse de l'ADN environnemental, l'échantillonnage d'eau de surface, la réalisation de profils physico-chimiques, la caractérisation des herbiers et des rives, la bathymétrie du plan d'eau et la caractérisation de la faune aquatique avec différents engins de pêche. La campagne terrain s'est déroulée du 9 au 14 juin 2022.

2.1 ADN ENVIRONNEMENTAL

L'échantillonnage de l'ADN environnemental (ADNe) avec l'appareil Smith-Root a été réalisé lors de la première journée de la campagne. Avant l'utilisation, l'appareil et tous les autres équipements utilisés ont été nettoyés avec une solution d'eau 10 % d'eau de javel et d'eau distillée. L'échantillonneur a également été nettoyé en filtrant 2 litres de la solution de javel 10 %. Les données physico-chimiques ont été récoltées à chaque station d'échantillonnage. Cinq stations ont été échantillonnées pour l'analyse de l'ADNe (tableau 1.)

Tableau 1 Localisation des stations d'ADNe, d'échantillonnage d'eau de surface et de réalisation de profils physico-chimique dans le lac Kapiskama, juin 2022.

Nom station	Latitude	Longitude	ADNe	Eau de surface	physico-chimie
ADN-2022-ST01	52°14'21,3"N	77°04'31,6"W	X		Station
ADN-2022-ST02	52°14'23,1"N	77°04'33,1"W	X		
ADN-2022-ST03	52°14'23,2"N	77°04'27,7"W	X		
ADN-2022-ST04	52°14'21,8"N	77°04'23"W	X		
ADN-2022-ST05	52°14'20,8"N	77°04'25,0"W	X		
KAP-2022-ST-01 + DUP	52°14'22.39"N	77° 4'28.56"W		X	Profil
KAP-2022-ST-02	52°14'22.98"N	77° 4'30.80"W		X	Profil
KAP-2022-ST-03	52°14'21.37"N	77° 4'25.58"W		x	Profil

2.2 ÉCHANTILLONNAGE D'EAU DE SURFACE ET PROFIL PHYSICO-CHIMIQUE

L'échantillonnage de l'eau de surface a été réalisé à trois stations à une profondeur de 1 m (tableau 1). Un duplicata a été réalisé. Une perche à échantillonnage a été utilisée pour récolter l'eau. L'eau a ensuite été mise dans les contenants fournis par le laboratoire certifié, soit Bureau Véritas. Les paramètres analysés par le laboratoire sont les suivants : phosphore total, les solides totaux dissous, la turbidité, les matières en suspension, la teinte et la couleur vraie, comme recommandé par la gestion de la faune.

Les paramètres physico-chimiques *in situ* de base ont été récoltés à chaque station d'échantillonnage d'eau et d'ADNe. La température de l'eau, le pH, la concentration en oxygène dissous (mg/L et %) et la conductivité ont été récoltés avec une sonde multi paramètres (YSI ProPlus). Chaque paramètre a été mesuré à 0,5m puis à chaque mètre jusqu'au fond du lac. La transparence a été mesurée avec un disque de Secchi.

2.3 CARACTÉRISATION DES RIVES DU LAC ET BATHYMÉTRIE

La caractérisation du lac a été réalisée par segment de rive homogène en fonction, entre autres, de la granulométrie, de la profondeur et du type de recouvrement végétal. Les paramètres suivants ont été notés : la longueur du segment, la profondeur moyenne, la granulométrie, la pente de la rive, le recouvrement (arborescent, arbustif, herbacé), la présence d'abris, la présence de frayères potentielles et la présence d'herbiers aquatiques. De plus, des observations supplémentaires pertinentes comme la présence d'herpétofaune, de mammifères, etc. ont également été notées. Lors de la caractérisation du lac, les herbiers ont aussi été caractérisés en notant la longueur, la largeur, la superficie, les espèces végétales présentes, le type et la densité des tiges. Les paramètres physico-chimiques ont été récoltés au site des herbiers.

La bathymétrie du lac a été réalisée sur l'entièreté du lac avec un sonar Garmin 521s, en quadrillant le lac à l'aide de transects prédéterminés suivis par GPS.

2.4 INVENTAIRE DE LA FAUNE AQUATIQUE

Afin de diversifier les engins de pêche utilisés antérieurement pour les pêches dans le lac Kapisikama (2012 et 2017), un verveux, deux bourolles ainsi qu'un filet maillant ont été utilisés à raison d'une nuit par engin, afin de cibler différents types habitats lors de la campagne de juin 2022. La profondeur à laquelle les bourolles et verveux ont été installés a été notée ainsi que les profondeurs minimale et maximale pour le filet maillant. De plus, la température et l'heure ont été notées lors de la pose et de la levée des engins.

PÊCHE AU FILET MAILLANT

Le filet maillant utilisé possédait six panneaux de longueur de 22,9 m, largeur de 1,8 m et avec des mailles de 25, 32, 38, 51, 64 et 76 mm. Le filet a été posé perpendiculairement à la rive pour une période de 19,5 h incluant la nuit à une profondeur de 2,2 m. La période de pêche ainsi obtenue permettait de couvrir les grandes périodes d'activité des poissons, soit du crépuscule au lever du jour.

VERVEUX

Le petit verveux utilisé était muni d'un cadre d'ouverture de 0,6 m, de quatre cerceaux de 0,6 m et des mailles de 0,5 et 0,8 cm. Le verveux a été posé sur la rive opposée à celle où le filet maillant a été installé.

BOUROLLES

Afin de couvrir les habitats ne permettant pas l'utilisation d'un filet, des bourolles ont été déployées. Deux bourolles de 40 cm de longueur sur 25 cm de largeur, avec un maillage de 4 mm, ont été déployées entre 0,8 et 1,2 m de profondeur. Elles ont été appâtées à l'aide d'un mélange de pain et de nourriture humide pour chats et elles ont été déployées pour une période approximative de 21 h, incluant la nuit.

Chaque poisson capturé a été identifié, mesuré et pesé. Trente (30) individus de perchaudes capturées ont été sélectionnés aléatoirement entre les engins de pêche, afin de faire l'objet d'analyses supplémentaires. Les individus sacrifiés ont été identifiés, mesurés et pesés; le sexe et la maturité sexuelle ont aussi été déterminés. Pour chaque individu sacrifié, le rayon de la nageoire pectorale a été récolté pour faire l'objet d'analyses génétiques et le rayon de la nageoire dorsale a été récolté pour déterminer l'âge des individus. La santé générale des individus a aussi été notée en fonction de la présence de parasite, de tumeur, d'érosion ou encore de lésions.

La chair a été récoltée et a été conservée au congélateur à -20 °C pour les 30 perchaudes sacrifiées, dans le but d'en analyser éventuellement le contenu en mercure, biphényles polychlorés, dioxines et furanes et chlorobenzène.

Les structures prélevées pour la génétique ont directement été envoyées à la Gestion de la faune qui sont responsables des résultats de ce volet, tandis que les structures d'âge récoltées seront analysées par des employés formés de WSP.

3. RÉSULTATS

3.1 ADN ENVIRONNEMENTAL

Les résultats des analyses de filtre pour l'ADNe requièrent plus de temps à obtenir et seront présentés dans une version finale de la note technique. Au moment de la rédaction de la présente version (préliminaire), les résultats n'étaient pas connus.

3.2 ÉCHANTILLONNAGE D'EAU DE SURFACE ET PROFIL PHYSICO-CHIMIQUE

L'échantillonnage d'eau de surface a été réalisé à trois stations différentes et un duplicata a été fait à la station KAP-2022-01. Un « blanc » a été effectué pour le phosphore total seulement, également à la station KAP-2022-01. Les profils physico-chimiques ont été réalisés aux trois mêmes stations que l'eau de surface.

Les résultats des analyses d'eau sont présentés au tableau 2. La présence du duplicata permet de vérifier la réplicabilité des analyses, soit la variation des résultats obtenus dans les mêmes conditions par des analyses successives de l'échantillon. La comparaison entre les résultats obtenus à la ST01 et le DUP est très similaire, à l'exception du résultat des solides totaux dissous, où l'échantillon KAP-2022-ST01 est supérieur (+13 %) à celui de KAP-DUP. Les stations présentent tout de même des résultats comparables pour chaque paramètre. Aucun critère ministériel qui permet de déterminer la qualité de l'eau pour la protection de la vie aquatique n'existe pour les paramètres analysés. Par contre la quantité de phosphore total présente dans les échantillons d'eau permet de catégoriser le lac Kapisikama en tant que lac ultra-oligotrophe (MELCC, 2022). Également, le pH mesuré pourrait être un facteur limitant pour la faune aquatique avec des valeurs entre 4,48 et 4,84 puisque le MELCC (2021) considère la valeur limite inférieure pour la protection de la vie aquatique à 6,5.

Les résultats des profils physico-chimiques sont présentés au tableau 3 et les profils pour chacun des paramètres sont présentés à la figure 1. Ces profils démontrent une constance entre les stations aux différentes profondeurs du lac et le début de l'installation d'une thermocline entre 1 et 2 m de profondeur (figure 1a). L'oxygène dissous varie entre 86,2 % et 83,5 % en surface et entre 63,1 % et 74,3 % à 2,5 m de profondeur (figure 1b). Le pH varie entre 4,5 et 4,8 en surface et 4,5 et 4,6 à 2 m de profondeur (tableau 3 et figure 1c). La conductivité spécifique moyenne est de 14,64 µS/cm et est constante entre les stations et en profondeur. L'augmentation marquée de la mesure de conductivité à la station 3 à une profondeur de 2,5 m pourrait être attribuable à un contact de la sonde avec le substrat, augmentant ainsi la quantité de sédiments en suspension dans l'eau et, par le fait même, la conductivité spécifique.

Tableau 2 Résultats des analyses d'eau de surface par le Laboratoire Bureau Veritas

Paramètre	Unités	LDR[1]	KAP-2022-ST01	KAP-2022-ST02	KAP-2022-ST03	KAP-DUP	KAP-BLA
Physico-chimie							
Couleur vraie	UCV	2,00	200,00	190,00	200,00	190,00	-
Matières en suspension (MES)	mg/L	2,00	1,90	1,20	1,90	1,70	-
Solides dissous totaux	mg/L	10,00	94,00	71,00	91,00	81,00	-
Turbidité	NTU	0,10	2,00	<2,0	3,00	2,00	-
Anions et nutriments							
Phosphore total	mg/L	0,01	0,02	0,03	0,01	0,02	<0,010

Tableau 3 Résultats des profils physico-chimiques du lac Kapiskama, juin 2022

Station	Profondeur (m)	Temp °C	pH	Oxygène dissous mg/l	OD (%)	Cond (µs/cm)
ST01	0,5	16	4,78	8,25	83,5	14,2
	1	15,4	4,72	7,96	79,6	14,4
	2	13,4	4,63	8,18	78,2	14,6
	2,5	12,4	4,49	7,94	74,3	14,8
ST01 DUP	0,5	16	4,78	8,25	83,5	14,2
	1	15,4	4,72	7,86	79,6	14,4
	2	13,4	4,63	8,18	78,2	14,6
	2,5	12,3	4,49	7,94	74,3	14,8
ST02	0,5	15,6	4,84	8,43	84,8	14,4
	1	15,2	4,67	8,24	82	14,4
	2	13,4	4,62	8,13	77,9	14,7
	2,5	11,6	4,6	7,25	66,7	15
ST03	0,5	16,1	4,5	8,5	86,2	14,3
	1	15,7	4,56	8,41	84,4	14,4
	2	13,5	4,53	8,05	76,9	14,7
	2,5	11,7	4,48	6,71	63,1	16,4

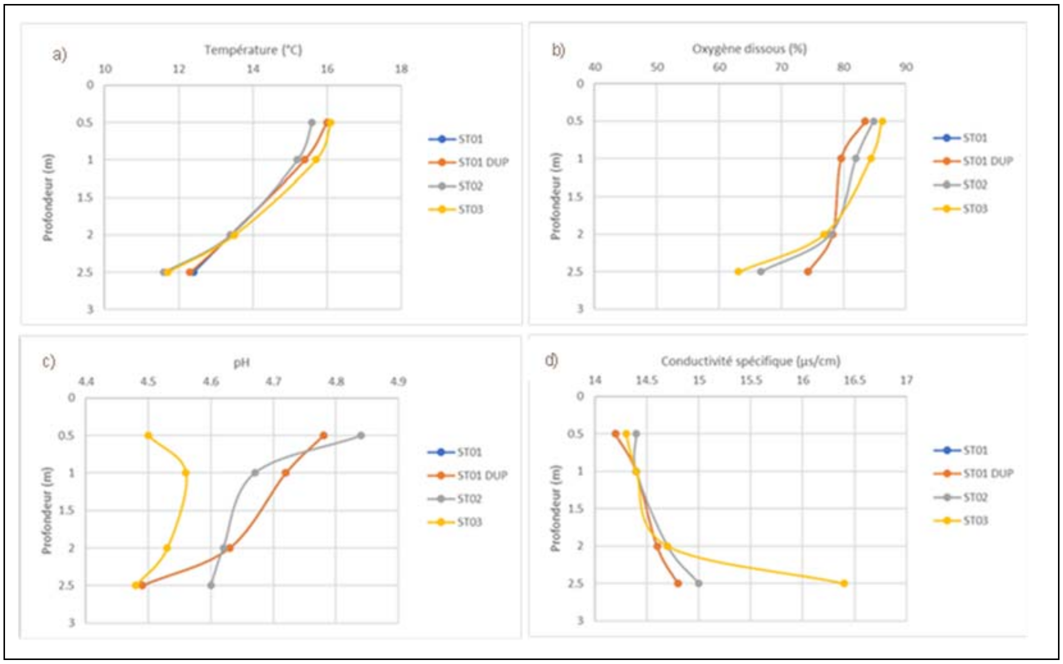
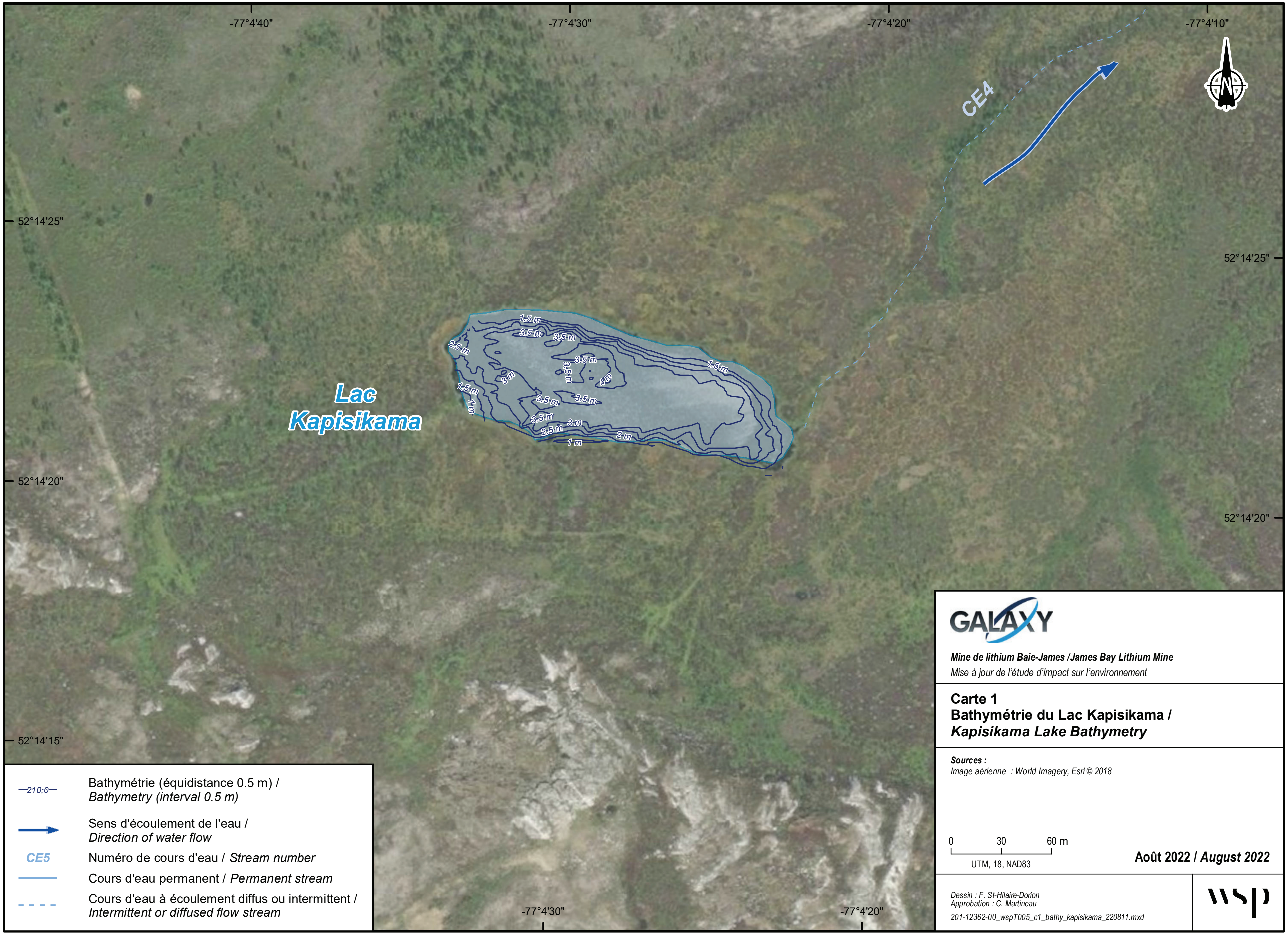


Figure 1 Profils des différents paramètres (température, pH, oxygène dissous et conductivité spécifique) en fonction de la profondeur du lac Kapisikama, juin 2022

3.3 CARACTÉRISATION DES RIVES DU LAC ET BATHYMÉTRIE

Lors de la caractérisation des rives du lac, il a été observé que le secteur aurait été ravagé par un feu. Les rives du lac étant très homogènes, elles ont, par le fait même, été considérées comme étant un seul segment de rive. Le segment caractérisé (soit l'entièreté du tour du lac) mesurait 480 m, avec une profondeur moyenne de 2,5 m. La présence d'un herbier flottant a été notée en périphérie du lac occupant une superficie approximative de 2 m^2. Le substrat était composé à 100 % de matière organique et les berges étaient surplombantes pour le segment entier. Plusieurs types d'herbacés ont été observés surplombant toute la circonférence du lac. Cette végétation surplombante était en partie submergée et pourrait alors être utilisée comme substrat de fraie pour les perchaudes qui fraie en eau peu profonde à proximité de la végétation enracinée (MFFP, 2019). Des photos sont disponibles dans l'annexe 2.

La bathymétrie a permis de déterminer la profondeur maximale du lac ainsi que sa superficie et son volume. La profondeur maximale du lac est de 4 m (carte 1), la superficie de 12 047,1 m^2 (1,2 ha) et le volume de 25 266,24 m^3.



Bathymétrie (équidistance 0.5 m) / *Bathymetry (interval 0.5 m)*

Sens d'écoulement de l'eau / *Direction of water flow*

CE5 Numéro de cours d'eau / *Stream number*

Cours d'eau permanent / *Permanent stream*

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

GALAXY

Mine de lithium Baie-James / James Bay Lithium Mine

Mise à jour de l'étude d'impact sur l'environnement

Carte 1
Bathymétrie du Lac Kapisikama /
Kapisikama Lake Bathymetry

Sources :
Image aérienne : World Imagery, Esri © 2018

Août 2022 / *August 2022*

Dessin : F. St-Hilaire-Dorion
Approbation : C. Martineau
201-12362-00_wspT005_c1_bathy_kapisikama_220811.mxd

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3.4 INVENTAIRE DE LA FAUNE AQUATIQUE

Comme observé en 2012 et 2017, et malgré l'utilisation de plusieurs engins de pêche différents (verveux, bourolles et filet maillant), seulement des perchaudes (*Perca flavescens*) ont été capturées lors de la réalisation des pêches au lac Kapisikama au mois de juin 2022. Le tableau 4 présente le nombre de captures par année par engin de pêche ainsi que la capture par unité d'effort (CPUE) pour chacun des engins. En 2017 et 2022, les filets maillants à petites mailles ainsi que le filet maillant expérimental ont démontré un bon succès de capture (entre 40,5 et 55 captures par unité d'effort) comparativement aux filets maillants grandes mailles (0 CPUE) aux bourolles (0,5 CPUE) et au verveux (5 CPUE).

Tableau 4 Nombre de capture et capture par unité d'effort de Perchaude par engin de pêche et par année dans le lac Kapisikama.

<table>
<tr><th>Année</th><th>Engin de capture</th><th>Effort</th><th>Nombre de capture</th><th>CPUE[1]</th></tr>
<tr><td rowspan="3">2012</td><td>Bourolle</td><td>5 nuits/ engin</td><td>22</td><td>22</td></tr>
<tr><td>Filet</td><td>1 nuit/ engin</td><td>16</td><td>3,2</td></tr>
<tr><td colspan="2">TOTAL</td><td>38</td><td>6,3</td></tr>
<tr><td rowspan="3">2017</td><td>Filet grande maille[2]</td><td>4 nuit/ engin</td><td>0</td><td>0</td></tr>
<tr><td>Filet petite maille[3]</td><td>2 nuit/ engin</td><td>81</td><td>40,5</td></tr>
<tr><td colspan="2">TOTAL</td><td>81</td><td>13,5</td></tr>
<tr><td rowspan="4">2021</td><td>Bourolle</td><td>2 nuit/ engin</td><td>1</td><td>0,5</td></tr>
<tr><td>Verveux</td><td>1 nuit/ engin</td><td>5</td><td>5</td></tr>
<tr><td>Filet expérimental[4]</td><td>1 nuit/ engin</td><td>55</td><td>55</td></tr>
<tr><td colspan="2">TOTAL</td><td>61</td><td>15,25</td></tr>
</table>

[1] CPUE: capture par unité d'effort (nuit)
[2] 2 bandes de 5 panneaux chacune, hauteur de 1,8 m; longueur totale de l'engin de 25 m, mailles de 13, 19, 25, 32 et 38 mm
[3] 2 bandes de 8 panneaux chacune; hauteur de 1,8 m; longueur totale de l'engin de 49,6 m, mailles de 38, 51, 64, 76, 89, 104, 114 et 127 mm.
[4] 6 panneaux d'une hauteur de 1,8m; longueur totale de l'engin de 22,9 m, mailles de 25, 32, 38, 51, 64 et 76 mm.

La figure 2 présente la fréquence de longueur à la fourche pour chaque perchaude prélevée en 2012, en 2017 et en 2022. Cette figure permet de constater une similarité dans les fréquences des classes de taille entre 105 et 144 par rapport au nombre de captures.

Lors des inventaires, il a été remarqué que plusieurs perchaudes capturées présentaient une coloration bleutée sur la mandibule inférieure (voir annexe 2). Cette coloration bleue est une adaptation observée généralement chez les dorés jaunes *(Sander vitreus),* en réponse à une forte exposition aux rayons ultraviolets (UV) dans les régions plus nordiques du Canada. Cette coloration semblerait être due à une protéine présente dans la couche muqueuse des poissons plus exposés aux UV (Ghosh et al, 2016; CBC, 2019). La forte occurrence de la présence de ce pigment dans la population de perchaude du lac Kapisikama pourrait être liée à la faible profondeur du lac et donc à forte exposition aux UV en comparaison avec d'autres populations habitant des lacs plus profonds.

Les résultats de la lecture des structures d'âge seront présentés dans une version finale de la note technique puisqu'au moment de la rédaction de la présente version (préliminaire), les résultats n'étaient pas connus.

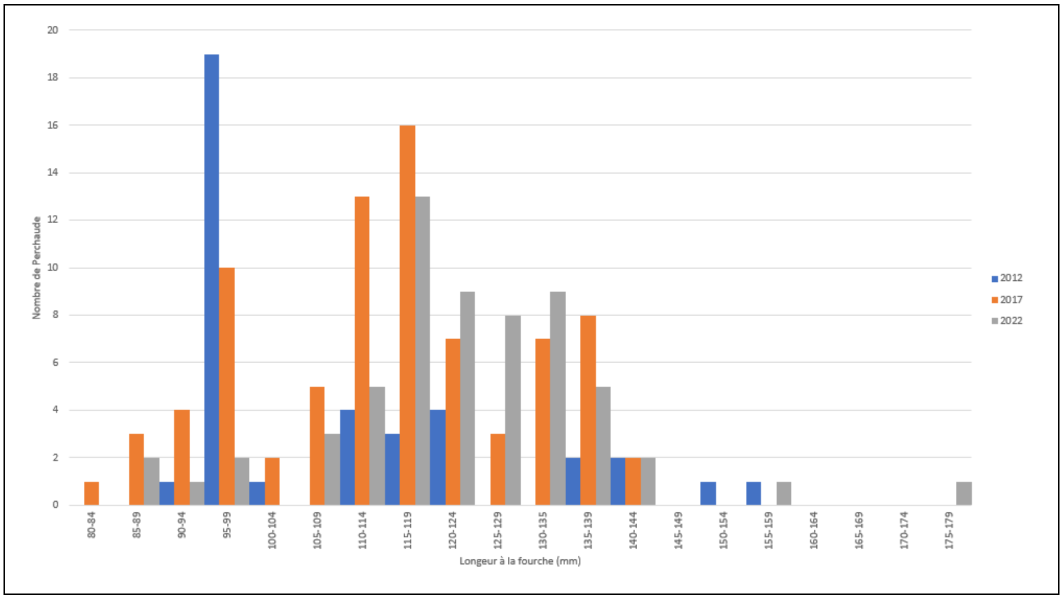

Figure 2 **Nombre de perchaudes capturées dans le lac Kapisikama (2012, 2017 et 2022) en fonction de la longueur à la fourche mesurée**

4. CONCLUSION

En bref, le lac Kapisikama est un lac relativement uniforme tant au niveau de la qualité de l'eau, de la physico-chimie qu'au niveau des habitats pour la faune ichtyenne du lac.

Les analyses de la qualité de l'eau et la faible concentration de phosphore dans l'eau ont permis de déterminer que le lac Kapisikama est un lac ultra-oligotrophe. Les paramètres physico-chimiques ont démontré une stabilité dans les mesures d'oxygène dissous et de conductivité spécifique entre les stations du lac. Toutefois un pH acide (autour de 4) a été observé à chacune des stations de profil physico-chimique du lac Kapisikama.

Les résultats de pêche de 2012, 2017 et 2021 ont seulement permis de confirmer la présence de perchaudes de classes de taille similaires d'une année à l'autre. Par contre, lors de la réception des résultats d'analyse de filtre pour l'ADN environnemental, il sera possible de confirmer les résultats de pêche, afin de s'assurer qu'aucune autre espèce de poisson n'est présente dans le lac.

Malgré que de déterminer la productivité du lac Kapisikama ne faisait pas partie de la liste des objectifs de cette étude, l'absence d'affluent et d'effluent permanent et les résultats obtenus (analyses physico-chimiques et pêches) démontrant des conditions ultra-oligotrophiques, semblent démontrer une faible productivité pour le poisson. Les résultats d'ADNe et de la structure d'âge de la population du lac Kapisikama viendront compléter la diagnose, lorsqu'ils seront disponibles. À ce moment, une version complète et finale de cette note technique sera présentée.

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p. j. Annexes

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ANNEXE 1

PROGRAMME DE TRAVAIL

NOTE TECHNIQUE

DESTINATAIRES :	M. Charles-Olivier Lapointe, Chargé de projet Direction adjointe des projets industriels et miniers M. Benjamin Jacob, Chargé de projet Direction adjointe des projets industriels et miniers
COPIE :	Mme Caroline Morissette, Directrice Environnement, Galaxy Lithium Mme Gail Amyot, Spécialiste SSE, Galaxy Lithium
EXPÉDITEURS :	Mme Marie-Hélène Brisson, biologiste, WSP Canada Inc. Mme Dominique Thiffault, directrice de projet, WSP Canada Inc.
OBJET :	**Activités proposées pour la diagnose du lac Kapisikama** – Projet de Mine de lithium Baie-James
N^O DE PROJET :	201-12362-00
DATE :	4 mai 2022

Une diagnose du lac Kapisikama sera réalisée en juin 2022 afin de répondre à la question QC4-62 de la 4e demande d'information reçue du ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), dans le cadre de l'évaluation environnementale du projet cité en objet. La question QC4-62 est reprise ici :

QC4-62	**À la section 7.3.4 du document *Étude d'impact sur l'environnement, version 2* (WSP, 2021), le promoteur indique que le plan de compensation comprendra une étude de l'état initial du lac (diagnose) et de la population de perchaude. La diagnose du lac et de la population de perchaude ne constitue pas une avenue de compensation. Toutefois, la diagnose doit être réalisée afin d'avoir un état de référence du milieu qui sera impacté et décrire adéquatement l'impact du projet sur l'habitat du poisson ainsi que sur la population de poissons que ce lac abrite. Le promoteur doit donc réaliser la diagnose du lac Kapisikama selon le *Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures Tome I – Acquisition de données*[1]. Il importe de statuer sur l'allopatrie de la population de perchaude et, si tel est le cas, d'en établir un portrait génétique et phénotypique (comparaison avec des populations locales ou plus au sud).** **Le promoteur doit présenter le rapport de diagnose du lac et de la population de perchaude à l'Administrateur provincial préalablement à la décision pour ce projet.**

La diagnose permettra d'obtenir un état de référence du lac Kapisikama et de sa population ichtyenne qui seront impactés par les activités du projet. En effet, le dénoyage de la fosse entraînera l'assèchement graduel du lac Kapisikama, à partir de la 4e année d'exploitation de la mine. Afin d'éviter la mortalité de la population de poissons présente dans le lac par l'assèchement de celui-ci, le maître de trappe RE02 ainsi que les membres de sa famille seront invités à venir pêcher les poissons avant que le lac ne soit complètement asséché.

1 Service de la faune aquatique, 2011. Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures, Tome I, Acquisition de données, ministère des Ressources naturelles et de la Faune, Québec, 137 p. Microsoft Word - Normalisation_17Fev2011_FINAL.doc (gouv.qc.ca)

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Bien avant cet asséchement, Galaxy devra obtenir les autorisations requises pour la destruction de l'habitat du poisson auprès du gouvernement fédéral. La perte des superficies d'habitat du poisson sera compensée.

La diagnose sera réalisée conformément au *Guide de normalisation des méthodes d'inventaire ichtyologique en eaux intérieures Tome I – Acquisition de données* (Service de la faune aquatique, 2011). Les activités de caractérisation prévues sont complémentaires à celles réalisées lors des travaux d'inventaire de 2018 (WSP, 2018). L'avis des experts du MELCC est souhaité afin de s'assurer que la caractérisation du lac satisfait vos attentes.

Les activités proposées sont les suivantes :

1. ADN environnemental à l'aide de « eDNA sampler » et des filtres « eDNA self-preserving » de Smith-Root :
   a. 5 stations d'échantillonnage et 1 blanc de terrain.
2. Bathymétrie sommaire du lac à l'aide d'un sonar Lowrance Elite Ti S-110.
3. Inventaire, délimitation et cartographie des herbiers aquatiques à l'aide d'une caméra GoPro sous-marine.
4. Qualité de l'eau :
   a. Paramètres à analyser *in situ* : température, oxygène dissous, conductivité et pH à l'aide d'une sonde multiparamètres, transparence à l'aide d'un disque de Secchi.
   b. Paramètres à analyser en laboratoire (3 stations d'échantillonnage, 3 duplicatas et 3 blancs de terrain) : solides totaux dissous, turbidité (M.E.S.), teinte et couleur vraie, phosphore.
5. Pêche aux verveux et bourolles pour analyses génétiques et des contaminants dans les tissus de poisson :
   a. Capture d'un minimum de 15 poissons (environ 2 nuits /engins).
   b. Paramètres à analyser dans les tissus des poissons (15 échantillons) : méthylmercure (Me-Hg), biphényles polychlorés (BPC), dichlorodiphényltrichloroéthane (DDT), hexachlorobenzène (HCB), mirex, dioxines et les furanes.
   c. Prise de la longueur, poids combinés, sexe, maturité, état de santé général.
   d. Aucune lecture d'âge des poissons.

Préparé par :

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Révisé par :

Dominique Thiffault, directrice de projet
WSP Canada Inc.

MHB/DT/cg

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ANNEXE 2
REPORTAGE PHOTO

Photo 1. Rives du lac Kapisikama, juin 2022.

Photo 2. Rives du lac Kapisikama, juin 2022.

Photo 3. Rives du lac Kapisikama, juin 2022.

Photo 4. Rives du lac Kapisikama, juin 2022.

Photo 5. Végétation surplombante sur les rives du lac Kapisikama, juin 2022

Photo 6. Accumulation d’eau à proximité des rives du lac Kapisikama, juin 2022.

Photo 7. Myrique Baumier observé sur les rives du lac Kapisikama

Photo 8. *Euriophorum* sp. observé sur les rives du lac Kapisikama

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Photo 9. Thé du Labrador observé sur les rives du lac Kapisikama, juin 2022.

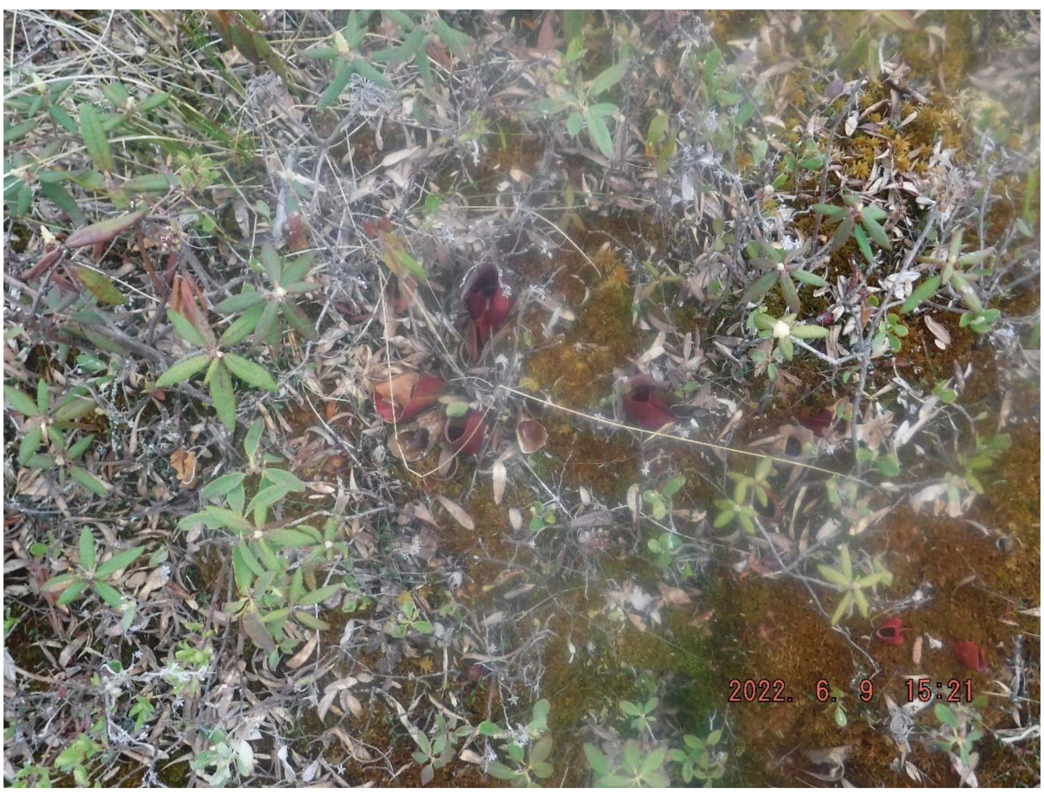

Photo 10. Sarracénie pourpe observé sur les rives du lac Kapisikama, juin 2022.

Photo 11. Andromède glauque observé sur les rives du lac Kapisikama, juin 2022.

Photo 12. Plaquebière observé sur les rives du lac Kapisikama, juin 2022.

Photo 13. Bleuet à feuilles étroites observés sur les rives du lac Kapisikama, juin 2022.

Photo 14. Coloration bleu observée sur le mandibule inférieur des perchaude du lac Kapisikama, juin 2022.