Desmaraisville, Québec

ANSWERS TO QUESTIONS AND COMMENTS BY COMEX

IMPACT ASSESSMENT – PROJECT TO PROCESS GOLD ORE FROM THE BARRY AND MOROY PROJECTS AT THE BACHELOR MINE MILL AND INCREASE OF THE MILLING RATE

ANSWERS TO THE 2nd SET OF QUESTIONS

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FOREWORD

This document contains the answers to the second set of questions and comments submitted to Bonterra Resources Inc. (hereafter Bonterra) on November 2, 2021, formulated in the context of the environmental and social impact assessment of the project to process gold ore from the Barry and Moroy projects and increase the milling rate to 2,400 tonnes per day at the Bachelor mill. (V/Ref.: 3214-14-027).

To make it easier to understand, additional questions are included in their entirety in the document and are followed by the answers. They are also grouped by topic. When a reference is made to a question or comment from the first questions and comments document, it is indicated as “QC-X”. A reference to a question or comment from the second question document is indicated as “QC2-X”.

PROJECT OVERVIEW AS DEFINED IN THE IMPACT ASSESSMENT

The first commercial operations and production activities were conducted at the Bachelor mine site from 1982 to 1989. In accordance with section 164 of the Environment Quality Act, authorization was issued on July 4, 2012 for the operation and processing of gold ore at a maximum production rate of 800 tons per day. Since the project was approved in 2012, there have been five amendments to the certificate of authorization. A new application to amend the certificate of authorization was submitted on March 26, 2018 and was withdrawn on September 28, 2018.

The project submitted by Bonterra therefore follows the previous operating and processing phases of the Bachelor mine site.

The initial project involved processing 4,000,000 metric tonnes of gold ore from the Moroy deposit at the mill of the Bachelor mine. The deposit is located approximately 600 metres south of the Bachelor mine. It also involves processing 5,000,000 metric tonnes of gold ore from a deposit located at the Barry mining site. The Barry deposit is located outside the territory under which the environmental protection regime under Chapter 22 of the James Bay and Northern Québec Agreement applies. There would also be further underground extraction of ore at the Bachelor mine at a lower rate (600 tonnes per day (t/d)). To process the ore from both mining sites, the mill’s current processing capacity (800 t/d) had to be increased to 2,400 t/d.

During the construction phase, the project included the development of new ore stockpiles and expansion of the tailings management area to hold 8 Mt of tailings from the Barry and Bachelor sites, as well as the replacement of equipment at the mill to increase its capacity. The proponent also planned to improve the existing road between the Bachelor and Barry mining sites (110 km) and to build a new 1.2 km road south of the Bachelor complex to connect the Bachelor ore mill to the existing road. During the operational phase, the project includes mining activities at the Moroy deposit of the Bachelor mining site. It also included transporting ore from the Barry deposits to the mill at the Bachelor site.

However, in the last few months, Bonterra proceeded with an internal economic study on the Moroy deposit and concluded that the known resources of this deposit are insufficient and economically unprofitable.

Thus, in light of this new information, Bonterra made the decision to withdraw extraction and processing of the Moroy deposit from the impact assessment currently under analysis by the Environmental and Social Impact Review Committee (COMEX). Several modifications to the initial project resulted from this. They are listed below.

MODIFICATIONS MADE TO THE PROJECT SINCE THE SUBMISSION OF THE INITIAL IMPACT ASSESSMENT

As introduced above, modifications and optimizations have been made to the project since the submission of the impact assessment by Wood (2019) for the processing of gold-bearing ore from the Barry and Moroy projects at the Bachelor site and the increase in milling rate. The main modification is the withdrawal of the Moroy project, which gives rise to several other modifications. Then, optimizations were also carried out to improve the environmental and technical control of operations and depend on the progress of the concept engineering stages. The changes made will allow, in particular, to reduce dust emissions associated with crushing and transportation of crushed ore. Bonterra also intends to continue this process of continuous improvement at the detailed engineering stage to ensure the efficiency of its operations and limit the environmental impacts of its project.

Here are some modifications and optimizations made to the project that have been incorporated into the review of the sector studies and in the answers to the questions:

- FOLLOWING the first set of questions, the route to the new south access had to be diverted given the presence of two species likely to be designated as threatened or vulnerable. An alternative route had been proposed. This route will not be retained and the initial route will be kept for operational reasons. However, mitigation measures will be put in place to mitigate the impact on these species
- Abandonment of the projected expansion in the northwest sector of the Bachelor mining site (stockpiling area). The areas already impacted will be used to develop infrastructure in this sector.
- Construction of a new building to house the future primary crusher. The building will be closed and a dust collector equivalent to that used for the current crushing building will be attached to it. The current crusher building will no longer be used for this purpose;
- Addition of an outdoor thickener, near three tanks, which will share the same retention basin.
- Construction of a dome, closed on three sides, will be installed on the site near the future crushing building to temporarily store the crushed material. A closed conveyor system will transport the crushed material to this dome. Another system of closed conveyors will transport the material from the dome to the mill.
- Optimization and reconfiguration of the layout plan of the tailings management area to increase the stability of the dikes, which slightly expands the impacted surface.
- Optimization and reconfiguration of the overburden dump, generating an area reduction of 0.29 hectare.
- Abandonment of the extraction and processing project of the Moroy deposit, resulting in the following changes:
    - Reduction in the quantity of chemicals and explosives used and stored.

  - Reduction of the number of workers (the number of workers will decrease from 190 for the present situation to 45 in the projected situation[1] at 1,800 tpd with the withdrawal of Moroy).
  - Shutdown of the ventilation and heating system allowing a significant reduction in the types of energy associated with an underground operation (propane, diesel, electricity, compressed air).
  - Shutdown of dry maintenance operations of underground mine galleries.
- Elimination of the ore stockpile for Moroy.
- Reconfiguration of the ore stockpiles. The three ore stockpiles will be replaced with a single ore stockpile separated in two, on each side of the new primary crusher building.
- Elimination of the secondary ore stockpile.
- Elimination of the waste rock dump for Moroy.
- Exclusive processing of ore from the Barry site and reduction of the total daily milling rate to 1,800 t.
- Improvement of ventilation of the building where the cyanidation tanks are currently located. Three roof ventilators will be added to ensure an hourly air change, as required by the *Regulation respecting occupational health and safety*.
- All the propane heating equipment will be converted to electricity, (apart from underground heating, which will no longer be required with the withdrawal of Moroy).
- Change from the propane furnace to an electrical induction furnace.

The modified infrastructure plans are presented in Appendix 1. They contain a revised general layout plan of the site and a revised layout plan of the mill.

Some other changes have been made following the revision of the sector study inputs. Indeed, an in-depth review of the operating data for the current situation and the projected situation was carried out by GCM Consultants (GCM) as part of the complete update of the greenhouse gas (GHG) balance.

This review resulted in the following changes:

- Previous studies considered transport to be performed in 30-day cycles followed by a 10-day transport break. This was based on the assumption that ore processing will occur sequentially with 30 days of ore processing from the Barry mine site and 10 days of ore processing from the Moroy deposit. Transport will be continuous year round. Therefore, this assumption was modified in the sectoral studies (atmospheric modelling and GHG balance).

  It should be noted, however, that ore transport will be interrupted for a period of two weeks during the goose hunting period in the spring and that a reduction of at least 25% will be applied for two weeks during the moose hunting period in the fall to reduce nuisances for the users of the territory. However, the discussions with the communities will continue and Bonterra could adjust according to the mill's needs.

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[1] It should be noted that in the document, the current situation refers to the situation currently authorized at 800 tpd.

- The assumptions considered that the ore transport trucks would carry about 50 tonnes. However, the capacity of the trucks is rather of the order of 42 tonnes. Therefore, the number of trips and the associated diesel consumption have been revised accordingly.
- In general, the GHG balance is much more detailed and documents the different stages of the project (construction, operation and closure) with much more precision for the current and projected situation. This is not a project change per se, but it is important to mention that the balance is different from the initial version.

EFFECT OF MODIFICATIONS AND OPTIMIZATION ON THE IMPACT ASSESSMENT

To illustrate clearly the potential effect of the modifications and optimizations made to the project on the impact assessment, Table 5-1 "Categorization of Activities and Impact Sources” of the initial impact assessment (Wood, 2019) was revised. Thus, for each phase of the project (construction, operation and closure), an assessment was done to specify if changes to the impact sources related to the project’s activities were necessary by modifications and optimizations. This table is presented in Appendix 2 and documents the nature of the changes per activity and the scope of the modification, as applicable. In general, it should be noted that the scope of the changes is considered nil (0) to low (2).

The revised Table 5-1 also summarizes the sector studies and information that should be updated to assess the effect of the change on the project’s impacts. Among them, let us note:

- Greenhouse gas (GHG) balance (QC2-18 to 21).
- Modelling of atmospheric dispersion (QC2-1 to 4).
- Deforestation areas.
- Areas of wetlands and water environments impacted (QC2-39).
- Map of micromammals updated with the new route and review of the proposed mitigation measures (QC2-7).
- Table of hazardous materials (QC2-32).
- Tables of residual materials and residual hazardous materials produced (QC2-31).
- Workforce and socioeconomic impacts.

The results of the updated sector studies and information are presented in the relevant sections below and/or presented in the summary table of residual impacts of the project in Appendix 2. This table was adapted from Table 5-14 of Wood's initial impact assessment (2019) and presents the reassessment of the project’s impacts for the components associated with a major issue. In general, it should be noted that the importance of the residual impacts following the withdrawal of Moroy remains unchanged for all the issues of the project.

However, although the importance of the impact remains unchanged, it should be noted that the withdrawal of operation of the Moroy deposit allows reduction of the project's adverse impacts for certain issues, such as climate change (particularly with the significant reduction of propane consumption by eliminating underground heating).

This exercise also allowed updating the list of mitigation measures by adding those associated with the first set of answers to the COMEX questions and adding new mitigation measures of the adverse impacts or improvement of the positive impacts, when required. They are also presented in the revised Table 5-14 in Appendix 2.

COMMUNICATIONS WITH THE STAKEHOLDERS

It should be noted that Bonterra communicates regularly with its stakeholders to inform them of the progress of all of its activities and to involve them in the process of optimizing the project. Bonterra is committed to continuing to consult and communicate regularly with its stakeholders, particularly within the framework of the harmonization committees. The study report is presented in Appendix 3.

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1.0 2nd SET OF QUESTIONS

1.1 Atmospheric emissions

1.1.1 Modelling of atmospheric dispersion of contaminants study – Appendix 12

QC2-1. Modelling of hydrogen cyanide (HCN) emissions from the mill shows that the annual criterion is met at all sensitive receptors. On the other hand, the modelling also shows that the annual criterion is exceeded, at a distance of more than 300 metres from the project facilities. The maximum modelled concentration, 300 metres north of the mill, would be 0.32 µg/m³, which corresponds to a 200% exceedance of the applicable annual criterion for HCN, which is 0.16 µg/m³.

Consequently, the proponent must submit mitigation measures to control HCN emissions from the mill's eight vents and three outdoor leaching tanks, in addition to the supernatant and recirculation ponds located in the tailings management area. The proposed measures must be integrated into the modelling to demonstrate their impact on the reduction of HCN concentrations in the ambient air. The proponent must also present in its preliminary monitoring and follow-up program how it intends to monitor and ensure the effectiveness of the measures that will be implemented.

Answer:

As presented in the section of the report on the Atmospheric Contaminant Dispersion Modelling Study (IMAUSAR, 2022; appendix QC2-1), a Teams meeting was held on 2022-03-09, attended by Martine Proulx and Jean-Sébastien Dupont, MELCC experts in the city of Québec. Since the modelled exceedances are limited to a restricted area northwest of the site and no exceedance of the annual hydrogen cyanide criterion occurs at a sensitive receptor located outside the 300-metre zone around the limits of the mining lease, Bonterra must demonstrate that basic mitigation measures have been applied. Thus, Bonterra will ensure to rigorously monitor the process, particularly with regard to the pH maintained in the outdoor leaching tanks, as well as those located in the mill, in order to limit cyanide emissions into the atmosphere. In addition, optimizations are planned for the gas evacuation system in the refinery plant building, which will improve gas dispersion.

It is also important to remember that the modelling scenario used, which assumes a concentration of 4 ppm of cyanides at all times in the plant, is very pessimistic and conservative. This value is just below the alarm threshold set in the plant of 5 ppm, the concentration corresponding to the weighted average exposure value (WAEV) for cyanides according to the *Regulation respecting health and safety at work*, and does not represent normal operating conditions.

An update of the preliminary monitoring and follow-up program will be completed as part of the section 22 authorization application and will document the instrumentation and control measures that will be implemented to ensure the effectiveness of process control, particularly with respect to pH.

QC2-2. The proponent presents the operating period of each source only in the emission rate calculation file appended to the modelling report, without specifying whether these are the conditions that were retained in the model. Also, sources S1 (refinery chimney), S2 (coal furnace chimney), S4 (lime silo chimney), S6A to S6C (new ore stockpile stacking activity 1A, 1B 1C), S7 (Secondary ore stockpile stacking activity), S131 (Loader emissions related to Ore Stockpile 1), S131A to S131C (Loader emissions related to new ore stockpile 1A, 1b and 1C), S132 (Loader emissions related to Ore Stockpile 2), TBB1 (Truck emissions related to Barry ore (1.04 km on active site)) and TBB2 (Truck emissions related to Barry ore (5.92 km off active site)) do not continuously emit particles into the atmosphere.

For modelling purposes, a maximum and continuous emission from each of these sources must be considered, i.e. 24 hours a day, 7 days a week, 52 weeks a year, if the daily schedule for these sources is not set, in order to be able to determine the maximum concentrations likely to occur if all the possible sources of dust were in operation simultaneously.

Otherwise, the proponent must adjust the modelling according to the daily and annual operating hours of each source. More specifically, the proponent must specify certain information presented in the Excel spreadsheets “GI-IBTER-01 - Calcul taux emission_2021-01-19” and take into account the elements below:

Source S1:

The proponent indicates that the furnace is powered once a week and operates for a period of six hours at an unspecified time. The proponent must specify how the emission rates were applied in the model.

Source S2:

The operating schedule for the coal furnace chimney provided in the spreadsheet is 24 hours per week, up to 3 days per week, at non-specific times. From the information provided, it is not possible to verify that the maximum emission rate of particles per day has been considered in the model. The proponent must specify the operation of the coal furnace, in particular if the furnace is used for eight consecutive hours per day and how the emission rates were applied in the model.

Source S4:

The proponent assumes that this source produces emissions during the day, from 7:00 a.m. to 5:00 p.m., during the week. However, the emission rate was weighted over a 24-hour period. As indicated in question QC2-2, the emission rate should have been weighted over a period of 10 hours, rather than 24 hours, and applied in the modelling during the hours concerned, 7 days a week. The proponent must explain its choice of weighting over a 24-hour period and specify whether the filling of the lime silo can be carried out at any time of the day.

Sources S6A, S6B and S6C:

The proponent must indicate how the emission rates were applied in the model; according to our understanding, the emission rates have been applied to each of the ore stockpiles, which means that the three stockpiles receive material every day.

Sources S9A, S9B, S9C, S10, S19 and S26:

Calculations of emission rates generated by wind erosion of particles while stockpiling must be carried out as specified in section 3.10.2.5 of the *Guide d'instructions, préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques – Projets miniers*[2]. The equation resulting from the method recommended by the Ministère specifies that the hourly emission factor obtained is in g/m².s [EF (g/m².s) = 1.52 x 10-5 x J x s]. There is therefore no weighting to do with time. However, according to the indications of the spreadsheet, the proponent used the units kg/m² instead. The proponent must correct the emission rates for all the sources concerned and resume the modelling.

Source S13A:

To calculate the emission rates related to transportation, the proponent successively applied two adjustment factors for the unpaved segments, namely the mitigation measure related to the regular watering of the roads (70%) and a mitigation of 44% linked to a 40 km/h speed limit for all transport trucks. This method is not accepted by the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). It is considered that a reduction in speed generates a reduction in atmospheric emissions, but it will necessarily be less than the value put forward (44%) when the reduction in speed is carried out on a road segment on which there has been spreading of water or dust suppressant. Only one mitigation measure can be considered in the modelling. As a reference, the *National Pollutant Inventory (NPi), Emission Estimation Technique Manual for Mining, Version 3.1* (Australian Government, January 2012) indicates a 75% reduction in emissions for watering with a flow rate greater than 2 litres/m²/h in Table 4 - *Estimated control factors for various mining operations*. In the event that the proponent chooses to apply this mitigation rate, it must commit to maintaining this efficiency at all times. The proponent must also correct the emission rates and resume the modelling.

It is considered that, even in winter, different materials will be deposited on the road segments even if the ground is frozen. Particles will then be resuspended during the passage of mining vehicles. The assumption made by the proponent, namely that the emissions of contaminants into the atmosphere are nil for the period from November to April, is not representative. The proponent must consider emissions related to transportation with a mitigation rate similar to that related to the spreading of water or dust suppressant in order to have a more conservative approach.

Sources S13B and S27B:

Appendix H of the *Clean Air Regulation* (CAR) states: "The modeling scenarios must make it possible to reproduce the worst concentrations of contaminants expected according to the period of application of the limit value. (…)" Thus, the scenario chosen to verify compliance with emission standards based on durations of 24 hours or less must take into account the cycle that will have the worst expected contaminant concentrations. According to this reasoning, it should be during the 30-day cycle.

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[2] Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC), 2017. Guide d'instructions – Préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques – Projets miniers. 34 p and appendices. Available online: https://www.environnement.gouv.qc.ca/air/criteres/secteur_minier.pdf

Diesel consumption used to calculate contaminant emission rates should be based on daily consumption for operating conditions that occur during the 30-day cycle rather than annual consumption. The same reasoning applies to the calculation of emissions related to gasoline consumption. The proponent must therefore recalculate the emission rates with the daily consumption of diesel and gasoline. The proponent shows in its spreadsheet that it considered three different sources to establish the contaminant emission rates from the combustion of diesel and gasoline. It should be noted that comparison 1 and comparison 3 come from the same source since the NPRI uses the rates of section 3.3 of AP-42 (Stationary Internal Combustion Sources, Gasoline and Diesel Industrial Engines). The choice of contaminant emission rates for diesel is conservative. Section 3.3 of the EPA, dated 1996, refers to higher emission rates than those of the second reference (comparable 2), dated 2016.

For information, the emission rates from this reference (Comparison 2) for diesel combustion are considered to be representative for a certain period of use, as mentioned in note b of the document. Volume I of the main project impact assessment report states that the project aims to process ore at the Bachelor complex over a period of 10 years. There is another reference from the US EPA which proposes a method that takes into account the use of engines in transient state and the assumption of deterioration of emissions over time (US EPA, *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression Ignition* , Report no NR-009d, July 2010).

Source S14:

The emission rates obtained on an hourly basis must be used in the modelling of the atmospheric dispersion of contaminants. The proponent should refer to Schedule H of the CAR for verification of compliance with emission standards based on different time periods. The proponent must provide the two references cited in the spreadsheet regarding data on crystalline silica emissions generated by underground operations.

Sources S15 and S16:

The calculator developed by Colorado, available as an Excel file, is not an official publication. It was not possible to verify the origin of all the information contained in it, in particular, the mass percentage of contaminants contained in the emissions from the vent of the gasoline and diesel tanks. The proponent must provide the source of these percentages or refer to another publication.

Sources S20A to S20G:

The first alarm threshold for the cyanide concentration being at 5 ppm, a cyanide concentration of 4 ppm should be considered (instead of 1 ppm) in order to obtain the most conservative scenario.

Sources S21A to S21C:

The molar mass ratio (MWCN/MWHCN) seems to have been applied twice, rather than once, in the equation. If this is not the case, the proponent must provide more detail regarding its calculation.

Source S27A:

Even in winter, different materials will be deposited on the road segments even if the ground is frozen. Particles will then be resuspended during the passage of mining vehicles. The assumption made by the proponent, namely that the emissions of contaminants into the atmosphere are nil for the period from November to April, is not representative. The proponent must consider emissions related to transportation with a mitigation rate similar to that related to the spreading of water or dust suppressant in order to have a more conservative approach.

Answer:

As presented in section 1 of the report on the Atmospheric Contaminant Dispersion Modelling Study (IMAUSAR, 2022; Appendix QC2-1), an answer is provided below for each of the elements:

- Source S1:

  The rate applied in the model corresponds to the maximum possible rate over 24 hours, applied 24 hours a day, 365 days a year in the model. The rate is calculated by dividing the maximum quantity of particles emitted during the 6 hours of furnace operation per 24 hours and reporting the whole in g/s. The quantities of materials supplied at the time to the furnace will be reduced relative to the previous version of the study.

- Source S2:

  The emission rate is applied 24 hours a day, 365 days a year in the model. It should be noted that the operating schedule of the furnace will be two days a week.

- Source S4:

  The emission rates were corrected by weighting them over 10 hours instead of 24 hours and were applied between 7:00 a.m. and 5:00 p.m., 365 days/year in the model. In addition, by examining the EPA reference used to approximate the efficiency of the dust collector, the efficiency of a dust collector of the same type as the one used (“fabric filter”) is a minimum of 99%. For this reason, this efficiency was applied to the calculation of emission rates. Modelling of this source was repeated. The operating schedule will be twice a month instead of 3 times a month.

- Sources S6A, S6B and S6C:

  The proponent changed the projected layout for stockpiling raw ore. It will be stored instead in a stockpile separated in two, one third on one side and two thirds on the other.

  The emission rates were applied to each of the two piles, which means it is assumed that the two piles receive material every day in proportion to their size. Henceforth there will be two sources, S6A and S6B.

- Sources S9A, S9B, S9C, S10, S19 and S26:

  There was an error in the calculations for the emission rates of these sources; the calculations have been corrected and the modelling of these sources has been resumed. This error stemmed from the first modelling study where the results in kg/m^2 were converted into g/m^2-s whereas it was a unit error since the results were already in g/m^2-s. Therefore, the correction factor ended up being applied twice unnecessarily. This error has been corrected in the new model.

Because there will be two raw ore piles from now on, source S9C no longer exists. Moreover, source S26 will no longer exist, because the abandonment of operation of the Moroy deposit means waste rock will no longer be generated.

- Source S13A:

  The following corrections have been applied in the calculations of emission rates for these sources:

  - A 25% adjustment factor (75% reduction) was applied to loader road segments between May and October. The same adjustment factor was applied between November and April to account for the winter period, at the suggestion of the MELCC. The proponent undertakes to maintain this efficiency at all times on these segments, with the application of a flow greater than 2 litres/m^2/h.
  - No speed limit is necessary on road segment TBB1 due to optimization of transportation activities. The 56% optimization factor (44% reduction) between May and October therefore was withdrawn. However, an adjustment factor of 25% (75% reduction) was applied between November and April to take into account the winter period, at the suggestion of the MELCC.

  During the Teams call with MELCC representatives, the status of the TBB2 road segment that had been included in the model was clarified. Because this is a road segment of a public road, despite the fact that the proponent maintains this segment to make it safe for ore haulage trucks, it was removed from the model due to its public road status.

  The rearrangement of the raw ore piles triggered changes in the routes of the trucks and the loader on the site. Moreover, the route of road segment TBB1 was changed slightly.

  Modelling of these sources was repeated with these changes.

- Sources 13B and S27B:

  For source S13B, as mentioned for source 13A, road segment TBB2 has been removed from the model as it is part of a public road. The diesel combustion gas emission calculations thus were adjusted accordingly to account for this removal.

  For sources S13B and S27B, the initial modelling considered 30-day cycles followed by a 30-day interruption, which was not realistic for transport. Ore therefore will be transported continuously at a daily tonnage lower than was forecast in the initial modelling. Moreover, the maximum weight of the ore transported by truck was reduced from 50 to 42 tonnes.

  Finally, an error that had slipped into the previous assessment was corrected. Indeed, although the maximum production forecast was previously 2,400 tonnes/day, the maximum tonnage from Barry was always 1,800 tonnes/day. The emission rate calculations due to routing of segment TBB1 were therefore corrected to a maximum tonnage transported of 1,800 tonnes/day. Emission rate calculations related to diesel combustion have been modified to take this into account. Fuel consumption was also evenly distributed over 365 days/year.

  With regard to emission factors, the three references have been retained. We added the factor to the 2nd benchmark to account for transient state and the deterioration over time. The emission factors chosen for the emission rate calculations is the most conservative of the three.

As mentioned previously, the rearrangement of the raw ore piles triggered changes in the routes of the trucks and the loader on the site. Moreover, the route of road segment TBB1 was changed slightly.

Modelling of these sources was repeated with the new emission rates calculated.

- Source S14:

  This source will no longer exist for this project, because operation of the Moroy deposit is abandoned.

- Sources S15 and S16:

  An Internet link exists to download the calculator:
  https://oitco.hylandcloud.com/POP/DocPop/DocPop.aspx?docid=7055891

  A copy of it is available in Appendix G of the modelling study (IMAUSAR, 2022; Appendix QC2-1).

  The reference used for this calculator comes from the EPA AP-42 database, table 5.2-5. No change was made to the emission rates already calculated.

- Sources S20A to S20G:

  Following the Teams call with the MELCC experts, the modelling was carried out assuming a concentration of 4 ppm in the ambient air of the mill, both for the verification of compliance with the 4-minute criterion and the annual hydrogen cyanide criterion. This is a very conservative value, since the alarm threshold is set at 5 ppm, which corresponds to the 8-hour weighted average exposure value (WAEV) in Appendix 1 of the *Regulation respecting health and safety at work*. Modelling of this source was repeated with the new emission rates calculated.

- Sources S21A to S21C:

  Effectively, this had been applied twice a year. The calculation was corrected and modelling of these sources was repeated.

- Source S27A:

  An adjustment factor of 25% (75% reduction) was applied on the road segment between November and April, similar to that related to spreading water or dust suppressant. No adjustment factor was used between May and October.

  As mentioned previously, changes were made for the calculation of the emission rate of road segment TBB1 in order to reflect the maximum tonnage from Barry, which was always 1,800 tonnes/day.

  The calculations were corrected and modelling of this source was repeated.

QC2-3. In Table 5.2.1 of the modelling of atmospheric dispersion of contaminants study (Appendix 12), the emission heights from the mill roof vents (S20A to S20G), from the laboratory dust collector chimney (S22) and from the explosives bags kiln chimney (S23) differ from the information presented in the emission rate calculation file appended to the report. These elements must be checked and corrected, if necessary. In addition, in the case of source S23, given that it is positioned on the dry tailings impoundment areas covered with waste rock (S26), the base elevation must include the height corresponding to the pile of materials that will be stored under it.

Answer:

As presented in section 1 of the report on the Atmospheric Contaminant Dispersion Modelling Study (IMAUSAR, 2022; Appendix QC2-1), transcription errors were found in table 5.2.1. They have been corrected in this revised report. Moreover, source S23 will no longer be used, because the abandonment of operation of the Moroy deposit means abandonment of the use of explosives. As mentioned previously, source S26 will also no longer exist, because waste rock will no longer be generated.

QC2-4. Given that the application for authorization concerns an increase in the production capacity of the ore processing mill from 800 to 2,400 tonnes per day as well as the expansion of the tailings management area, compliance with section 197 of the CAR must be demonstrated. Thus, if the projected situation still shows exceedances of the standard for total particles and of the annual atmospheric quality criterion for hydrogen cyanide (HCN) following the revision of the modelling, the proponent must present a modelling scenario corresponding to the currently authorized situation and a scenario of the projected situation. The scenarios should be carried out using the same methodology.

In particular, the proponent must ensure that the version of the AERMOD model, the meteorological data and the characteristics of each source that are not affected by the project are identical. This should make it possible to assess the impact of the new project on ambient air quality and determine whether it leads to an increase in the concentration of contaminants for which exceedances were observed in the currently authorized situation.

Answer:

As presented in section 1 of the report on the Atmospheric Contaminant Dispersion Modelling Study (IMAUSAR, 2022; Appendix QC2-1), in the revised emission rate calculation file in the appendix, the total particulate emission rate and the HCN rate were calculated according to the current situation, with an ore processing mill production of 800 tonnes per day. Details have been added in green to each tab of the file. To properly represent the current emission sources and calculate their rates, the following two documents served as references:

- Genivar, Modelling of atmospheric dispersion of particles in ambient air, report dated November 2011;
- Wood, Impact assessment, Processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase in the milling rate, Desmaraisville, Québec, TX17021601-000-REI-0001-0, September 26, 2019.

The modelling of these two parameters, according to the emission rates equivalent to the current treatment production of 800 tonnes/day, was carried out.

Finally, we note that the maximum production concerned now decreases from 2,400 to 1,800 tonnes/day.

1.1.2 Dust Management Plan – Appendix 7

QC2-5. In section 5.2.6 (Coal Reactivation) of the Dust Management Plan (Appendix 7), the proponent indicates that particle emissions from the furnace chimney will be monitored by a three-year chimney sampling. The proponent must ensure that the results of these samplings are transmitted to the MELCC as well as the information required to verify compliance with the emission standard.

Answer:

As part of the Dust Management Plan, the proponent undertakes to carry out a sampling program for particulate emissions from the furnace chimney every three years. Sampling of emissions into the atmosphere is required to verify compliance with the standards applicable to this type of activity and will be carried out according to the reference methods prescribed by the Sampling Guide for Environmental Analysis – Booklet 4 – Sampling of Atmospheric Emissions from Stationary Sources from the Centre d'expertise en analyse environnementale du Québec (CEAEQ).

The analysis results of these campaigns will be the subject of a sampling report drawn up according to the methods prescribed in Booklet 4 of the CEAEQ. This report will contain all the information required to verify compliance with the particulate emission standard under the *Clean Air Regulation*. The report will be sent to the MELCC on paper and electronically within 120 days of the end of the sampling campaign. Finally, if the analysis reveals that a limit value or another emission standard set by regulation has been exceeded, a mention will be made in the report and corrective measures will be taken to remedy the situation.

As mentioned in the section on the modifications made to the project since the submission of the initial impact assessment, a new building will be constructed to accommodate the future primary crusher. The building will be closed and a dust collector equivalent to that used for the current crushing building will be attached to it.

As with the other dust collectors on the site, the current mitigation measures provided for in the Dust Management Plan will be applied to ensure the optimal functioning of this new dust collector.

The Dust Management Plan will be updated as part of the Section 22 authorization application to be filed with the MELCC to include the commitment to submit the furnace chimney sampling report to the MELCC and the procedures to monitor the proper functioning of the new dust collector.

QC2-6. Several sensitive environments have been identified by the proponent in *Table 1. Location of sensitive receptors near the Bachelor site* in Appendix 7 of the document “Addendum – Answers to questions and comments by COMEX” (Bonterra, 2021). The proponent must identify the dust monitoring methods that it intends to implement in these sensitive environments.

Answer:

Modelling demonstrated that there was no exceedance at sensitive receptors (see Appendix QC2-1). The proponent will use dust suppressants on the mine site (including the camp).

The proponent is aware of the importance of reducing nuisances. The proponent’s complaint management system will watch for user concerns. In the event that there are complaints from various users on the public road, additional measures could be taken, such as the application of dust suppressants.

Since the use of the territory is likely to vary over time for a given territory, Bonterra carried out consultations with the son (Matthew Blacksmith), of the former tallyman of lot W24A (Frank Blacksmith now deceased) and with one of the main users of the territory (Allan Saganash), as well as Joshua Blacksmith from the community of Waswanipi. The meeting confirmed that no new permanent camp is present in the limited study area and that some camps are non-existent or unoccupied. According to the information gathered, no new camp would be present along the Bachelor-Barry road. The report of the meeting on July 12, 2022, with the tallymen and the users of trapline W24A is attached to Appendix QC2-6.

1.2 Reptiles, amphibians and mammals

1.2.1 Reptile, Amphibian and Mammal Inventory Report – Appendix 3

QC2-7. The answer to QC-57 states that a report will be produced subsequently to document the methodology used to take the inventory of the small mammals, the results of the inventories, as well as the avoidance, mitigation or compensation measures that will be applied. The document “Addendum – Answers to questions and comments by COMEX” (Bonterra, 2021) puts forward recommendations on the avoidances to be carried out to limit the impacts on the habitat of status voles that have been confirmed. Among other things, this document mentions that it will be necessary to relocate the projected access road on the outskirts of the construction of the dikes in order to minimize the impact within the home ranges of the two species recorded on the MM02 transect and in a checkerboard of stands of great interest for wildlife, considering the diversity of plant species and the diversity of natural elements (snags, decomposing dead trees, dead wood on the ground, rocky cape with crevices).

It is then mentioned that Map 3 of Appendix 1 of the Reptile, Amphibian and Mammal Inventory Report presents an alternative route for the access road from the road south of the tailings management area and a proposed location for the overburden dump. The route suggested for the south access minimizes the impact on status species while limiting the fragmentation of stands since it runs along the planned ditches and approaches the tailings management area.

The technical note (Appendix 5 of the Reptile, Amphibian and Mammal Inventory Report) on the layout of the south access road presents the scenarios considered. A set of other recommendations is presented in this document.

The proponent must present the route officially selected (route, work footprint, road width, road elevation, etc.) and the mitigation measures that will be implemented to avoid or reduce the loss of wetlands and preferential habitats for small mammals. It must also present the rationale for the chosen route (environmental impacts, costs, safety of the route, etc.).

Answer:

Bonterra had chosen to retain route 2 presented in the study of the routes envisaged for the southern access road, presented in the technical note of Appendix 5 of the Reptiles, Amphibians and Mammals Sector Inventory Report (GCM, 2021). However, during the additional studies for the access road and the detailed engineering of the tailings management area (hereinafter TMA), the choice again shifted to the original route. This choice is based on transport safety and the needs of mining operations. With the new footprint of the tailings management area, routes 1 and 2 came into conflict with the TMA itself. Route 3, on the other hand, has steep slopes, which could cause significant safety problems in winter conditions. It was therefore quickly excluded. Moreover, contrary to routes 1 and 2, the Original route does not involve constraints with the various water collection ditches projected around the tailings management area. It also allows two-way traffic because it is the only space sufficient to accommodate a class 1 road. This operational advantage is not negligible.

The Original route is the second least expensive route among the options evaluated, excluding the costs related to the rock present in the middle third of Original routes 1 and 2 (see Table QC2-7-1). The Original route is on a mountainside, which potentially involves the excavation of rock to develop the road. It is also the route that has slopes with the greatest winter safety level.

Table QC2-7-1. Cost estimate per route (GCM, 2021)

Routes	Route length (m)	Cost ($)[1]
Route 1	900	687,900
Route 2	815	621,100
Route 3	1,075	663,450
Original route	1,000	641,400

[1] 50% accuracy

Route optimization is in progress in the detail engineering. Thus, a revised-Original route is being developed. According to the latest information, this route would be 1,175 metres long. Costs for the revised-Original route are currently under study but should be similar to the Original route. For the selected revised-Original route, a class 1 road is considered, for which a running surface of 8.5 to 9.1 metres, a shoulder of 1 metre and a ditch are planned. The road's maximum deforestation right-of-way will be 35 metres. The elevation of the road will vary between approximately 330 and 350 metres. The route and the infrastructure rights of way are illustrated on the map in Appendix QC2-7.

Although Bonterra would have wanted to avoid the restricted activity areas suggested by GCM (2021) for micromammals with status, this route does not allow them to be avoided.

Out of a concern to minimize the impacts on the Southern Bog Lemming and the Rock Vole, two species likely to be designated threatened or vulnerable, a notice was requested from the Ministère des Forêts de la Faune et des Parcs (hereinafter MFFP). Special measures were suggested and are presented in the following section.

Efforts will also be deployed to minimize the impacts on the Southern Bog Lemming in the overburden dump sector. In particular, the width of the overburden dump was reduced and it was moved further away from the restricted activity area suggested by GCM (2021) and from the initial layout. The change can be viewed on the map in Appendix QC2-7. Moreover, special measures will be taken to limit the impacts on the perimeter of the dump during its construction. They are listed in the following section.

Avoidance and mitigation measures

Bonterra is committed to following the recommendations of the MFFP and the general recommendations of GCM (2021) to limit the loss and disturbance of vegetation since these have a direct link with the available wildlife habitats. Thus, the following general recommendations will be applied:

- Favour maintenance of small-diameter wood debris (e.g. branches) on the ground in the right of way of the road where the shrub cover will have been suppressed by the work, because this practice allows conservation or creation of quality habitats that are used by these species and that will contribute to their protection (GCM and MFFP).
- Avoid soil compaction and rutting as much as possible during the work.
- Limit deployment of roads in the restricted activity zones defined for occurrences of micromammals with status based on the home ranges of the species (see the map in Appendix QC2-7) (GCM and MFFP). Apply best practices to limit the risks and mitigate the consequences of a petroleum, chemical or de-icing agent spill in the natural environment (GCM).
- Physically delineate the deforestation areas, traffic areas and material storage areas to limit the movement of machinery in the sector, limit rutting and conserve shrub forest cover and thus minimize habitat loss for these species (GCM and MFFP).
- Ensure compliance with deforestation limits previously identified by a site supervisor (GCM).
- Avoid soil compaction and soil rutting during work as much as possible (MFFP).
- Perform the work in winter (when the ground is frozen or in the presence of 30 cm or more of snow cover) (MFFP).
- Respect the strips of woodland in relation to the watercourses and wetlands, as provided in the Regulation respecting the sustainable development of forests in the domain of the State (RSDF) (MFFP).
- Recommend scenarios that avoid or minimize the loss of wetlands (GCM).
- Favour the use of surfaces already disturbed for storage of cut timber and wood debris (GCM).

The chosen location of the overburden dump will also allow compliance with the specific recommendations proposed by GCM Consultants (2021) relating to the species of micromammals with status identified in the sector, namely:

- Minimize disturbances of the natural environment within a radius of 100 m around each record of southern bog lemming and favour sectors adjacent to an already disturbed surface to avoid fragmenting its habitat.
- Minimize disturbance of the natural environment within a radius of 120 m around each rock vole record and favour sectors adjacent to an already disturbed surface to avoid fragmenting its habitat.

QC2-8. In 2021, the proponent must conduct a complete inventory of bats. This inventory must be based on the *Protocol for acoustic inventories of bats in the context of wind turbine installation projects in Québec*.[3] Also, as specified in Appendix 3 of the addendum, visits to the buildings should make it possible to detect signs of use by bats, if there are any. One of the main objectives of the inventory during the breeding season is to detect the presence of areas of concentration of individuals, which could constitute maternity wards, for example.

In the event that concentration areas are found on the Bachelor mine site (e.g. maternity, building used as a lodge, etc.), the proponent must identify protection and mitigation measures as well as plan long-term monitoring.

Answer:

An inventory during the bat reproduction period was carried out in June and July 2022 to improve the study carried out in 2020 during the migration period. Like the previous inventory, this one was based on the *Protocol for acoustic inventories of bats in the context of wind turbine installation projects in Québec*.[4] In addition, during this 2022 inventory, the buildings were visited to detect signs of use by chiroptera. The results of this study are presented in the report of Appendix QC2-8.

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[3] Ministère des Ressources naturelles et de la Faune, 2008. Protocole d'inventaires acoustiques de chiroptères dans le cadre de projets d'implantation d'éoliennes au Québec. 10 p and 1 appendix. Available online https://mffp.gouv.qc.ca/documents/faune/protocole-chauves-souris.pdf

[4] Ministère des Ressources naturelles et de la Faune, 2008. Protocole d'inventaires acoustiques de chiroptères dans le cadre de projets d'implantation d'éoliennes au Québec. 10 p and 1 appendix. Available online https://mffp.gouv.qc.ca/documents/faune/protocole-chauves-souris.pdf

1.3 Sound component

QC2-9. In section 8.4.1.8 of the document "Impact Assessment – Volume I: Main Report" (Wood, 2019), the proponent states: "The Certificate does not contain any noise requirements. Nevertheless, Metanor complies with the relevant articles of the Regulation respecting occupational health and safety and the Act respecting occupational health and safety." Although the certificate does not specify it, it is the proponent's obligation to comply with the note d'instructions *Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent* (NI 98-01). For information, this obligation will be included in the authorization under section 22 of the EQA.

In connection with the note d'instruction cited above, the proponent must take into consideration noise mitigation measures with regard to the equipment and vehicles used during construction and ensure compliance with the measures identified in the impact assessment.

Answer:

The proponent undertakes to respect the note d'instructions *Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent* [Instructional note – Handling noise complaints and requirements for companies that generate noise] (NI 98-01). The proponent also agrees to take noise mitigation measures into consideration during construction and respect the measures identified in the impact assessment.

It is also important to remember that the proposed ore processing mill will be less noisy than the one currently in place due in particular to the replacement of the conveyors.

QC2-10. The proponent has established that its biophysical study area (ZEB) includes the transportation road, the borrow pits, the Bachelor site as well as the receiving stream and Bachelor Lake in its entirety and that it considers that the nuisance caused by road noise will be limited within a radius of 500 m.

Section 2.4.1 of Directive 019 on the mining industry (Directive 019) states that: "The evaluation acoustic level of a fixed source associated with a mining activity must be evaluated according to the instructions of Note d'instructions 98-01 (traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent). The sound levels measured must comply with the sound levels established in this "note d'instructions." Section 3.3.4.1 of Directive 019 states that: "When noise can be a significant problem (impact zone located less than 600 m from noise sources) for the noise assessment points described in section 2.4.1 or relative to the sound level established according to neighbouring zoning or based on ambient noise, an assessment of the sound level including ambient sound levels and those generated by mining activities must be made according to the provisions described in the Note d'instructions 98-01. The mitigation means envisaged are presented as well as the anticipated level of noise reduction."

Finally, the noise assessment point is defined in Directive 019 as: "A residential dwelling, an establishment, a campground, a recreational site, including outfitters, agricultural or industrial land or land intended for one of these uses by municipal by-law and which is exposed to a source of noise."

Pursuant to Directive 019, the proponent must make a sound level assessment including, but not limited to:

- the identification of stationary and mobile noise sources, whether temporary or permanent;
- the location of noise sources;
- the duration of use of each of the sources (per day, per week or per year) as well as the hours of use.

Answer:

The proponent agrees to carry out a study to assess the sound level under section 2.4.1. of Directive 019 on the mining industry (Directive 019) and similarly, according to the requirements of Note d'instructions 98-01. This study will include, but not be limited to, the determination of fixed, mobile, permanent and temporary noise sources, their location as well as their duration and hours of use. The study will be presented part of the authorization application for a certificate of authorization under section 22 of the EQA.

1.4 Hydrogeology

QC2-11. In section 3.8.2.2.7 of the document "Impact Assessment – Volume I: Main Report" (Wood, 2019), the proponent has undertaken to waterproof the portions of the tailings management area that will not meet the percolation flow criterion of 3.3 L/m²/day (s. 2.9.4 – Directive 019) and mentions that it "will line the areas where the clay cover is insufficient using a layer of clay or a "Bentoflix"-type geomembrane intended to increase the degree of impermeability of the soil in the area." To respect this commitment, the proponent must consider the results of the modelling under pessimistic conditions to compensate for the sources of uncertainty in the hydrogeological modelling (delimitation of unconsolidated deposits, hydraulic conductivities based on a geometric mean, etc.) during waterproofing work in areas where the clay cover is insufficient.

Answer:

The hydrogeological modelling including the results in pessimistic conditions has been sent to BBA and will be part of the detailed engineering.

As an indication, in order to consider the results of the modelling in pessimistic conditions, the flow map was used to locate the area of the land to be covered with a geomembrane. As can be seen on plan INF0784-55001 in Appendix QC2-11, the area that is planned to be waterproofed is much larger than the single area within which flows greater than 0.5 L/m²/day are expected.

QC2-12. The proponent must install observation wells at least at the sites of virtual wells OBS-1, OBS-3 and OBS-5. These new wells will have to be at two levels (drilled in the unconsolidated deposits and in the bedrock) and added to the wells retained in the environmental monitoring program. An information sheet titled: Analysis of groundwater quality monitoring results, relating to groundwater quality monitoring is available on the Ministère's website[5] and should be considered for the interpretation of environmental monitoring data.

Answer:

Six new observation wells (PO22-01 to PO-22-06) were drilled from July 11 to 21, 2022 in the unconsolidated deposits. These wells have been added to the environmental monitoring program.

Bonterra commits to constructing three additional dual-level observation wells (drilled in the unconsolidated deposits and bedrock) at the virtual well sites OBS-1, OBS-3, and OBS-5 and adding the new selected wells to the environmental surveillance and monitoring program.

The specifications recommended in the technical note of Richelieu Hydrogéologie (2021) (Appendix QC2-12) with regard to the location and development of the observation wells in the bedrock will be respected. The additional wells will be added to the groundwater monitoring network already present on the site.

Finally, the analysis of the results on the quality of groundwater in the context of environmental monitoring will be based on the content of the information sheet "Analysis of groundwater quality monitoring results, relating to groundwater quality monitoring" available on the Ministère's website and in Booklet 3 of the CEAEQ's Sampling Guide for Environmental Analysis. The results will also be published with the MELCC as part of the annual report required under Directive 019 on the mining industry.

QC2-13. In compliance with section 2.3.2.3 of Directive 019, the proponent must undertake to determine the background level of the groundwater circulating in the site under study. These background levels must have been established and must be detailed in the final version of the environmental monitoring program that will be submitted with the first application for ministerial authorization required under section 22 of the EQA.

For your information, a guide for the physicochemical characterization of the initial state of groundwater before the implementation of an industrial project is being prepared and its publication is expected soon. This guide will specify the recommended method for calculating the background levels of substances in groundwater. Insofar as the guide is made available, the proponent must use the methodology recommended in this guide to update and statistically process its data.

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[5] Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC), 2019. Information sheet: Analysis of groundwater quality monitoring results. Available online: https://www.environnement.gouv.qc.ca/eau/souterraines/fiche-info-analyse-resultats-suivi-qualite.pdf

Answer:

Background level monitoring will be detailed in the final version of the environmental monitoring program that will be submitted with the first application for ministerial authorization required under section 22 of the EQA. In addition, the sampling will be carried out in accordance with Booklet 3 of the CEAEQ's Sampling Guide for Environmental Analysis. Finally, the proponent agrees to use the recommended method for calculating the background levels of substances in groundwater, *"Guide to the physicochemical characterization of initial groundwater state prior to the establishment of an industrial project."*

1.5 Tailings management area

QC2-14. Appendix 9 "Preliminary surveillance and monitoring program" of the document "Addendum – Answers to questions and comments by COMEX" (GCM Consultants, 2021) is insufficient with regard to the risks and consequences of a rupture. This aspect needs to be reviewed by the proponent.

In March 2019, the Mining Association of Canada published a *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities*[6]. This document is in its second edition and section 3.5 specifically covers this aspect. This document could guide the preparation of an appropriate surveillance and monitoring program for the infrastructures that must be presented when requesting ministerial authorization for the construction of mining infrastructures.

Answer:

As mentioned in the answers to the previous questions, a final version of the surveillance and monitoring program will be submitted when applying for a certificate of authorization under section 22 of the EQA of the MELCC. This will be revised to include the additional monitoring methods to which Bonterra has committed in the context of the 2nd set of answers to the COMEX questions and to improve the elements related to controlling the risks and consequences of a dike rupture.

The final surveillance and monitoring program will include the drafting of an Operation, Maintenance and Surveillance Manual for tailings management areas and water management facilities based on the Mining Association of Canada Guide.

This Guide-compliant manual will be ready for Day 1 of the restart of operations.

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[6] Mining Association of Canada. 2019. Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities. 2nd edition. Available online https://mining.ca/wp-content/uploads/dlm_uploads/2021/08/MAC-OMS-Guide_2019-Apple-Mobile.pdf

QC2-15. A geochemical characterization report of the ore and waste rock from the two mining sites as well as the Bachelor mine tailings was carried out by Wood in 2019. According to this report, limited volumes of tailings produced during the milling of Bachelor and Moroy ores could have a neutralization potential ratio (NPR) between 1.5 and 3. Wood therefore recommends carrying out geochemical monitoring of the tailings as they leave the mill to verify the NPR of the tailings. The proponent must agree to comply with this recommendation and carry out geochemical monitoring of the tailings.

Answer:

In 2017, following the COMEX assessment, the proponent received an authorization modification[7] to its Certificate of Authorization (CA)[8] for its project to mine and process 600,000 tonnes of additional gold ore at the Bachelor mine site. Condition 1 of this amendment specified that the proponent must undertake an ongoing geochemical characterization program for any new mineralized zone that would be discovered during exploration activities that would be mined or processed, after authorization from the Administrator, on the Bachelor mine site.

However, the proponent has undertaken to analyze, on a weekly basis, the mine tailings leaving the concentrator to determine their sulphur (S) and carbon (C) content. In the case of the Bachelor site, sulphur is almost entirely associated with pyrite, while carbon is mainly associated with carbonates. This allows the calculation of acidification potential (AP) and neutralization potential (NP). The AP and NP will thus allow to determine if the tailings are potentially acid-generating (PAG).

By carrying out this monitoring on a weekly basis and by combining the values with the tonnage deposited in the tailings management area, the proponent is able to assess the quality of the stored mine tailings. All of the weekly data is compiled in a database, which the proponent transmits to the Administrator in its annual report.

This database was developed to gather the following weekly data:

- Weekly quantity of mine tailings deposited in the tailings management area
- Amount of process water sent to the tailings management area
- pH at the final effluent
- Sulphates at the final effluent (indication of sulphide oxidation)
- Concentration in S of the weekly sample (converted in AP)
- Concentration in C of the weekly sample (converted in NP)
- Acid generation potential of deposited tailings (PAG).

Thus, from January 2018 to October 2018, nearly 26 samples of tailings were collected from the Bachelor mill.

It should be noted that from May 2018, due to the lack of profitability of the Bachelor deposit, the mining and ore processing operations gradually slowed down to cease in October 2018.

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[7] Modification Ref./No. 3214-14-027 – Mining and processing project of 900,000 mt of gold ore from the Bachelor mine site - Mining and processing of 600,000 tonnes of additional gold ore issued on February 10, 2017 by the Deputy Minister Marie-Renée Roy of the MDDELCC.

[8] Certificate of authorization Ref. No. 3214-14-027 – Mining and processing project for 900,000 mt of gold ore from the Bachelor mine site issued on July 4, 2012 by Deputy Minister Diane Jean of the MDDEP.

This explains the decrease in sampling in 2018 and the absence of samples between 2019 and 2022. Bonterra is currently awaiting the authorizations required to process Barry ore on a basis of 1,800 t/d at the Bachelor mill.

The proponent undertakes to resume this geochemical monitoring program as soon as operations at the Bachelor mill resume.

QC2-16. Appendix QC-51 covers in particular the characterization of the ore from the Barry site and the Moroy deposit. However, no characterization of the tailings resulting from the processing of the Moroy deposit is presented in this report. Given that the project involves the mining of 4 Mt of Moroy ore and 5 Mt of ore from the Barry site as well as their processing at the Bachelor mill, the characterization reports provided in Appendix QC-51 do not make it possible to determine whether the tailings produced in the future will be acidogenic or not, and whether the remediation concept presented is admissible. The proponent must provide the complete characterization of samples of tailings from the processing of Moroy and Barry ore. This report must also be provided as an addendum to the rehabilitation and restoration plan submitted to the MERN in March 2021.

Answer:

Authorizations to process 550,000 t of Barry ore at the Bachelor site were first obtained in 2008 (No. 3214-14-027 and 7610-10-01-70018-27/200207917). Then, in 2009, authorizations to increase the operating rate of the Bachelor processing mill from 800 to 1,200 tonnes per day in order to process 1.2 Mt of ore from the Barry mine site (No. 3214-14-027 and 7610-10-01-70018-29/200242770) were obtained. However, since 2008, approximately 606,000 tonnes of ore from the Barry site have been processed at the concentrator and stored in the Bachelor tailings management area. As detailed in the geochemical study results interpretation report (GCM, 2020), the tailings present in the Bachelor tailings management area were characterized several times in 2016, 2018 and continuously since.

According to the Characterization Guide (MELCC, 2020) all of the mine tailings sampled in 2016 are considered to be non-PAG. Column test results (2018) demonstrate that both the fresh tailings and the tailings mixture are non-PAG in the long term (URSTM, 2019). As for continuous sampling, Bonterra is committed to the COMEX to analyze on a weekly basis the mine tailings leaving the concentrator to determine their sulphur (S) and carbon (C) content. In the case of the Bachelor site, S is almost entirely associated with pyrite, while C is almost entirely associated with carbonates. This allows the calculation of acidification potential (AP) and neutralization potential (NP). The AP and NP allow to determine if the tailings are potentially acid-generating (PAG).

When compared to criteria of Price (2009)9 and the MELCC (2020),[10] the residues characterized continuously since 2018 are classified as non-PAG since all the samples have an NP/AP ratio greater than 2 and a net neutralization potential (NNP) greater than 20 kg $CaCO_3$ (GCM, 2020).

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[9] Price, W.A, 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND report 1.20.1, December 2009.

[10] MELCC, 2020. Guide de caractérisation des résidus miniers et du minerai

In addition, it should be noted that since 2008, either during bulk sampling of the Barry deposit or during ore extraction operations as authorized in the authorization for Mining Operations-Barry Mine Site dated April 26, 2011 (No. 7610-08-01-70172-24-400807257) and the modification of authorization dated January 25, 2018 (No. 7610-08-01-70172-24-401656138), the proponent collected a total of 103 ore samples at the Barry site.

According to the results collected from the 103 Barry ore samples, detailed in the interpretation report (GCM, 2020) presented in Appendix 5 of the rehabilitation and restoration plan (GMC, 2021), 17% of the samples are considered to be PAG according to the criteria of D019 and 6% according to the criteria used by Wood (2019).

It should be noted that the criteria used by Wood (2019) are based on the *Guide de caractérisation [Characterization guide]* (MELCC, 2020) which considers samples with an NP/AP ratio (NPR) of less than 2 as being PAG.

It is important to remember that the main mineralized zone of the Barry deposit is linked by:

- Quartz, carbonate and albite veins cutting intrusions (porphyries) to the south and;
- Quartz, carbonate and albite veinlets/veins located in altered shear zones in basalt, to the north.

On the surface, the gold is associated with the proximity of a granodioritic intrusion and at depth (>100 metres), the gold is controlled by narrow shear zones (0.5 metres to 4 metres) following a direction identical to that observed on the surface. This means that on the surface, it is possible to observe very clearly that the auriferous shear zone follows the contact of the intrusion, but the gold is located in the basalt shear zones. The intrusions are target geological markers for the interpretation of the deposit and sometimes present gold values from the veins intersecting them.

Therefore, the samples analyzed in previous studies carried out within the framework of the exploitation of the open pit deposit at less than 100 m depth are representative of the material that will be extracted at more than 100 m depth during underground exploitation since it is the same mineralogical system, i.e. quartz, carbonate and albite veins from basalt shear zones.

However, considering that the processing of Barry ore at the Bachelor concentrator was authorized in the past (2008-2009), tailings from the processing of Barry ore are already present in the Bachelor tailings management area. As mentioned above and detailed in the geochemical study results interpretation report (GCM, 2020), the tailings present in the Bachelor tailings management area were characterized several times in 2016, 2018 and continuously since.

In addition, considering that Barry ore is uniform, that the tailings from Barry ore processing have already undergone geochemical characterization, and that they will continue to be sampled at the end of the pipe (discharge point for mine tailings in the tailings management area), the proponent considers that a new ad hoc characterization of the tailings from Barry ore processing is not required.

As for the Moroy deposit, it will ultimately not be exploited and therefore no longer relevant.

For information, despite the withdrawal of the Moroy operation, a bulk sample of approximately 15,000 tonnes of Moroy ore was taken in the fall of 2020 and was processed at the Bachelor concentrator.

Thus, tailing samples have been collected and a geochemical characterization report is being prepared.

1.6 Climate change and greenhouse gas emissions

QC2-17. To answer QC-94, Table Q94-1 satisfactorily presents the hazards affected by climate change and the proposed adaptation measures. However, it should be noted that Directive 019 does not take into account climate change, nor, with regard to buildings, the codes and regulations in force. The proponent must indicate whether an increase in the criteria of Directive 019 as well as the codes and regulations in force is necessary to ensure the resilience of its project in a future climate, both for the elements of Table Q94-1 and for the design criteria presented in Appendix Q42.

In addition, since the hazards presented in the table concern the operation phase only, the proponent must complete the table with the hazards likely to affect the project in its restoration phase, as well as the proposed adaptation measures for all the components of the project that will be in place in the long term (e.g. tailings management area, stockpiles, pits, etc.).

Answer:

Climate change is a new issue that must be taken into account when designing projects. This is particularly the case during the development of water management plans and the design of buildings or hydraulic infrastructures such as ditches, culverts, basins and emergency spillways. However, risk mitigation measures and adaptation measures may be considered.

Climate changes that may have an impact on mining operations are mainly manifested by an increase in temperatures and an increase in precipitation (rain and/or snow).

In the northern context, the increase in temperatures could lead to a more or less rapid melting of the permafrost, which would put the foundations of infrastructures and their stability at risk. The Bachelor mine and its tailings management area are located in an area that is not known as a permafrost zone. Therefore, this risk is not present. In addition, the stability analysis demonstrates that the short-term, long-term and pseudo-static safety factors comply with the safety factors required by Directive 019 and the *Guide de préparation du plan de restauration [Guide to preparing the restoration plan]* (Appendix QC-15b).

The potential increase in precipitation is reflected in the quantities of water to be managed (volumes) and in the extreme flood flows (design flows). For the design of the water retention basin of the Bachelor tailings management area and its ancillary structures, an increase in extreme precipitation was taken into consideration with a 20% increase. The design elements are detailed in the report prepared by BBA (Ref.: 6098002-000000-4G-ERA-0001-R03; Appendix QC-42).

The risks linked to climate change in terms of water management for the construction and operation phases have been analyzed by BBA on the basis of the available scientific data and more particularly the climate projections produced by the Ouranos research consortium for all of Québec.

According to (Ouranos, 2018), for the Abitibi region and for the city of Val d'Or, the variations in temperature and precipitation for the 2041-2070 horizon will be as presented in Table (https://www.ouranos.ca/climate-portraits/).

These forecasts are based on a scenario of high greenhouse gas (GHG) emissions. Several simulations were carried out and the median simulation in terms of variations was retained (50th percentile).

As the mine will probably be restored before 2041, taking this data into account is considered conservative for safe management of the excess water that will have to be managed in the coming decades.

Table QC2-17-1: Projections of temperature and precipitation variations in Val-d'Or for the 2041-2070 horizon according to Ouranos (2018)

Period	Temperature		Precipitation		
	Current average value (° C)	Projected variation (°C)	Current average value (mm)	Projected variation (mm)	Projected variation (%)
Year	2.0	+3,2	900	+85	+9
Winter	-14.0	+3.8	161	+30	+19
Spring	1.4	+2.6	188	+32	+17
Summer	16.3	+3.1	295	-5	-17
Fall	4.2	+2.9	261	+25	+10

Thus, the design of drainage ditches and water retention basins was carried out by considering a 20% increase in volumes and/or flows, which amounts to making an increase of the same order on the precipitation of the stations of references used: Matagami; Lebel-sur-Quévillon and Chibougamau.

With regard to the post-operation phase, the purpose of the BTMA restoration concept is to allow the evacuation of water (see section 4.6.4 of the restoration and rehabilitation plan). The selected concept considers the impact of climate change since it will no longer require the management of water retention structures in the BTMA following restoration. In fact, the supernatant pond operating spillway will be redesigned (if required) to ensure that there is no accumulation of water on the tailings at all times.

A breach will be made in the median dike of the recirculation basin to ensure that there is no accumulation of water in the basin at all times. It will be the same for the sedimentation basin by replacing the operation spillway of the north dike with a breach. In addition, all management-related calculations consider a provision for climate change.

In addition, the surface of all the basins (supernatant, recirculation and sedimentation) of the BTMA will be covered with organic matter to then be vegetated by hydraulic seeding.

Finally, with regard to the design of the buildings, the detailed design of the future buildings that will be required for the development of the project will take into account the anticipated impact of climate change on the buildings.

In this sense, the various recommendations issued by government authorities on buildings, including the *Climate-Resilient Buildings and Core Public Infrastructure Report*[11] issued by Environment and Climate Change Canada will be considered.

These modifications have been added to the revision of Table QC-94 of the hazards associated with climate change presented on the following page.

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[11] Climate-resilient buildings and core public infrastructure 2020: an assessment of the impact of climate change on climatic design data in Canada / Authors: Alex J. Cannon, Dae Il Jeong, Xuebin Zhang, and Francis W. Zwiers.

Table QC-94 (revised). Table of hazards associated with climate change

Hazards associated with climate change	Modification risks	Proposed adaptation measures	Comments
Operational phase			
Extreme weather events: (storms, floods, tornadoes, high winds, extreme precipitation and ice)	Increased risk of flooding	The design of the BTMA tailings management area takes climate change into consideration as well as the design flood to adequately manage the risks associated with the increase in extreme weather phenomena (rain and melting snow). **For the design of the water retention basin of the Bachelor tailings management area and its ancillary structures, an increase in extreme precipitation was taken into consideration with a 20% increase.**	The Bachelor mill site is in an area that is not very prone to flooding, being located on the top of a hill. Because it is located in a valley, the tailings management area is more prone to flooding. The BTMA is located at the head of the watersheds, which limits the risk of being affected by the flood stream. Clean water diversion ditches also limit the water supply to the BTMA.

Hazards associated with climate change	Modification risks	Proposed adaptation measures	Comments
	More frequent power outages due to increased storms, high winds and ice.	More frequent deforestation, cleaning and brush cutting in the electricity corridor. Generators in case of failure.	
	Increased risks for buildings	Existing buildings and equipment on the Bachelor site, and new ones that will be built, are in compliance with current codes and regulations to withstand overloads created by extreme weather conditions. **The anticipated impact of climate change will also be considered in the design of future buildings and the recommendations issued by government building authorities will be followed.** In addition, excessive snow and ice accumulations will be removed as needed.	**Examples of government recommendations include those contained in the *Climate-Resilient Buildings and Core Public Infrastructure Report* issued by Environment and Climate Change Canada.**

Hazards associated with climate change	Modification risks	Proposed adaptation measures	Comments
Instability of the ground	The increase in the amount of water in soils during extreme rainfall makes them more susceptible to instability. Risk of dam rupture in the event of poor design.	Stability sensitivity analyses were conducted to ensure the stability of the BTMA dikes even during periods when the water table would be higher.	
Increased periods of drought	Increased risk of forest fires	Employees will be made aware of this risk during welcome training. This risk will also be mentioned during health and safety meetings when the fire forecast index is moderate to extreme. Construction of fire barriers around the project site (as needed).	As discussed in the answer to question QC-93, climate change means that the seasons will be marked by longer and warmer growth periods, thus increasing the risk of drought and fire.
	Decrease in air quality in relation to the increase in dust carry-over associated with more violent or frequent winds and higher temperatures.	Use of dust suppressants (water or product complying with Standard BNQ 2410-300) on roads and application according to best practices recommended by Environment Canada (2007). Active monitoring of surfaces susceptible to wind washout and application of mitigation measures, as needed. Gradual restoration of bare surfaces, when possible.	

Hazards associated with climate change	Modification risks	Proposed adaptation measures	Comments
Restoration phase			
Extreme weather events: (storms, floods, tornadoes, high winds, extreme precipitation and ice)	Increased risk of flooding	The aim of the BTMA restoration concept is to allow the evacuation of water. The selected concept considers the impact of climate change since it will no longer require the management of water retention structures in the BTMA following restoration. The supernatant pond operating spillway will be redesigned (if required) to ensure that there is no accumulation of water on the tailings at all times. A breach will be made in the median dike of the recirculation basin to ensure that there is no accumulation of water in the basin at all times. It will be the same for the sedimentation basin by replacing the operation spillway of the north dike with a breach. In addition, all management-related calculations consider a provision for climate change.	All the basins (supernatant, recirculation and sedimentation) of the BTMA will be covered with organic matter to then be vegetated by hydraulic seeding.

QC2-18. On page 18 of the report "Analysis of the impact of climate change and GHG emissions" (ACS, 2019), it is mentioned that 4,824 tCO2e per year will be emitted for the transport by truck of ore between the Barry and Bachelor sites. According to the report, 48 trips per day are planned to transport the ore to the mill, which will represent a total of 316,800 km travelled per month, or 3,801,600 km per year. At the same time, the consumption of trucks was estimated at 0.625 L/km. According to our calculations, the direct GHG emissions associated with the transport of the ore would rather be 6,483.5 tCO2e per year. The proponent must therefore correct the value presented, or better justify the calculations and the results obtained.

Answer:

As described in the impact assessment, the projected use of the transportation road was based on the milling sequence envisioned, namely 30 consecutive days of ore from the Barry site, followed by a 10-day interruption during which ore from the Bachelor site will be milled (Wood, 2019, Vol. I, p. 1-3). Over the course of a year, we therefore obtain 9 cycles of 30-day ore transport followed by a 10-day stoppage, for a total of 270 days of transport during an operating year. However, as mentioned earlier in this report, it was found that the assumption that the transport would follow the milling cycles was erroneous, since there will be continuous transport, except for two weeks during the spring snow goose hunt, when transport will be interrupted, and two weeks during the moose hunt, when transportation will be reduced by at least 50%.

Furthermore, the calculation of GHG emissions associated with ore transport considered a load of 50 tonnes. This assumption had to be revised due to the actual capacity of the transport trucks and the load limitations associated with the thaw. Thus, the average load was estimated instead at 42 tonnes per trip.

Therefore, the GHG emissions attributable to ore transport have been reviewed as part of the update of the GHG report by GCM Consultants (2022) presented in Appendix QC2-18.

The revised GHG balance therefore considers that ore will be trucked 365 days a year. For a milling rate of 1,800 mt per day, this will represent 43 round trips per day during normal transport periods. This number will decrease to 32 round trips for the two weeks of the fall moose hunt, i.e. a 25% reduction of transport; and to zero (0) during the two weeks of the spring goose hunt. Therefore, the revised annual distance travelled will be 3,286,580 km. The diesel consumption of the ore transport trucks is estimated at 0.625 L/km, which would bring the annual consumption to 2,054,113 L/year, for a total of 5,560 tonnes of CO_2 eq per year.

- Fuel consumption: 0.625 L/km
- Distance between Barry and Bachelor = 110 km.
- (110 km one way + 110 km return) x ((337 days x 43 shipments per day)+ (14 days x 32 shipments per day (reduced transport)))= 3,286,580 km per year
- 0.625L/km*3,286,580 km/year = 2,054,113 litres of diesel per year
- 2,054,113 L * 2,706.6 g CO_2 eq/litre /1 x 106 g/tonne= 5,560 tonnes of CO2 eq.

QC2-19. According to the study produced by S&P Global Market Intelligence[12], which collected GHG emissions from more than 90 gold mines worldwide, the average emissions from gold mines would be 0.4 tonnes of CO2 equivalent per ounce of gold, or 14.1 tCO2e per kg of gold. The article also points out that Canadian mines, due to the higher gold content of the ore, would have lower than average emissions. On the other hand, the "Ecoinvent" database version 3.7.1 also presents the average GHG emissions of Canadian gold mines per kg of gold produced: they are 11.9 tCO2e per kg of gold. According to the document "Impact Assessment – Volume I: Main Report" (Wood, 2019), ore production from the site will be 2,400 metric tons per day and, based on the information presented in section 1.4 of the main study report, the average gold grade of the different deposits would be 5.33 grams of gold per tonne of ore (weighted average). According to these data, the annual gold production would be equivalent to:

2,400 t x 365 x 0.00533 kg gold/t = 4,669 kg/year.

For this gold production, the study produced by S&P Global Market Intelligence estimates operating emissions of 65,897 tCO2e per year, while the "Ecoinvent" database estimates operating emissions of 55,674 tCO2e per year. The project proponent estimated that the project's annual operating emissions would be 6,181 tCO2e.

Given the discrepancy with the data in the literature, the proponent must carry out a complete revision of the calculation of GHG emissions during the operation phase of the project, or present an explanation to justify the significant discrepancy between the project's emissions and average emissions from other gold projects (literature data).

Answer:

To validate the answer to this question, we repeated the calculations above. According to the study produced by S&P Global Market Intelligence, underground mines emit an average of 0.4 tonnes of CO_2/oz of gold produced. Considering that the unit of measurement for gold is the Troy Ounce, which is equivalent to 31.103 grams, the emissions are 12.86 tonnes of CO_2 eq/kg of gold produced. According to NI 43-101, the weighted average gold grade of the indicated and inferred resources for the Barry deposit would be 5.44 g/tonne of ore, while the weighted average gold grade of the indicated and inferred resources for the Moroy deposit would be 4.85 g/tonne of ore. Based on a daily production of 2,400 t/d and a milling sequence of 30 days of Barry ore followed by 10 days of Moroy ore and average gold grades for all measured, inferred and indicated resources contained in NI-43-101, the approximate annual gold production would be 2,400 t x 270 d x 0.00544 kg of gold/t for Barry and 2,400 t x 95 d x 0.00485 kg of gold/t for Moroy, for a total of 4,631 kg of gold. If the emissions are evaluated using the average value, they would be 4,631 kg of gold x 12.86 tonnes of CO_2/kg of gold produced = 59,556 tonnes of CO_2 eq. This value differs from that calculated in the question, but remains in the same order of magnitude.

With the withdrawal of Moroy, these figures must be revised to consider only the Barry site and production of 1,800 tpd 1,800 t. x 365 d x 0.00544 kg of gold/t = 3,574 kg of gold. If the emissions are evaluated using the average value, they would be 3,574 kg of gold x 12.86 tonnes of CO_2/kg of gold produced = 45,962 tonnes of CO_2 eq.

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[12] S&P Global Market Intelligence, 2020. Metals and Mining Research. Greenhouse gas and gold mines: Nearly 1 tCO2 per ounce of gold produced in 2019. Available online: https://www.ecovoice.com.au/wp-content/uploads/2020/08/SP-Global-Market-Intelligence-Greenhouse-gas-and-gold-mines-Part-1.pdf

The revised GHG report allowed to review all the sources of GHG emissions at the different phases of the project (construction, operation, closure) (see Appendix QC2-18)). The revised average annual greenhouse gas emission value is now 7,307 tonnes of CO_2 eq , with an annual value varying from 2,291 tonnes of CO_2 eq during the closure period to 12,369 tonnes of CO_2 eq during the construction period.

Although the greenhouse gas emissions are lower than what could be expected according to the calculation factors of the S&P Global Market Intelligence study, it is important to mention that, as mentioned in the said study, several factors influencing the GHG emissions including the source of electricity generation and the gold content of the ore. Therefore, it seems difficult to make a good approximation of emissions using this value which globally assesses the gold production of underground mines in the world. In fact, the proponent uses the Hydro-Québec electrical network as a source of electricity, which has a low emission rate. The revised GHG balance also considers that the furnace and the propane heating units will be converted to electricity. Moreover, the project no longer considers operation of the Moroy deposits and the operations at the Barry site are excluded from the impact assessment and the GHG balance. Finally, the withdrawal of operation of Moroy from the project implies that the underground heating system, the main propane consumer for the site, is no longer required. All these factors contribute to a considerable reduction of the project's greenhouse gas emissions.

QC2-20. It is mentioned that the capacity of the ore processing mill should be increased from 800 t/d to 2,400 t/d. However, it is not clear if this increase in tonnage at the processing mill is taken into account in the calculation of the project’s operating emissions. The proponent must provide details on the calculation of GHG emissions due to the increase in tonnage to be processed at the mill.

Answer:

To clearly illustrate how the increase in ore processing at the plant has been taken into account in the calculation of the project’s GHG emissions during the operating phase, a new detailed quantification of GHGs has been carried out by GCM Consultants in 2022 (Appendix QC2-18). This describes the changes associated with the increase in the milling rate for each of the emitting sources, for each phase of the project (construction, operation and closure).

The report details the calculations and presents a table of annual emissions for the entire project, including the expansion of the tailings pond and the increase in the milling rate, as well as a table representing only the contribution of the expansion and the increase in processing (obtained by subtracting the GHGs associated with the currently authorized operations). This allows to visualize the impact of Barry ore processing and the increase in ore processing on the overall balance of GHG emissions. The expansion of the site and the increase in the ore will cause an increase of 69,661 tonnes of CO_2 eq over the entire life cycle of the mine.

By including the activities associated with the milling rate already authorized, this brings the overall GHG emission balance to 94,994 tonnes of CO_2 eq for the life of the project.

QC2-21. Certain mitigation measures related to air quality are presented on pages 5-181 and 5-182 of the document "Impact Assessment − Volume I: Appendices" (Wood, 2019) as well as the emission reduction actions provided for on page 23 of Appendix 4-1 of Volume 2 of the impact assessment, "Impact Assessment − Volume II: Main Report" (Wood, 2019). These proposed GHG emissions mitigation measures are considered insufficient in a GHG reduction framework.

The proponent must present an opportunity study for the electrification of its mining activities. This study will specify the electrical equipment already planned for the project as well as a detailed study of the possibilities of electrification of other project activities. The proponent must also demonstrate and justify which mining activities will not or cannot be electrified.

Answer:

ASDR was commissioned by Bonterra to carry out an opportunity study for the electrification of its activities. The ASDR (2022) study report is presented in Appendix QC2-21. This study aimed to detail the opportunities for the electrification of mining activities at the Bachelor mine site in connection with the Barry ore processing project and to increase the milling rate.

Two spheres of opportunity were identified as representing the greatest potential for the electrification of mining activities since they represented the two main sources of fossil energy consumption, namely the replacement of propane heating systems and ore transport. The electrification of the light van fleet was also analyzed. Here are the study's main findings (QC2-21):

- The Bachelor/Moroy and Barry sites do present some achievable mid-to long-term electrification opportunities, although in all cases power line capacity is a major constraint.
- An agreement has been reached between Osisko Mining and the Cree First Nation of Waswanipi (CFNW) for the construction and operation of a 120 kV power line, which will be connected to the Hydro-Québec network, to supply the Windfall project. The addition of a 120 kV line in the vicinity of the Barry site would give Bonterra more alternatives, but such an addition will not improve the possibilities of electrification of the Bachelor mine site. The route for this new line is not finalized at the time of writing this document.
- At the Bachelor site, some propane heating loads may be replaced by electrical loads as soon as the client's new power supply line is in place.
- Replacing underground heating with electric heating is impractical and uneconomical for reasons of efficiency, but also electrical capacity. *However, with the withdrawal of the Moroy project, this heating system will no longer be operational, which will contribute propane consumption significantly.*
- With respect to transport by 50-tonne truck between sites, electrification of this sector is unrealistic at this time due to the lack of options available on the market and the danger of workers travelling on isolated roads.

  Some stakeholders are currently working to develop electric trucks, but these changes are not for the near future.

- As for the fleet of light vehicles, such as vans, the technology is just beginning to prove itself in urban locations, already showing failures such as drastic loss of load in winter. In addition, for an isolated region such as that where the client's sites are located, where infrastructure is very limited, the replacement of gasoline vehicles by electric vehicles represents a huge risk in terms of the safety of the users of these vehicles and the viability of this change. Also, the specialized maintenance of these vehicles requires skilled labour that is not present in the region, so the vehicles will have to be sent off-site to perform this maintenance.
- Finally, the Barry site does not currently have a power supply, which would make safe travel between the two sites difficult.

In conclusion, until technologies improve and the construction of a new power line in the vicinity of the client's sites, when the new 6.4 MW power line to the Bachelor site is in place, certain propane equipment will be replaced by electrical equipment. These concern all propane heating units, except for the one for underground heating, as well as the furnace which will be replaced by an induction furnace (electric). With the withdrawal of Moroy, the underground propane heating system will no longer be operational, which will considerably reduce the site's propane consumption. The electrification of other mining activities is not currently possible, but may be reconsidered in the future when there will be the new power line, charging stations around the sites and labour specialized in electric vehicles, and once the technology will have improved. Bonterra is also committed to remaining on the lookout for new technologies and the resulting electrification opportunities.

1.7 Contaminated lots

QC2-22. In the answer to QC-53, the proponent agrees to transmit the characterization report to the MELCC as part of the authorization request in accordance with section 22 of the EQA. The purpose of the land characterization study is to describe the environment (section 4.3 of the directive), which is part of the content of the impact assessment (section 4). The proponent must indicate, by means of a work plan or a timetable, how it intends to respect the commitment to carry out the characterization work and submit the results.

Answer:

The soil characterization work took place between November 9 and 11, 2021.

According to Schedule III of the *Land Protection and Rehabilitation Regulation*, gold ore mining (NAICS code 21222) is an activity that is likely to contaminate soil and groundwater. As such, during construction, development and/or repair of facilities, environmental characterization of the soil is notably intended to ensure the proper management of the excavated materials (soil/overburden). The environmental characterization of the soil is also required to ensure that the soil is managed properly and that the permanent facilities are not built on contaminated soil beyond the regulatory limit values applicable to the land depending on the activity.

Another of the objectives of the study was to describe the quality of the soil on the outskirts of the operations before the expansion of the site and the increase in the milling rate. Particular attention was also paid to the validation of airborne contamination risks.

The soil characterization report presenting the work and the results is presented in Appendix QC2-22 and includes a description of the sampling strategy and the methodology used, the analysis of the results and the conclusions.

All the soil samples taken were found to be below criterion C of the Guide d'intervention [Intervention guide] and the limit value of Appendix II of the RPRT, i.e. the acceptable limit for industrial land.

For petroleum hydrocarbons (C10-C50), PAH and VOCs, all collected samples were below the detection limit. No visual or olfactory signs of contamination were observed at the various sampling points.

QC2-23. In the answer to QC-54, the proponent indicates that if the soil must be excavated, it will have its C_{10}-C_{50} PH content assessed. If there are no petroleum hydrocarbons, the soil will be transported to the tailings management area.

Unless a justification is provided by the proponent, the soils must be analyzed not only for C_{10}-C_{50} PH, but for all the contaminants which, according to the ESA Phase I, are likely to be found in the excavation area. The proponent must present the management measures planned based on these results.

Answer:

The soil characterization results (Report ENV0266-1514-00, Appendix QC2-22) indicate that for all the analysis parameters, i.e. metals, sulphur, C_{10}-C_{50} PH and cyanide, the results are lower than the criterion C of the *Guide d'intervention* [Intervention guide] and the limit value of Appendix II of the RPRT, i.e. the acceptable limit for industrial land. Consequently, the soil does not have to be sent off-site to an authorized site and will be sent to the tailings management area. However, since some parameters present results within the B-C range, they cannot be reused for the expansion of the infrastructures.

In addition, in the event that olfactory or visual signs of contamination are discovered during excavation work, Bonterra will carry out analyses and dispose of hydrocarbon-contaminated soils at an authorized location. Bonterra will also ensure that the regulations in force are respected throughout the process (declaration, storage of contaminated soils, etc.).

QC2-24. In section 3.1 of the Environmental Site Assessment - Phase I (ESA Phase I), it is mentioned that Bonterra holds a mining concession (CM-510) with an area of 16.08 m² and a mining lease (BM-1025) with an area of 83.44 m². The unit used seems wrong. The proponent must confirm the total area of the land under study or according to each lot.

Answer:

The area of the mining concession (CM-510) is 16.08 ha. As for mining lease BM-1025, it covers an area of 83.44 ha. The unit was incorrect. A new version of the environmental assessment is presented in Appendix A of the soil characterization report attached to Appendix QC2-22 and incorporates the unit correction.

QC2-25. In section 3.1 of the ESA Phase I, the 2018 soil and groundwater status study conducted by Wood as part of the remediation attestation recommends obtaining accidental spill reports if they exist. The proponent must indicate whether this research has been carried out and, if so, present the results of the research.

Answer:

The spill reports for the years 2018, 2019 and 2021 are presented in Appendix QC2-25. No reports were completed in 2020 as there were no spills reported during that year. On these reports, the spill volumes are indicated or approximated.

QC2-26. In section 6.0 of the ESA Phase I, Environmental Site Assessment - Phase I, it is mentioned that the potential contaminants associated with a risk of airborne contamination and the presence of backfill are metals. Unless a justification on the source of the backfill is provided, these must at least be analyzed for metals, C_{10}-C_{50} PH and PAH. For airborne contamination, considering the ore treatment process, the minimal addition of parameters such as sulphur or cyanides to the characterization plan is recommended. Risk areas associated with the presence of backfill or airborne contamination must be indicated on the plan.

Answer:

A characterization of the backfill was carried out as part of the soil characterization study (Appendix QC2-22) to cover the risks of soil contamination by mining operations. The targeted sectors mainly targeted sectors targeted for building expansions or the addition of infrastructure. Metals, C_{10}-C_{50} petroleum hydrocarbons and PAHs were analyzed for all backfill samples.

In addition, surface samples were taken from various locations around the site to assess the risks of airborne contamination. Metals, C_{10}-C_{50} petroleum hydrocarbons, PAHs, sulphur and cyanide were analyzed.

The sampling results do not show any particular risk areas associated with the presence of backfill or airborne contamination. Therefore, these did not have to be included on a map in the report.

QC2-27. The ESA Phase I recommends characterizing the initial state of the site according to the Guide d'intervention – Protection des sols et réhabilitation des terrains contaminées. Unless it is demonstrated by the ESA Phase I that areas have never been subject to any risk associated with anthropogenic activities, including airborne contamination, normally the characterization of the initial state is not required for this project.
If the characterization of the initial state of the site is justified or carried out on a voluntary basis, it must be carried out in accordance with the Guide de caractérisation physicochimique de l'état initial des sols avant l'implantation d'un projet industriel.[13]

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[13] Ministère du Développement durable, de l'Environnement et de la Lutte contre les changements climatiques (MDDELCC), 2015. Guide de caractérisation physicochimique de l'état initial des sols avant l'implantation d'un projet industriel, Québec. Direction des lieux contaminés. 26 pages and 2 appendices. Available online: http://www.environnement.gouv.qc.ca/sol/terrains/guide/caracterisation-avant-projet-industriel.pdf

Answer:

A soil characterization was carried out and the results are presented in the ENV0266-1514-00 report) (Appendix QC2-22). Since this is an existing industrial site, it was not possible to exclude the risks of contamination linked to anthropogenic activities, including airborne contamination. Consequently, the characterization of the soil was carried out in accordance with the Guide d'intervention – Protection des sols et réhabilitation des terrains contaminées [Intervention guide – Soil protection and rehabilitation of contaminated soils], but no characterization of the initial state of the site was carried out.

1.8 Residual Materials Management

QC2-28. In section 3.6 of the document “Impact Assessment – Answers to questions and comments by COMEX” (GCM Consultants, 2020) (QC-28 to QC-36), the proponent refers to the Lignes directrices relatives à la gestion de béton, de brique et d'asphalte issus des travaux de construction et de démolition et des résidus du secteur de la pierre de taille (guidelines for the management of concrete, brick and asphalt resulting from construction or demolition work and tailings from the stone sector).[14] However, since December 31, 2020, construction and demolition debris consisting of crushed stone, concrete, brick or asphalt can be reclaimed under section 284 of the *Regulation respecting the regulatory scheme applying to activities on the basis of their environmental impact* (REAFIE) and in accordance with the *Regulation respecting the reclamation of residual materials* (RVMR).

Answer:

Granular residual materials will first be recovered on the Bachelor site according to the methods authorized by section 284 of the *Regulation respecting the regulatory scheme applying to activities on the basis of their environmental impact* and in accordance with the *Regulation respecting the reclamation of residual materials*.

If it is not possible to reclaim them according to these regulations directly on the site, the materials will be sent to a duly authorized processing centre.

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[14] Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), 2009. Lignes directrices relatives à la gestion de béton, de brique et d'asphalte issus des travaux de construction et de démolition et des résidus du secteur de la pierre de taille, Québec, Ministère du Développement durable, de l'Environnement et des Parcs, Direction des politiques en milieu terrestre, ISBN 978-2-550-56288-7, 51 pages. Lignes directrices relatives à la gestion de béton, de brique et d'asphalte issus des travaux de construction et de démolition et des résidus du secteur de la pierre de taille (gouv.qc.ca)

QC2-29. Section 1.4.1.9 of Appendix Q75 mentions that the Bachelor site has a final disposal site for the storage of residual non-hazardous materials. The concept of final disposal sites is not found in the *Regulation respecting the landfilling and incineration of residual materials* (REIMR). Storage of domestic residual materials can be done in containers before being directed to a disposal facility governed by the REIMR, but residual materials cannot be disposed of directly on the grounds of the Bachelor mill.

In addition, the proponent mentions that no additional requirements to those contained in the REIMR will be required for the storage of non-hazardous residual materials. However, there are no storage standards in the REIMR. Reference is also made to the *Regulation respecting solid waste*. This reference is no longer valid since this regulation has been replaced by the REIMR.

The proponent must specify what it means by final disposal site for the storage of residual non-hazardous materials.

Answer:

The proponent does not have a final disposal site. Confusion may have arisen in wanting to designate the waste disposal centre of Lebel-sur-Quevillon.

The sorting and storage method before being transported to the various reclamation or landfill sites is as follows.

Materials are sorted at source, directly on the work site. For example, underground, if a wood residue is designated as non-compliant and must be eliminated, it is analyzed to verify whether or not it is free from contamination. If contamination is present, the residue is placed directly in a dedicated bin for hazardous materials. If part of the wood residue is contaminated, the contaminated part is removed and placed in the same bin. Non-contaminated residues are placed in a bin dedicated to the recovery of wood. The same goes for other materials (garbage, hazardous materials, explosives). They are all sorted at the source. Everything is brought to the surface and is transported to dedicated storage areas, such as a garbage container, a container at the hazardous materials warehouse, a container for explosive packaging, or in the wood pile to be recovered before being disposed of at an authorized site.

The same procedure is applied to the surface; residual materials are sorted at source (garbage, hazardous materials, wood, explosives packaging) and are stored in identified containers or in piles for uncontaminated wood.

The recovered uncontaminated wood is sent to the Chapais cogeneration plant, the non-hazardous residual materials are sent to the Lebel-sur-Quevillon waste disposal centre and the hazardous residual materials are recovered by a specialized company such as GFL Environmental (Terrapure).

QC2-30. Contrary to section 1.4.1.9, which is quite vague on the disposal of residual materials, section 3.8.4 of Appendix Q75 specifies that residual materials, i.e. domestic residual materials that cannot be recovered, will be stored in containers and transported monthly to the trench landfill site (TL) of Lebel-sur-Quévillon. This management complies with the REIMR. The proponent must clarify whether the residual materials from the Bachelor site are already sent to this LT with its approval. Otherwise, the proponent must provide a document confirming the technical landfill's agreement to receive residual non-hazardous materials from the Barry and Moroy Projects.

Answer:

Domestic residual materials from the Bachelor site are already sent to the TL in Lebel-sur-Quévillon with its agreement.

QC2-31. In section 7.2 of the document "Addendum – Answers to questions and comments by COMEX" (GCM Consultants, 2021) and the answer to QC-32 of the document "Impact Assessment – Answers to questions and comments by COMEX" (GCM Consultants, 2020), reference is made to the recovery of wood for restoration purposes. The proponent indicates that the wood it will use will not be contaminated. However, it is important to specify what the MELCC recognizes as uncontaminated wood. Uncontaminated post-consumer wood should be free of varnished, painted, stained, treated or engineered wood, wood from oriented strand board, plywood or particle board. Cut wood, branches, stumps, bark and pieces of bare wood are also considered uncontaminated. Recoverable wood must be sorted before it is stored, since certain types of wood will no longer be identifiable over time. Sorted materials must be stored in clearly identified separate spaces.

For information, the reclamation of residual materials as well as the storage prior to this activity require an authorization under section 22, subsection 8 of the EQA. For the reclamation of other types of wood, the applicant must contact the MELCC to validate the types of admissible wood, the sorting and storage process as well as the additional analyzes required according to the contaminants suspected in these types of wood.

Answer:

There are two categories of wood generated on the site: post-consumer wood and woody material. Post-consumer wood came mainly from wood used in underground drifts (e.g. floor and wooden pallets), storage of core samples and camps (trailers). It may or may not be contaminated. As underground mining operations have ceased, the amount of post-consumer wood will be negligible. The second category concerns woody material generated during deforestation or brush-clearing operations.

In general, post-consumer wood is dismantled to be temporarily disposed of in an area intended for this purpose. Subsequently, this wood is visually examined to detect the presence of oil. This visual inspection step ensures the segregation of contaminated post-consumer wood from the uncontaminated wood in order to direct the contaminated wood to the storage area for contaminated residual materials (solid oily debris). Contaminated materials are grouped in a bin for recovery by the company GFL Environmental (Terrapure).

Uncontaminated post-consumer wood is stored in the woody material accumulation zone to be transported to a place authorized by the REIMR. This wood is generally transported to the Chapais cogeneration plant to recycle them.

Woody material is generally shredded and reused on site. However, it is possible that volumes of commercial wood, depending on the quantity and size, are logged and piled temporarily to be recovered by forestry companies. Appendix QC2-31 presents the location of the storage sites for all the materials generated on the Bachelor site according to their classification.

Finally, it should be noted that Bonterra does not intend to set up a process for the reclamation of non-contaminated ligneous residues, as defined by section 22, 8th paragraph of the EQA.

Table QC2-31-1 on the following page presents the different categories of wood generated by operations and their management methods.

Table QC2-31-1. Reclamation of wood

Material	Source	Maximum stored quantity	Storage location	Reclamation method
Woody materials	Surface	Variable depending on the scope of the work to be carried out (estimate of the order of 3000 m^3/year)	Refer to the image presented in Appendix QC2-31, illustrating the new temporary storage location	Shredding by an external company when the quantity stored is close to the maximum, reuse on site or transport to a reclamation company: Barette-Chapais company or other authorized disposal site
<u>Uncontaminated</u> post-consumer wood	Clean pallets, support timber used in underground drifts, etc.	Variable depending on the scope of the work to be carried out (according to the annual reports produced over the past three years, a maximum volume of around 1,000 m^3/year is estimated	Refer to the image presented in Appendix QC2-31, illustrating the new temporary storage location	Transported to a reclamation company: Barette-Chapais company or other authorized disposal site
Contaminated post-consumer wood	Pallets, support timber used in underground drifts, etc. containing oil or hydrocarbon residues	About 43 m^3/year (estimated)	Refer to the image presented in Appendix QC2-31, illustrating the storage location for residual hazardous materials (RHM)	Recovered by a specialized company (e.g. GFL Environmental (Terrapure))

1.9 Accident and malfunction risk management

QC2-32. To clarify and group together in the same table information pertaining to the storage of certain hazardous materials, the proponent must update Table 7-2. Chemicals used at the Bachelor site of the document "Impact Assessment − Volume I: Main Report" (Wood, 2019) to add or correct the following elements:

- Add a column to present the previously authorized quantities of stored hazardous materials (in metric tons);
- Present the additional quantities of hazardous materials stored as part of this application for authorization (in metric tons);
- Add a column to specify the storage method for each hazardous material;
- Specify the type of cyanide that will be used (e.g. sodium cyanide);
- Add a column to specify the concentrations of each hazardous material;
- Add rows to the table for stored explosives.

Answer:

Table 7-2 has been modified to include the additional data requested. The revised version is included in Appendix QC2-32.

QC2-33. In QC-85, the proponent was asked to present the potential consequences on the human population of the accidents and malfunctions listed in Table 7-1 of the document "Impact Assessment − Volume I: Main Report" (Wood, 2019). In response to this question, the proponent does not present the risks to human health for several of these accidents and malfunctions. In addition, according to the summary map of sensitive elements presented in Appendix 10 of the document "Addendum – Answers to questions and comments by COMEX"

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(Bonterra, 2021), permanent Cree camps are located approximately 1.5 – 2.0 km from the site of the expansion project and the explosives storehouse.

Therefore, the proponent must:

- Present and provide details on whether there are possible risks to human health (injury, mortality, etc.) for the population near the project site in the event of a risk of a major technological accident caused by the hazardous materials, provided for in this project, having a high level of danger such as, but not limited to, acetylene, cyanide and propane. In the event that such risks cannot be ruled out, the proponent must present and provide quantitative details on the possible impacts envisaged concerning major technological risk accidents for these hazardous materials.
- Following the previous point, present the additional emergency measures necessary for these accident risks.

Answer:

A technological risk analysis was carried out by MF Environnement (Appendix QC2-33). As part of this exercise, a complete review of operations, sensitive receivers, their location, hazardous materials and the process was carried out to assess internal and external hazards. This analysis led to the identification of 14 standardized accident scenarios and 3 alternative scenarios.

The alternative accident scenarios correspond to situations that are more likely to occur and consider passive and active mitigation measures.

The purpose of assessing the consequences of standard and alternative scenarios is to determine the distances at which the effect of hazards attributable to an accident could be felt. The danger zone is therefore a circle around the accident site. This validation was carried out by modelling using the ALOHA software.

The risk analysis confirms that the individual risk is acceptable according to MIACC criteria, taking into account the mitigation measures planned or already in place, which are based on the requirements of the current standards. Therefore, additional risk reduction measures are not recommended.

However, attention should be paid to the following measures:

1. Ensure adequate maintenance of BTMA dikes.
2. Ensure that the cyanide monitoring systems (detection system) and pH at the various basins of the plant are well maintained according to the manufacturer's specifications and that they are functional.

QC2-34. In section 7.2 of the document "Impact Assessment – Volume I: Main Report" (Wood, 2019), the proponent mentions that certain activities of its project entail a risk of forest fire. The proponent must specify the emergency measures planned in the event of a forest fire and undertake to add them to its "Environmental Emergency Response Plan" presented in Appendix 7-1 of the same document.

The proponent must also indicate whether it has an agreement with the Société de protection des forêts contre le feu (SOPFEU) or if one is required.

Answer:

The Emergency Measures Plan (EMP) for the Bachelor site is currently being revised. This revised version will include a section on fires based on the procedures provided for in the Barry site EMP in the event of a fire (Bonterra, 2022; Appendix QC2-34).

Currently, the proponent does not have a specific agreement with SOPFEU. However, as mentioned in the Barry site EMP, in the event of a fire threatening the forest, SOPFEU will be notified directly and their instructions for evacuation will be followed. The same is true for the Bachelor site.

The proponent undertakes to revise the Bachelor EMP when applying for a certificate of authorization under section 22 of the EQA.

QC2-35. In Appendix Q17 of the document "Impact Assessment – Answers to questions and comments by COMEX" (GCM Consultants, 2020), the proponent presents the list of all the Material Safety Data Sheets for the products used in the context of their activities. The proponent must commit to adding these Material Safety Data Sheets to its "Environmental Emergency Response Plan."

Answer:

Instead of including all of the material safety data sheets for the products used in their activities in its "Environmental Emergency Response Plan," the proponent proposes to include the list of its products used as well as a reference to the effect that the safety data sheets (SDS) of the products listed in the list are grouped together in the binders accessible to employees. The physical location of the binders containing all SDS and the frequency of data updates will be indicated in the Environmental Emergency Response Plan. The update of the Environmental Emergency Response Plan will be presented when applying for a certificate of authorization under section 22 of the EQA.

QC2-36. The proponent must specify whether all current and future hazardous materials tanks comply with section 56 of the Regulation respecting hazardous materials, i.e. with the exception of double-walled tanks equipped with an automatic leak detection system between the walls and tanks that have a watertight basin that can contain 110% of the capacity of the tank, that all aboveground tanks are placed in a location with a watertight tank that can contain 110% of the capacity of the tank or, if there are several tanks, 125% of the capacity of the largest tank (can only be placed inside the same basin as the tanks containing materials that are compatible).

Answer:

Bonterra confirms compliance with the provisions applicable to the storage of current and future hazardous materials in a tank (s. 56 of the Regulation respecting hazardous materials) as the case may be. Table QC2-36-1 presents the characteristics of the tanks present on the site. They are all equipped with pressure gauges to detect leaks.

Table QC2-36-1. Characteristics of the tanks present on the site

Hazardous material tanks	Location	Number	Tank capacity	Retention basin capacity
Propane	Underground heating (this tank will be removed from the site)	1	18,000 gallons	None/double walls
	Crushers	1	2,000 gallons	None/double walls
	Refinery	1	1,000 gallons	None/double walls
	Garage	3	420 L	None/double walls
	Dry house	1	2,000 gallons	None/double wall
	Core bank	1	1,000 gallons	None/double wall
	Kitchen	1	1,000 gallons	None/double wall
Cyanide	Door #8 inside the mill	1	45,400 L	None/double wall
Lime	Door #8 inside the mill	1	43 t	None/double wall
Diesel	Backyard	1	22,700 L	None/double wall
	Backyard	1	14,496 L	Unknown

Hazardous material tanks	Location	Number	Tank capacity	Retention basin capacity
Used oil	Garage	1	2,000 L	3,000 L/retention basin
Gasoline	Backyard	1	4,500 L	None/double wall
	Backyard	1	4,550 L	None/double wall

It should be noted that section 56 of the Regulation respecting hazardous materials does not apply to tanks that cannot contain more than 2,000 kg of materials.

In addition, above-ground tanks that can contain more than 20,000 litres of current and future hazardous materials are equipped with an automatic continuous inventory device and a spill prevention device as specified in section 57 of the Regulation respecting hazardous materials.

QC2-37. In section 7-4 of the document "Addendum – Answers to questions and comments by COMEX" (Bonterra, 2021), the proponent mentions that the quantity of explosives stored and used will be increased. The proponent must:

- Mention the maximum total quantities provided;
- Confirm that the instructions of Natural Resources Canada for the storage of explosives, in particular with regard to the quantity/distance principle, remain respected with the increase in the quantity of stored explosives;

Specify whether the increased storage and use of explosives affect the risk incurred by the surrounding population and if so, to what extent.

Answer:

As mentioned in the GHG quantification study (Appendix QC2-18), it is no longer planned to use explosives in the operational period of the ore processing mill, because there will be no mining on the Bachelor site, due to the abandonment of extraction of the Moroy deposit. However, there will be a small quantity of explosives used during the construction period. In fact, explosives will have to be used during construction of the south access road and during expansion of the tailings storage area. The use of explosives is estimated at less than the quantity used during an operating year at the extraction rate of 800 T (372,150 kg of explosives).

Bonterra undertakes that the prescriptions of Natural Resources Canada for storage of explosives will continue to be respected.

1.10 Archaeological potential

QC2-38. In QC-65, the proponent was asked to provide the two archaeological potential studies that are relevant to the analysis of the file. These documents are:

- CHRÉTIEN, Y. (2011) Étude de potentiel archéologique pour l'étude d'impact environnemental et social du projet d'exploitation et de traitement du minerai d'or du site minier Bachelor by Ressources Métanor inc. in Desmaraisville, Étude de potentiel archéologique (study of archaeological potential), 49 pages.
- Archéo-Mamu (2018) Subject: Characterization of the archaeological potential on the route of the path linking the Barry and Bachelor sites.

Only the reference from Chrétien (2011) has been submitted. Although the proponent indicates that the text of Archéo-Mamu was integrated directly into the impact assessment, there is a lack of information on the methodology used to carry out the characterization of the archaeological potential on the route of the path linking the Barry and Bachelor sites. The proponent must therefore present the document (Archéo-Mamu, 2018) in its entirety.

Answer:

Archéo-Mamu was contacted on February 25, 2022 and Jean-Simon Labbé, Managing Director of the firm, confirmed that the text written in 2018 by François Guindon, Ph.D., former director of the firm at the time of writing the impact assessment, would have been integrated directly into the impact assessment. Therefore, an independent report would not have been produced. However, the text that had been prepared by Mr. Guindon was obtained and is presented in Appendix QC2-38. The alignment between the texts was verified and, although one methodology section is not clearly identified, the method is found in the text of section 4.2.5 of the impact assessment (Wood, 2019). It contains the following elements:

- Consultation of an existing archaeological study, including the Bachelor Site (the biophysical study area]hereinafter BSA] nearby) (Chrétien, 2011)
- The firm Archéo-Mamu Côte-Nord was solicited to characterize the archaeological potential within a radius of 100 metres around the culverts to be repaired. To realize this potential, the following data was consulted:
  - Field photographs
  - Recent satellite photographs
  - Topographic plans
  - Online database of the Inventaire des sites archéologiques du Québec (ISAQ, 2018), and Map 006.

1.11 Wetland offset project

QC2-39. In section 5.7.4 of the document “Impact Assessment – Volume I: Main Report” (Wood, 2019), the proponent planned to transform the submerged portion as well as the BTMA water basins into marshes with areas of open water. This would have allowed the creation of an interesting wetlands complex for both the reproduction and the migration of waterfowl. In Appendix 6 of the document “Addendum – Answers to questions and comments by COMEX” (Bonterra, 2021), it is indicated that the option of transforming the tailings management area into a marsh during the closure period was not selected because the conservation of bodies of water in a tailings accumulation area increases the risk of failure, especially in the context of climate change.

To compensate for the loss of wetlands and bodies of water associated with its project, the proponent proposes to create a wetland in an impacted environment near an existing borrow pit. The proposed development covers only a small area compared to the anticipated loss of wetlands.

The proponent must commit to submitting a complete offset plan for wetlands or bodies of water, for approval, within a maximum period of one year following the authorization of the project, if applicable. This plan must present, non-exhaustively, the assessment of losses/gains in area, cartography or plans, the value and ecological functions of the proposed projects, monitoring of new environments, and any other information deemed relevant.

The proponent must also indicate the stakeholders consulted during the development of the offset plan, in particular the communities, tallymen and users of the territory.

Answer:

The proponent commits to submitting a complete offset plan for wetlands or bodies of water, for approval, within a maximum period of one year following the authorization of the project. This plan will include, non-exhaustively, the assessment of losses/gains in area, cartography or plans, the value and ecological functions of the proposed projects, and monitoring of new environments. Stakeholders such as local communities, tallymen and land users will be consulted during the process of developing the compensation plan. At the time of writing, the proponent has consulted Maggy Blacksmith, Steven Blacksmith and Joshua Blacksmith to this effect during the Harmonization Committee meetings. During the discussions, suggestions were made that were not applicable to the project. However, the proponent will continue to communicate with the community about this.

With the optimizations and modifications made to the project, the area of the wetlands affected by the project was revised. A map superimposing the revised projected infrastructure on the wetlands was produced and the wetland areas in the project's right of way were recalculated. The map can be consulted in Appendix QC2-39. For each infrastructure, the following rights of way were considered :

- South access road (class 1): A width of 35 metres was considered.
- Mill and warehouse buildings: No expansion required; the existing areas remain unchanged.
- Overburden dump: it will be possible to develop the overburden dump from the interior, from the access road to the outer limits of the dump. Construction and operations therefore may be performed from spaces already deforested. This practice will limit deforestation and the impacts on natural environments. Therefore, only the right of way was considered.
- Tailings management area: the expansion area, and a 15-metre buffer zone around the limit of the planned infrastructure were considered to allow construction equipment to circulate and operate.

The wetland and water environment areas that will be affected by the revised project are broken down as follows:

- Tree swamp: 0.41 ha
- Shrub swamp: 0.24 ha
- Littoral environment: 1.42 ha
- Forested bog: 2.84 ha
- Open bog: 0.15 ha

Open bog in regeneration: 1.71 ha

Total: 6.76 ha

QC2-40. In the answer to question QC-19 of the document “Impact Assessment – Answers to questions and comments by COMEX” (GCM Consultants, 2020), the proponent presents the steps taken to ensure that it has enough equipment for the work that may require various materials. The developer has four non-exclusive leases (BNE) to its credit. The volumes of materials available are presented for only one of the four borrow pits, namely borrow pit BNE23822. As the operation of this borrow pit is coveted by another mining company, the volume of material from this borrow pit will not meet the demand. The proponent must present the volumes of materials available for all the other active BNEs to ensure the availability of materials while including a cartographic representation of the four borrow pits at a scale allowing the borrow pits and the surrounding environments to be clearly seen.

Answer:

Bonterra is committed to supplying the volume of materials available for all of its active non-exclusive leases (BNEs).

The compilation of the volumes will be completed following the survey work for each of the borrow pits (active BNE) and the results will be presented when applying for authorization under section 22.

Bonterra further undertakes to:

- Have Bonterra’s active BNEs surveyed to ensure there is enough material to build the planned paths.
- Obtain all the authorizations necessary for the new pits required for the needs of the project, if the current pit proves to be insufficient. Note that Bonterra has already targeted other potential borrow pits in the vicinity.

Note that the geotechnical studies carried out as part of the studies for the design of the tailings management area expansion revealed that a potential of interesting construction materials was found in the footprint of the expansion of the tailings management area. As such, Bonterra plans to use some of this material for the construction of the tailings management area expansion. Excess material will be stored on the overburden stockpile.

1.12 Monitoring of the condition of the use of the territory

QC2-41. In section 1.4.2.10, of Appendix 9 of the document “Addendum – Answers to questions and comments by COMEX” (Bonterra, 2021), the proponent mentions that a register will be created to monitor wildlife and user safety. The proponent must specify to whom the results of this register will be communicated. The proponent must also specify what measures are planned in the event of a high number of complaints from land users or a high number of wildlife-related incidents.

Answer:

A register will be created in 2022 and communicated to the environment department, which will be responsible for it. It will be reported in the monthly management report. The observations will also be incorporated into the annual report that is sent to COMEX each year, in addition to being presented to the harmonization committee with Waswanipi. Each accident involving an animal will be reported to the environment department, which will issue an event report following the analysis of the situation.

Recommendations will be made to the management who will take the measures deemed necessary to avoid or reduce the repetition of similar events.

In the event of a high number of complaints from land users or a high number of wildlife-related incidents, the proponent will call a meeting with the harmonization committee as well as the GIR table of the appropriate sector and will discuss the strategy to be adopted to solve the problem.

QC2-42. The proponent must provide a schedule of meetings it plans to hold with stakeholders, including tallymen and their families over the next few months, as well as the frequency of meetings planned during the years of operation.

Answer:

In 2022, the proponent met with the following tallymen: Lot 19 on 24-02-2022 from 11 a.m. to 11:44 a.m., W25A on 23-02-2022 from 3 p.m. to 3:54 p.m., W25B on 28-02-2022 from 2 p.m. to 2:46 p.m., Waswanipi Vice Chief and their delegation on 02-03-2022 from 3 p.m. to 4:35 p.m. The proponent resumed the harmonization committee on July 18, 2022, at a frequency of at least twice a year. If the Waswanipi Indigenous entity or the proponent requires additional meetings, they will be added to the schedule. The means of communication in place is email at community@btrgold.com.

It should be noted that the promoter has a socio-economic agreement at Bachelor with the Crees. A Memorandum of Understanding (MOU) is in place for the negotiation of an Impact and Benefit Agreement (IBA) with the Crees for all Bonterra projects. An agreement with the committee for maximizing economic benefits with the city of Lebel-sur-Quévillon (LSQ) was concluded, following a meeting with the mayor of LSQ. Two letters of support from the community (LSQ and the Crees of Waswanipi) have been added to Appendix 3.

1.13 Emergency response plan

QC2-43. In the answer to question QC-134, the proponent indicates that the information relating to the coordination procedures with the health system in the event of incidents with a high number of victims who could require the evacuation of patients by ambulance or by air will be added to a separate health and safety procedure. In addition, the proponent has indicated that it will communicate with the Cree Board of Health and Social Services of James Bay and with the health services of Lebel-sur-Quévillon when developing this procedure.

The proponent must communicate with the Cree Board of Health and Social Services of James Bay and with the health services of Lebel-sur-Quévillon and provide details of the planned coordination with the health system in the event of incidents with a high number of victims who could require evacuation of patients by ambulance or air.

Answer:

The proponent contacted the Lebel-sur-Quévillon service point of the CRSSS de la Baie-James. In the event of an incident where there are several injuries, 9-1-1 must be called to assist in coordinating evacuations, transporting the injured and directing them to the various care centres (Waswanipi Health Centre or Lebel-sur-Quevillon Hospital Centre). The Waswanipi Health Centre is part of the Cree Health Board organization and offers services similar to a Family Medicine Group (FMG), without a doctor present at all times.

Although agreements are possible for fires, this is not a medical centre that can treat multiple casualty emergencies. However, it could be asked to contribute if recommended by 9-1-1 authorities. For its part, Centre Hospitalier de Lebel-sur-Quevillon has an emergency and triage scale. It is able to receive casualties and coordinate transport by air or ambulance to another hospital once stabilized. An evacuation and transport protocol for casualties will be produced and appended to the Emergency Measures Plan for each of the proponent’s sites. It will be presented when applying for authorization to build the mining infrastructure. The protocol will be produced using the example provided by the CRSSS de la Baie-James, which can be consulted in Appendix QC2-43.

2.0 CONCLUSION

To ensure compliance with the commitments contained in the impact assessment and in the answers to COMEX questions, Bonterra has set up a table for monitoring commitments which will be updated regularly. This table is attached to Appendix 4.

3.0 REFERENCES

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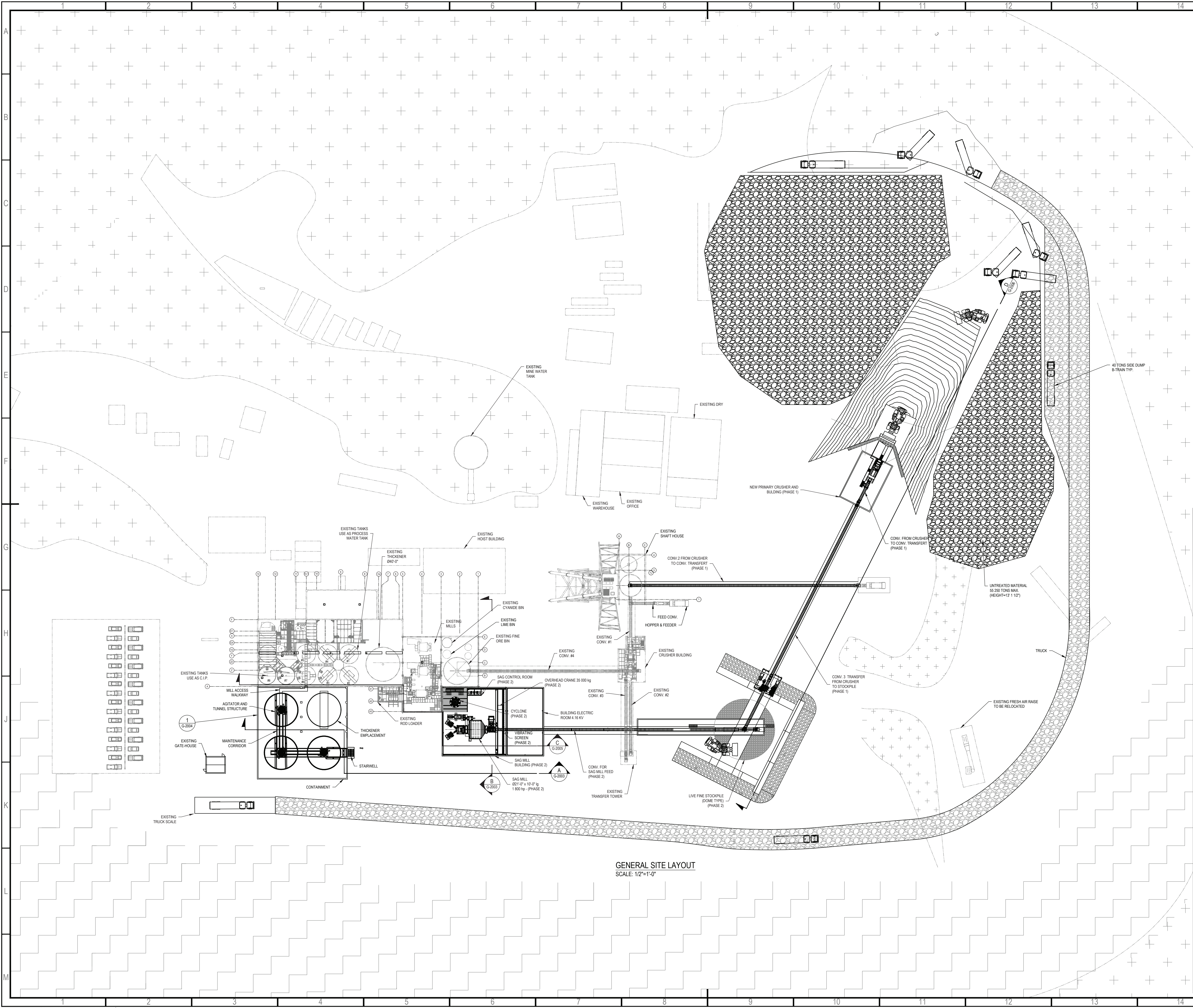
APPENDIX 1

MODIFIED INFRASTRUCTURE PLANS



GENERAL SITE LAYOUT

SCALE: 1/2"=1'-0"

ASDR
FOR PERMIT
DO NOT USE FOR CONSTRUCTION

SEAL & SIGNATURE

INGÉNIEUR Martin Lessard 135055 QUÉBEC
2022-09-30

REV.	DATE	DESCRIPTION	BY	VER.	APP.
P1	2022-09-30	FOR PERMIT	ABA	ABA	ML
P0	2022-06-28	FOR PERMIT	W.S	APHG	APHG
ZC	2022-06-23	FOR COMMENTS	W.S	APHG	-
ZB	2022-04-26	IN PROGRESS	W.S	APHG	-
ZA	2022-03-10	IN PROGRESS	APHG	APHG	-

CLIENT

BONTERRA

INFO CLIENT	10636 - BONTERRA RESSOURCES

ASDR

DRAWN BY	WILLIAM ST-AMAND
VERIFIED BY	ADAM-PIERRE H. GAGNON, ing.
APPROVED BY	ADAM-PIERRE H. GAGNON, ing.

CREATION DATE	SCALE	PROJECTION
2022-03-10	INDICATED	

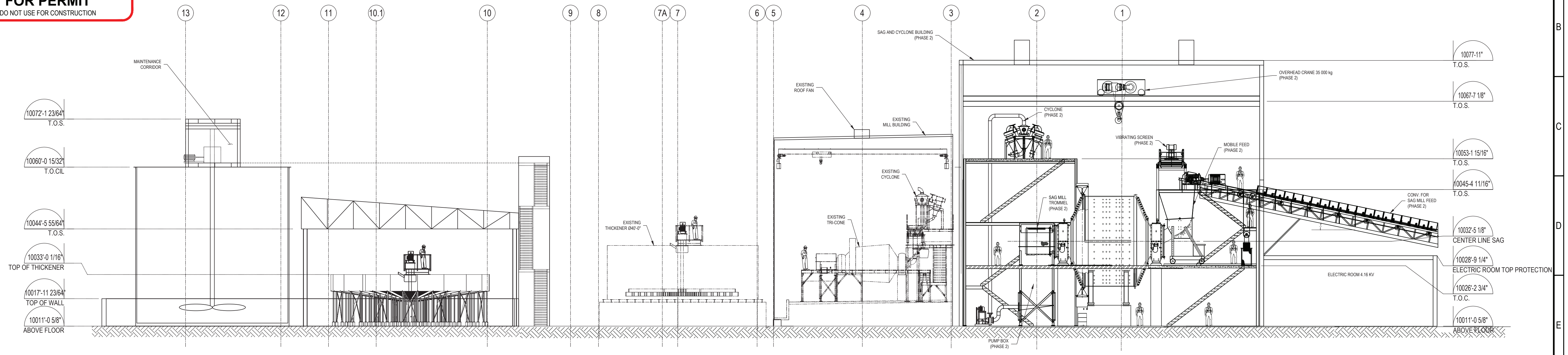
DRAWING TITLE

SURFACE AREA
GENERAL
GENERAL LAYOUT - 1800 TPD
URBAN-BARRY PLANT

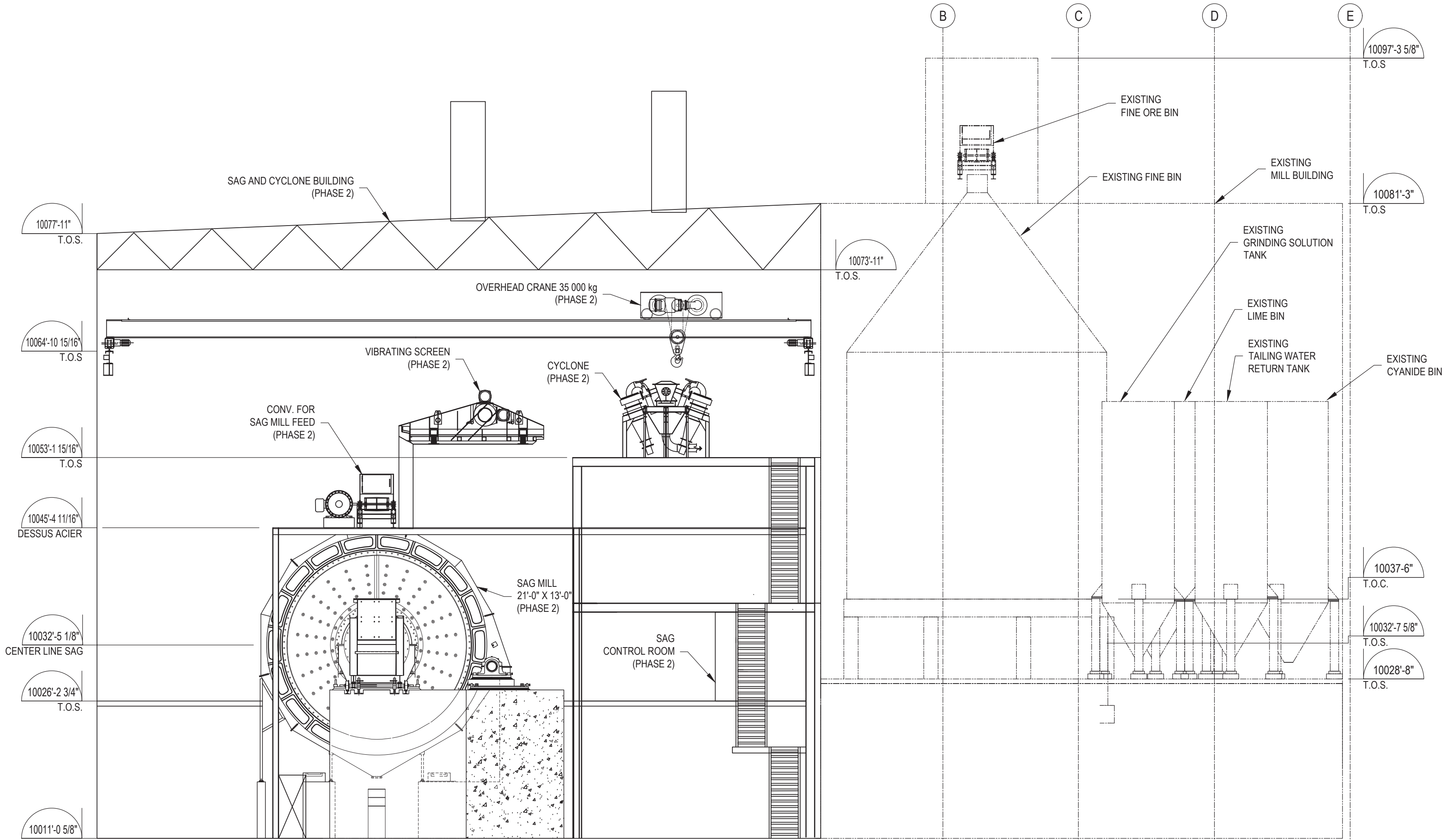
PROJECT #	DRAWING #	REV.	SHEET
10636	5000-000-G-2002	P1	1/1

SECTOR–LEVEL – DISCIPLINE – SEQUENTIAL #

ASDR
FOR PERMIT
DO NOT USE FOR CONSTRUCTION



SECTION A
SCALE: 2"=1'-0" G-2002



SECTION B
SCALE: 3"=1'-0" G-2002

SEAL & SIGNATURE

Martin Lessard 135055 2022-09-30

P1	2022-09-30	FOR PERMIT	K.B.	A.B.A.	M.L.
P0	2022-06-28	FOR PERMIT	W.S	APHG	APHG
ZC	2022-06-23	FOR COMMENTS	W.S	APHG	-
ZB	2022-04-26	IN PROGRESS	W.S	APHG	-
ZA	2022-03-10	IN PROGRESS	APHG	APHG	-
REV.	DATE	DESCRIPTION	BY	VER.	APP.

CLIENT

BONTERRA

INFO CLIENT	10636 - BONTERRA RESSOURCES

ASDR

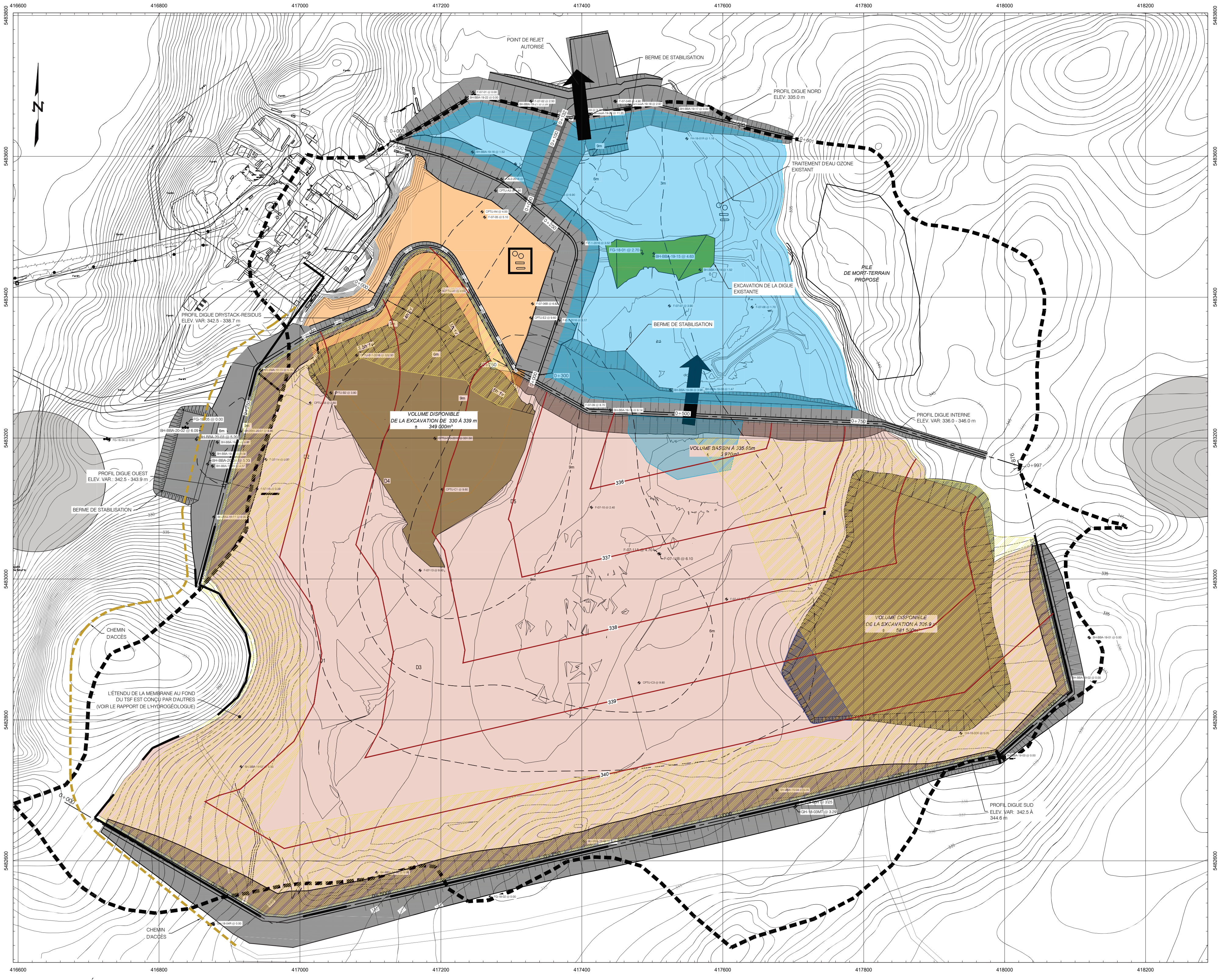
DRAWN BY	WILLIAM ST-AMAND	
VERIFIED BY	ADAM-PIERRE H. GAGNON, ing.	
APPROVED BY	ADAM-PIERRE H. GAGNON, ing.	
CREATION DATE	SCALE	PROJECTION
2022-03-10	INDICATED	⌖ ⊏

DRAWING TITLE

SURFACE AREA
GENERAL
SECTION "A" AND "B" - 1800 TPD
URBAN-BARRY PLANT

PROJECT #	DRAWING #	REV.	SHEET
10636	5000-000-G-2003 SECTOR–LEVEL – DISCIPLINE – SEQUENTIAL #	P1	1/1

6098005-000000-41-D50-0001



INDEX DES PLANS

6753003-41-D50-0001	PARC À RESIDUS AN 10		-		VUE EN PLAN
6753003-41-D01-0001	DIGUE SUD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0002	DIGUE OUEST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0003	DIGUE INTERNE	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0004	DIGUE INTERNE	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0005	DIGUE NORD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0006	DIGUE NORD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0007	DIGUE DRYSTACK -RESIDUS	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0008	DIGUE DRYSTACK -BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0009	DIGUE DRYSTACK -BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0010	DIGUE DE SÉPARATION - BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D50-0002	PARC À RESIDUS AN 2		-		VUE EN PLAN
6753003-41-D01-0011	DIGUE CELLULE OUEST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0012	DIGUE SUD AN 2	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D02-0001	TABLEAU DES MATÉRIAUX				
6753003-41-D50-0003	PARC À RESIDUS AN 3				
6753003-41-D01-0013	DIGUE BANC D'EMPRUNT EST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0014	DIGUE SUD AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0015	DIGUE OUEST AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0016	DRYSTACK AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0017	DIGUE INTERNE AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0018	BANC D'EMPRUNT EST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL

STOCKAGE DANS LE PARC À RESIDUS			
CAPACITE DE STOCKAGE (Mm3)	HAUTEUR DIGUE SUD*	HAUTEUR DIGUE OUEST*	TEMPS DE DÉPOSITION CUMULATIF (ANNÉES)
6.5	341.5 - 342.5 m	341.5 - 342.5 m	10
4.44	340 - 342.1 m	340 - 341.4 m	7.4
2.96	337.5 - 339.6 m	337.5 - 338.9 m	4.9
1.58	335 - 337.1 m	335 - 336.4 m	2.6

*Niveau de la crête, revange compris (1.5 m pour sud et ouest, 1.0 interne)

POUR COMMENTAIRES
NE PAS UTILISER POUR CONSTRUCTION
DATE: 2022-09-16
BBA

DESCRIPTION DE DÉPOSITION

DÉPOSITION
CONVENTIONNELLE
TONNAGE VISÉ: 1200 t/j (340 000 m³/an)
VOLUME (1.3t/m³): ± 660 000 m³

LÉGENDE:

▬ ▬ ▬	BASSIN VERSANT
➡	DÉVERSOIR D'OPÉRATION PROPOSÉ
➡	DÉVERSOIR D'URGENCE ET STRUCTURE DE DÉCANTATION PROPOSÉS
— —	COURBE ARGILE (INTERVALLES AUX 3 m)
▨	MEMBRANE À INSTALLER DANS LE PARC À RESIDUS
▨	EXTENSION DE MEMBRANE POUR LA ZONE D'EMPRUNT

NOTES
1. LORS D'UNE CONCEPTION DÉTAILLÉE, IL EST ESSENTIEL DE PROCÉDER À UNE CAMPAGNE D'ESSAIS GÉOTECHNIQUES SUR LE SITE AINSI QU'À DES TEST DE LABORATOIRE ET CE, AFIN DE MIEUX CARACTÉRISER L'ARGILE EN PLACE.
2. INTERPRÉTATION BASÉE SUR DES FORAGES GÉOTHECNIQUES LIMITÉS
3. LE SYSTÈME DE COORDONNÉES EST UTM, ZONE 18, DATUM NAD83

VUE D'ENSEMBLE

ÉCHELLE 1:2 000

1 : 2000 — 40 20 0 40 80 120 160 200 m

DESSINS DE RÉFÉRENCE	
DESSIN No	DESCRIPTION
SURFACE .BAUX.MINIER	PLAN DE DÉPOSITION OPTION 6
BAIL VUE CAMPEMENT	BAIL SURFACE (18 SEPTEMBRE 2018)
ENVI_182038-1	BATHYMÉTRIE ET TOPOGRAPHIE DU PARC À RÉSIDUS
	(RELEVÉ 25-26 SEPTEMBRE 2018)

RÉVISIONS				
RÉV	DESCRIPTION	VÉRIFIÉ PAR	APPROUVÉ PAR	DATE
AA	CONCEPTUEL	V. MAREFAT	L. PICIACCHIA	2022-09-16

SCEAU:

CLIENT: BONTERRA

PROJET: ÉTUDE PARC À RÉSIDUS BONTERRA

TITRE: PARC À RESIDUS AN 10
VUE EN PLAN

CONÇU PAR: L. PICIACCHIA	DESSINÉ PAR: O. PARADA
VÉRIFIÉ PAR: V. MAREFAT	APPROUVÉ PAR: L. PICIACCHIA
ÉCHELLE: 1:5000	DATE: 2022-09-16

DESSIN No:	FEUILLE:	FORMAT:	RÉV.
6098005-000000-41-D50-0001		A0	AA

0 1 2 3 4 5 6 7 8 9 10 cm

PAR:MARC-ANDRÉ DOUCET
IMPRIMÉ:2022-10-13 13:29:31

C:\USERS\MADOU\DROPBOX (COMPTE PERSONNEL)\FAMILY ROOM\PROJET\22\010-10 BONTERRA\6.CAD\3.EN COURS\6753003-000000-41-D50-0001.DWG

APPENDIX 2

REVISED IMPACT TABLES

Table 5-1 revised: Categorization of the activities and the impact sources

Phase	Activity	Sources of impact	Changes compared to the impact study and the 1st series of answers to the questions	Precision of the modification	Extent of the modification (/5)	Sectorial study or information to be updated
Construction	Improvement of the haul road	Clearing Levelling Work in wetland and hydric environment Amélioration de la bande de roulement (matériel de banc d'emprunt) Traffic and refuelling Maintenance of machinery and equipment/Management of residual materials and hazardous materials labour and purchase of goods and services	No	The last 50 km of the Barry-Bachelor route will be transformed into class 1. Already included in the 1st set of questions.	0	--
Construction	Construction of the new south access and expansion of the Bachelor complex	Clearing Stripping, excavation, and earthwork Blasting Work in wetlands and hydric environments Traffic and refuelling Use of sterile mine waste and borrow pits. Maintenance of machinery and equipment/Management of residual materials and hazardous materials Labour and purchase of goods and services	Yes	After the first round of questions, the new southern access road was to be diverted due to the presence of two species likely to be designated as threatened or vulnerable. An alternative route was proposed. This route will not be retained and the original route will be kept for operational reasons.	1	Updated small mammals map with new alignment and review of proposed mitigation measures. (QC2-7)
Construction	Redevelopment of the ore processing plant	Traffic and refuelling Maintenance of machinery and equipment/Management of residual materials and hazardous materials Redevelopment of the factory and installation of the new equipment Excavation labour and purchase of goods and services	Yes	Abandonment of the site expansion. Construction of a new enclosed building to house the future primary crusher. Addition of a thickener outside, near the three tanks and reservoirs, which will share the same retention basin. Construction of a dome near the future crushing building with conveyor systems. Ventilation improvements to the building where the cyanidation tanks are currently located.	2	GHG Report (QC2-18 à 21) Atmospheric Dispersion Study (QC2-1 à 4) Hazardous Materials Table (QC2-32) Clearing Areas and Affected Wetlands and Waterbodies (QC2-39).
Construction	Expansion of the PAR	clearing Stripping, excavation, and earthwork Raising and installation of dikes Installation of drainage ditches Circulation et ravitaillement Maintenance of machinery and equipment/Management of residual materials and hazardous materials Labour and purchase of goods and services	Oui	Optimization and reconfiguration of the tailings facility layout to increase the stability of the dikes, slightly expanding the affected area. Optimization and reconfiguration of the overburden pad resulting in an area reduction of 0.29 hectares.	1	Clearing Areas and Affected Wetlands and Waterbodies (QC2-39).

Phase	Activity	Sources of impact	Changes compared to the impact study and the 1st series of answers to the questions	Precision of the modification	Extent of the modification (/5)	Sectorial study or information to be updated
Operation	Extraction of Moroy ores	Blasting	Yes	Abandonment of the Moroy deposits extraction and processing project; Reduction in the amount of chemicals and explosives used and stored; Decrease in the number of workers; Shutdown of the ventilation and heating system (significant reduction in propane consumption); Discontinuation of the dry holding operations of the galleries.	1	GHG Report (QC2-18 to 21) Atmospheric dispersion study (QC2-1 to 4) Hazardous Materials Table (QC2-32) MR. and MDR Table (QC2-31)
		Development of galleries				
		dewatering				
		Maintenance of machinery and equipment/Management of residual materials and hazardous materials				
		labour and purchase of goods and services				
Operation	Moroy sterile mine waste and ore management	Traffic and refuelling	Yes	Elimination of the ore pile for Moroy. Elimination of the secondary ore stockpile. Elimination of the sterile mine waste piles.	1	GHG Report (QC2-18 to 21) Atmospheric Dispersion Study (QC2-1 to 4)
		Maintenance of machinery and equipment/Management of residual materials and hazardous materials				
		Labour and purchase of goods and services				
Operation	Transportation and unloading of the ores from Barry to the Bachelor site	Traffic and refuelling	Yes	Stopped hauling ore on Barry-Bachelor haul road for two weeks during goose hunt and reduced by at least 25% for two weeks during moose hunt. Reconfiguration of ore piles and yard layout - The three ore piles will be replaced by a single ore pile separated into two on each side of the new primary crushing building.	1	GHG Report (QC2-18 to 21) Atmospheric Dispersion Study (QC2-1 to 4)
		Maintenance of machinery and equipment/Management of residual materials and hazardous materials				
		Levelling				
		clearing				
		Labour and purchase of goods and services				
Operation	Treatment of the Moroy and Barry ores	Energy supply	Yes	Barry milling only 1,800 t/d, modification of the GHG and air dispersion reports. However, the frequency of shipment of ingots will remain unchanged. Reduction of chemical consumption and production of hazardous and non-hazardous waste.	2	GHG Report (QC2-18 to 21) Atmospheric Dispersion Study (QC2-1 to 4) Hazardous Materials Table (QC2-32) MR. and MDR Table (QC2-31)
		water supply				
		Geochemical properties				
		Crushing and grinding (noise)				
		Crushing and grinding (air)				
		Maintenance of machinery and equipment/Management of residual materials and hazardous materials				
		labour and purchase of goods and services				

Phase	Activity	Sources of impact	Changes compared to the impact study and the 1st series of answers to the questions	Precision of the modification	Extent of the modification (/5)	Sectorial study or information to be updated
Operation	Tailings management	Traffic and refuelling Maintenance of machinery and equipment/Management of residual materials and hazardous materials Dry tailings pile Spigotting of pulp tailings Water management Location of the final effluent Quality and quantity of the final effluent Labour and purchase of goods and services	Yes	Reduction in the number of tailings produced due to the reduction in the milling rate. Change in the nature of the tailings due to the removal of Moroy.	1	--
Operation	Management of the camp and related services	Drinking water supply Sanitary waste water supply Tailings management Labour and purchase of goods and services	Yes	Reduction in the number of workers and consequently in drinking water consumption, septic sludge production, etc.	1	GHG report (QC2-18 to 21) Labour estimates Socio-economic benefits
Closure	Site dismantling and restoration	Restoration of galleries Traffic and refuelling Maintenance of machinery and equipment/Management of residual materials and hazardous materials Water management Labour and purchase of goods and services Presence of the remains of the site Revegetation	Yes	Area to be rehabilitated has slightly increased.	1	Revision of the restoration plan every 5 years

Table 5-14 revised : Summary of Residual Project Impacts

Major Issue	Significance of Initial Residual Impact	Significance of Revised Residual Impact	Nature of Change (Enhancement (+), Similarity (S), or Increase in Adverse Impact (-))	Details of the change in impact	Specific measures (changes from the mitigation and/or optimization measures presented in the initial impact study are identified in blue).
Climate Change	Negative, very low	Negative, very low	+	GHG assessment current situation: 25,332 tons $CO_{2\ eq}$	PGS0-1 Include environmental selection clauses/criteria in tender documents for ore trucking
				GHG assessment projected situation at 2400 tpd: 85,029 tons of $CO_{2\ eq.}$	PGS0-2 Retreading of tires on ore trucks
					PGS2-1 Conversion of propane heating equipment to electricity (except underground heating which will no longer be required with the removal of Moroy)
				GHG assessment revised to 1800 tpd: 69,661 tons of $CO_{2\ eq}$	PGS2-2 Conversion of propane furnace to electric induction furnace
Conservation of the air quality of the Bachelor site	Negative, very low	Negative, very low	S	As with the previous modelling, no exceedance is recorded at sensitive receptors beyond 300 m from the mine lease boundary. It is difficult to qualify the impact of the Moroy withdrawal as other components of the project have been affected by optimizations resulting from the advancement of concept engineering.	PQA0-1 Spraying water on heavily travelled roads to reduce dust emissions in dry weather
					PQA1-1 Develop maintenance and inspection program for the lime silos dust collector. PQA1-2 Ensure that the lime silos dust collectors will be equipped with a leak detector. PQA1-3 Use only BNQ 2410-300 certified products for dust suppression. PQA1-4 Conduct sampling as prescribed in the Cahier no 4 du Guide d'échantillonnage du RAA du Programme d'échantillonnage des émissions de particules à la cheminée du four
					AQP2-1. Update and implement the preliminary monitoring and follow-up program. AQP2-2 Maintain dust abatement effectiveness at all times on roadway segments on the mining lease, with the application of a flow rate greater than 2 litres/m2/hr.
Protection of the water resource of Bachelor Lake	Negative, low	Negative, low	+	The sources of the impact remain similar, the risk reduced with the removal of the Moroy ore and the milling rate reduced.	PRE0-2 Periodic analysis of Barry's tailings (initially one sample per milling cycle) including PGA to confirm LM and DMA characteristics and provide a baseline of overall deposited tailings characteristics. Adapt the sampling program thereafter under the supervision of a qualified geochemist.
					PRE0-3 Perform LM/DMA characterization of the ore supplying the plant in addition to performing regular tailings analysis.
					PRE0-8 Add a monitoring point for the quality of the supernatant at the outlet of the new recirculation basin, in order to detect any exceedance of metal levels and to proceed with the required adjustments of the industrial water treatment
					PRE0-9 Regularly ensures that the exfiltration water pumping facility to the PARB is functional and in good condition
					PRE1-1 Conduct a background groundwater study. If necessary, install new observation wells upstream of the PARB. PRE1-2 Include in the preliminary final effluent monitoring program all physico-chemical parameters that will be subject to EDOs as well as chronic toxicity. PRE1-3 Monitor physico-chemical parameters on a quarterly basis and acute toxicity on a monthly basis. PRE1-4 Place a geomembrane in the bottom of the PARB expansion. PRE1-5 Conduct spot inspections of bridges and culverts as needed.
					PRE2-1 Build a minimum of three double-level observation wells (at the OBS-1, OBS-3 and OBS-5 virtual well sites) and add them to the wells retained in the environmental follow-up program. PRE2-2 Revise the monitoring and follow-up program by considering the Mining Association of Canada's Manual for the Operation, Maintenance and Monitoring of Tailings and Water Management Facilities, the additional follow-up procedures in the framework of the 2nd round of answers to COMEX questions, and to improve the elements related to the control of risks and consequences of a dam failure.

Major Issue	Significance of Initial Residual Impact	Significance of Revised Residual Impact	Nature of Change (Enhancement (+), Similarity (S), or Increase in Adverse Impact (-))	Details of the change in impact	Specific measures (changes from the mitigation and/or optimization measures presented in the initial impact study are identified in blue).
Conservation of wetlands and water resources	Negative, very low	Negative, very low	-	Compared to the original impact assessment, the area of wetlands affected will be slightly increased. This will be primarily associated with the modification of the PARB right-of-way and the construction of certain infrastructure (overburden storage area, south access, etc.). However, the storage area to the northwest will not have to be expanded for the development of the ore stockpiles. The area of wetlands and waterbodies affected by the project will increase from 5.19 ha (as per the initial assessment) to 6.76 ha with the removal of the Moroy operation from the impact assessment and the optimizations to the project resulting from the conceptual engineering. This increase also results from the addition of a buffer zone for the circulation and operation of machinery around the periphery of the proposed infrastructures.	PMH1-1 Complete a wetlands and hydric environments compensation plan. Make sure to consult the stakeholders including the Waswanipi community. PMH2-1 Delineate work areas and limit encroachment into natural environments, and particularly wetlands and hydric environments, to the minimum required for the execution of the work.
Preservation of the biodiversity	Negative, low	Negative, low	-	The significance of the residual impacts on biodiversity will remain unchanged, but the revised scenario will result in a slight increase in the area of clearing, which will affect more natural environments and habitats. In fact, the total clearing area for the project has increased from 33 ha initially to 39.58 ha. In addition, it should be noted that for operational reasons, the southern access road will pass through a sector where Cooper's voles and rock voles, two status species, have been identified, and will fragment the habitat. However, several measures will be put in place to limit residual impacts.	PBIO0-1 Avoid interventions in natural environments from late April through mid-August. PBIO0-2 Follow the recommendations for active sand quarries of Regroupement Québec Oiseaux (RQO) (2016)1 PBIO0-3 Install nesting boxes for chiropterans
					PBIO2-1 Encourage the maintenance of snags and woody debris on the ground in the clearing right-of-way. PBIO2-2 Apply best practices to limit the risks and mitigate the consequences of petroleum and chemical spills or de-icing agents in the natural environment. PBIO2-3 Physically delineate clearing areas, traffic areas and material storage areas. Ensure compliance with clearing limits previously identified by a site supervisor. PBIO2-4 Recommend scenarios that avoid or minimize the loss of wetlands. PBIO2-5 Prioritize the use of previously disturbed areas for the storage of cut wood and woody debris. PBIO2-6 Ensure compliance with the Règlement sur l'aménagement durable des forêts du domaine de l'État (RADF). As part of the construction of the southern access road and in order to limit potential impacts on small mammals, the following mitigation measures will be applied: PBIO2-1 Leave small-diameter woody debris (e.g., branches) on the ground in the road right-of-way where the shrub canopy will have been removed by the work, as this practice conserves or creates quality habitats that are used by these species and will contribute to their protection. PBIO2-2 Delineate the work area to limit the movement of machinery in the sector, to limit rutting and to maintain a shrubby forest cover and thus minimize the loss of habitat for these species. PBIO2-3 Avoid soil compaction and rutting as much as possible during the work; PBIO2-4 Carry out work during winter (when the ground is frozen or when there is a snow cover of 30 cm or more); PBIO2-5 Limit the installation of roads in the restricted activity zones defined for small mammal occurrences based on the species' home ranges (see map Appendix QC2-7).
Maintenance of healthy fish populations in lake Bachelor	Negative, low	Negative, low	+	The removal of Moroy and the decrease in the milling rate compared to the initially projected situation are likely to reduce the risk of anticipated impacts.	PPP0-1 Extend contaminant analysis to walleye liver
					PPP0-2 Notify local fishermen in case of contamination detected in the flesh or liver, or of increased contamination of any substance

Major Issue	Significance of Initial Residual Impact	Significance of Revised Residual Impact	Nature of Change (Enhancement (+), Similarity (S), or Increase in Adverse Impact (-))	Details of the change in impact	Specific measures (changes from the mitigation and/or optimization measures presented in the initial impact study are identified in blue).
Preservation of the wildlife resource	Negative, low	Negative, low	S	The main impacts related to the wildlife resource were associated with the Bachelor-Barry access road and ore transportation. No change is anticipated in these impact sources.	PRF0-1 Implement a 24-month monitoring program to assess the presence of hunted and trapped animals in the vicinity of the haul road (carcasses, documentation of observations by truck drivers) and provide for corrective action as needed (e.g., signage).
					PRF0-2 Install an ultrasonic whistle on each truck to draw animals away from the road and reduce the risk of collisions along the haul road
					PRF0-3 Keep vegetation low by clearing brush on both sides of the haul road across the width of the right-of-way for better visibility
					PRF0-4 Implement a truck driver awareness program to develop preventive driving behaviour that minimizes the risk of collisions with wildlife.
					Adapt this program based on the monitoring data collected through measure PRF1.
					PRF0-5 Prohibit workers from hunting or trapping during their shift.
					PUT1-17 Create and implement a wildlife and user safety monitoring logs, record local wildlife observations and accidents, and include the results in the annual report.
Continuity of land use	Negative, low (assuming renegotiation of the agreement with the Crees results in a mutually satisfactory resolution of the nuisance issue).	Negative, low (assuming renegotiation of the agreement with the Crees results in a mutually satisfactory resolution of the nuisance issue).	S	The impacts on traditional activities such as gathering, hunting, fishing and land use are mainly related to the Bachelor-Barry road, as well as to the ore haul and the associated nuisances. Since no modification is made to these elements compared to the initial situation, the impact on this issue remains unchanged. However, several mitigation measures have been added since the initial impact study.	PUT0-1 Inform land users of the frequency of Project trucking, to allow for the adjustment of user movements near the road
					PUT0-2 Reduce or suspend truck traffic during the two weeks of the fall moose hunt and the two weeks of the spring goose hunt. This measure is modified to suspend ore hauling for 2 weeks in the spring during the goose hunting season and reduce it by a minimum of 25% during the two weeks of the fall moose hunt.
					PUT0-3 Improve signage on the transportation route regarding the speed limit, the presence of camps, ATV traffic and snowmobile crossings, among other things
					PUT0-4 Implement a road safety plan on the transportation route, including mechanisms for responding to complaints and for immediate redress in the event of rule violations
					PUT0-5 Share the road safety plan with the representative bodies of the communities concerned and encourage their feedback on the operation of the Project trucks
					PUT0-6 Ensure regular training and awareness of workers on road safety and on the activities of land users
					PUT1-1 Post signs on the Bachelor road indicating speed limits, radio frequency used and following the recommendations made by Horizon SF. PUT1-2 Present the tallyman with the road signage report and discuss with the tallymen their satisfaction with the road safety measures planned. PUT1-3 Put up signs indicating the presence of camps. PUT1-4 Discuss with land users the schedule and operation of the mine during the hunt and make adjustments as needed. PUT1-5 Incorporate a road inspection schedule into the monitoring and follow-up program. PUT1-1 Continue to communicate and regularly consult with its stakeholders, particularly within the framework of harmonization committees. PUT1-6 Establish a register of complaints or comments with the date, nature and origin of the complaint or comment as well as the action taken to follow up on it. Ensure that requests are handled and followed up. PUT1-7 Set up a log with the number of incidents, the users involved and the corrective measures taken.Designate problem areas (if necessary) and take corrective measures (if any). PUT1-8 Make workers aware of road safety during orientation training at the mine site and during the monthly occupational health and safety meeting. PUT1-9 Address transportation route safety in the annual follow-up report. PUT1-10 Discuss traffic and user issues at stakeholder meetings. PUT1-11 Revise communication plan and implement a meeting schedule. PUT1-12 Enhance the Bonterra website and add links and contact information to the website. Develop periodic newsletters to be added to the website. PUT1-13 Investigate the possibility of setting up an information platform on social networks. PUT1-14 Hold information sessions in the WFN and invite the WFN to take part in defining the parameters of the consultation, social impact monitoring and land use plan. PUT1-15 Continue discussions on the methods of monitoring the impacts of the project and the concerns raised (work of the exchange and harmonization committees). PUT1-16 Continue to communicate and regularly consult with its stakeholders, particularly in the context of the harmonization committees. PUT1-17 Create a wildlife and user safety monitoring logs and ensure its implementation, record observations and accidents related to local wildlife and integrate the results into the annual report.

Major Issue	Significance of Initial Residual Impact	Significance of Revised Residual Impact	Nature of Change (Enhancement (+), Similarity (S), or Increase in Adverse Impact (-))	Details of the change in impact	Specific measures (changes from the mitigation and/or optimization measures presented in the initial impact study are identified in blue).
Socio-economic benefits	Positive, high (regional) Positive, high (local)	Positive, high (regional) Positive, high (local)	-	As with the situation initially presented in the impact study, the optimization measures will help maximize the socio-economic benefits and minimize the factors that could compromise these gains, as in the case of closure. Their implementation will enhance local and regional economic security and prosperity, including the current and future employability of the workforce and the expertise of suppliers. In addition, the renegotiation of the Bonterra-Cree Agreement will strengthen measures to integrate the Crees into the Project. The modification of the project with the withdrawal of the Moroy deposit will not change the significance of the impact. However, in the construction phase, the number of jobs generated decreases to 63 (initial: 186) and in operation it is 45 (initial: 245), which will slightly reduce the local spinoffs in terms of employment and purchases by workers. Despite the reduction in the number of jobs required at Bonterra, the measures in place to encourage the retention and employment of Aboriginal workers will remain.	PSE0-1 Maintain the policy of encouraging a local workforce by reimbursing only the first 100 kilometres of transportation and to encourage the purchase of goods and the awarding of contracts to competitive local businesses
					PSE0-2 Continuation of the policy of favouring Cree applicants and businesses of equal value in hiring and contracting
					PSE0-3 Maintain the policy of supporting studies and internships for students interested in working in the mining sector
					PES0-4 Continue to offer visits to the Bachelor site to residents of the local communities, including Waswanipi students, so that they can see first-hand what it is like to work in the mining industry
					PSE0-5 Early warning to the Exchange Committee, the Harmonization Committee and the representative bodies of the communities concerned of the reduction or cessation of activities at the Bachelor site, in order to be able to prepare a possible transition
					PSE0-6 Early coordination with the exchange committee, the harmonization committee and the representative bodies of the communities concerned in the planning of employment alternatives for the workers after the closure
					PSE0-7 Maintenance of the worker assistance program, which offers, among other things, advice on sound financial management, in order to reduce the negative impact of the Project's closure (e.g., debt) and to maximize the socio-economic benefits during the construction and operation phases.
					PSE0-8 Maintain a work schedule that is as close as possible to that of traditional activities, such as goose and moose hunting
					PSE0-9 Continue to provide extended bereavement leave for First Nation workers, given the importance of bereavement rituals to the social cohesion and spiritual well-being of First Nations
					PSE0-10 Conducting Workplace Diversity Training Workshops for Project Workers
					PSE0-11 Encourage the grouping of First Nation workers within the same team, in order to form a critical mass of these workers to strengthen their retention
					PSE0-12 Maintain the hiring of a community liaison officer
					PSE0-13 In collaboration with the Exchange Committee, the Harmonization Committee and the representative bodies of the communities concerned, ensure a mechanism to evaluate the impacts of the Project at regular intervals and a feedback mechanism for any potential problems
Note 1: A sequential number has been added after each mitigation measure in order to identify if it comes from the initial impact study (ex: PGS0-X), from the 1st round of questions (ex: PGS1-X) or from the 2nd round of questions (ex: PGS2-X).					
Note 2: When mentioning the current situation, it refers to the currently authorized situation, which corresponds to a milling rate of 800 tpd and an underground mine operation at Bachelor.					
1 Regroupement Québec Oiseaux (RQO). 2016. Protection de l'habitat des Hirondelles de rivage et des Hirondelles à ailes hérissées dans les sablières en exploitation. Lien: https://www.quebecoiseaux.org/index.php/fr/dossiers/conservation/1061-7-protection-de-l-habitat-des-hirondelles-de-rivage-et-des-hirondelles-a-ailes-herissees-dans-les-sablieres-en-exploitation					

APPENDIX 3

COMMUNICATIONS REGISTER AND SUPPORT LETTERS

Contacted people and function	Date of consultation	Mean of communication	Summary of meeting or communication	Concerns raised	Follow-up needed	Official report completed
Jackie Barney	2020-09-29	Email	Bonterra would like to know who is in charge of the fire services in order to present the Bachelor site in case of an emergency call.			
Joshua Blacksmith	2020-11-18	Email	Bonterra would like to know where Waswanipi is with the Christmas turkey distribution project provided by Bonterra.			
Joshua Blacksmith	2020-11-20	Email	Exchange on the presentation of the Bonterra updates to the band council			
Joshua Blacksmith	2020-11-24	Email	Return of Joshua on the distribution of Christmas turkeys			
Matthew Happyjack	2020-11-15	Email	Matthew returned to say that he will not be able to attend the Band Council presentation and returned his comments on the presentation.			
Joshua Blacksmith	2020-01-26	Email	Contacted Joshua about beaver problems at the site.			
Joshua Blacksmith	2020-01-26	Email	Joshua's response to the beaver problem			
Joshua Blacksmith	2021-04-27	Email	Response to concerns about red buoys on Lake Barry (Gladiator site)	Presence of red buoys on Lake Barry left over the winter. Will have to be picked up.		
Marshall Icebound	in 2021	Focused meeting - In person	Replaced his dog that was hit by a subcontractor.			
Marshall Icebound & Judy Trapper	2021-06-08	Focused meeting - In person	Concerns and requests raised by the W25B tallymen - want a meeting every 2 months on what is accomplished, what is done and what is coming up; - learn that the old Bonterra camp is now part of a 1% protection area and want to see a clean-up of this space; - they would like to see fish studies every year (like Osisko); - road improvement	- Consultation meeting every 2 months; - Would like to see fish surveys every year (like Osisko); - The old Bonterra camp is now part of a 1% protected area and would like to see the cores moved and the site cleaned up.	Yes	Done
Marshall Icebound, Judy Trapper, Joshua Blacksmith	2021-06-23	Email	Consultation on the future location of core storage east of the current camp (Gladiator site)	None	No	N/A
Marshall Icebound, Judy Trapper, Joshua Blacksmith	2021-06-30	Email	A member of the Icebond family asked us to help save a young caribou in trouble --> The caribou was taken to Osisko and the game wardens came to get it. Bonterra made the declaration to the MFFP, as the animal is a protected species.	None	No	Done
Lee-Roy blacksmith	2021-07-19	Email	Return indicating that he had to cancel the meeting of the visit of the Bachelor site.			
Marshall Icebound, Judy Trapper, Joshua Blacksmith	2021-07-21	Focused meeting - In person	Geological follow-up done and to come (Bonterra would like 5 barges on the lake next year), water quality and fish study, compromise to 3 barges maximum, replacement of buoys by floating plastic lures (bustards), area of the former Bonterra camp that has become a 1% First Nations protected area + cleaning of the former camp site.	Five barges on the lake at the same time is not acceptable, as it would greatly disturb the fish and their traditional activity on the lake + vibration would scare away fish according to JT. No Bonterra fish study. W25B tallymen's territory is the most affected and impacted by mining exploration. Prioritization of winter drilling more acceptable than 5-barge drilling. Compromise to 3 barges if winter drilling prioritized. For mud changes, a red or bright reflective collar should be put on to be able to identify decoys from real bustards.	Yes	Done

Contacted people and function	Date of consultation	Mean of communication	Summary of meeting or communication	Concerns raised	Follow-up needed	Official report completed
Marshall Icebound and Judy Trapper	2021-10-21	Focused meeting - In person	Presentation of the class 3 road plan between Gladiator and Barry to Marshall Icebound and Judy Trapper and other projects. I show Marshall and Judy the map of the planned class 3 road between Gladiator and Barry. Explain that the road will be used to truck the ore of the future operations. I show them the exact point where the road will hit the current access road to Gladiator at 1.5 km in straight from their camp. I talked about the main concerns : the noise and the dust. Explain that their camp is generally upwind from the road and dust should not affect them. Marshall and Judy do not have any objection with the plan. However they mentioned that Barrette Chapais Will harvest wood this winter around the planned trail and they highly suggest contacting Denis Chiasson from Barrette Chapais to see if their trail could be similar to our trail. Marshall and Judy will have a consultation meeting with Barrette in November and would like us to contact them before they have their meeting. We talked about the fish survey that will happen next week. GCM should contact Allen Icebound, son of Marshall Icebound (819 895 4587). He knows the territory very well and could be interested in guiding the GCM team on the lake. We also talked about the drilling plan for the next months until Christmas. I presented the program on Titan beside the St River, the program on Duke, the program North of the deposit and everything is fine. We had a look at some other hole on Duke located 1.5 km East of their camp and we will check what can be done for noise reduction before drilling there.	Marshall and Judy will have a consultation meeting with Barrette in November and would like us to contact them before they have their meeting (road option).	Yes	Done
Joshua Blacksmith	2022-01-19	Focused meeting - Videoconference	Presentation of Marc-André Pelletier incoming CEO + discussion if Waswanipi community needs anything + discussion about the compensation project for the 4.2 ha of wetlands.	None, Joshua will consult with colleagues on the compensation project.	Yes	N/A
John Kitchen	en continu	phone	several discussions and meetings between John Kitchen and Marc-Andre Pelletier			
Atikamekw Council	2022-02-22	Email	Introduction and request for meeting for discussion and consultation Barry-Gladiator Road projects	No response. Still trying.	Yes	N/A
Gary Cooper + Joshua Blacksmith	2022-02-23	Focused meeting - Videoconference	Presentation of a class 3 road project between Barry and Gladiator	No concerns, but would like to increase his contracts with Bonterra.	No	Recorded meeting
Ronnie Nayasit + Joshua Blacksmith	2022-02-24	Focused meeting - Videoconference	Presentation of a class 3 road project between Barry and Gladiator	Doesn't want to have to portage (wants the bridge to be high enough for him to go under). Wants to be able to access Otter Lake via this new path.	No	Recorded meeting
Marshall Icebound + Joshua Blacksmith	2022-02-28	Focused meeting - Videoconference	Presentation of a class 3 road project between Barry and Gladiator	MI wants to increase his contracts.	No	Recorded meeting
Ronnie Ottereyes + Steven Blacksmith + Joshua Blacksmith + Henry George Gull + Allan Saganash + Michel Ares	2022-03-02	Focused meeting - Videoconference	Presentation of a class 3 route project between Barry and Gladiator + Presentation of the new CEO + discussion on IBA in progress with Pascal & Greg	There may be a spawning ground at the proposed bridge location.	No	Recorded meeting
Ronnie Nayasit	2022-03-02	Messenger	Ronnie would like the impact mitigation money from his trapline to be paid directly to him instead of sending it to the band council, as he would like to take the money to pay for his daughter's education in Ottawa. A reply was sent to him saying that Bonterra cannot interfere in the internal affairs of Waswanipi.		No	N/A
Atikamekw Council	2022-03-07	Email	Shapefile sent at the request of Salome A. Soucy		Yes	N/A
Atikamekw Council	2022-03-07	Email	received email for meeting on March 25, 2022, from Sandra Vaillancourt, secretary of direction council of the Atikamekw nation		Yes	N/A

Contacted people and function	Date of consultation	Mean of communication	Summary of meeting or communication	Concerns raised	Follow-up needed	Official report completed
Atikamekw Council	2022-03-07	Email	Response to Sandra's email indicating that I am not available on those dates and proposal of a new date (week of March 20th).		Yes	N/A
Atikamekw Council	2022-03-24	Email	Follow-up from Bonterra on meeting requests			
Cuisine VB + Judy Trapper	2022-03-24	Focused meeting - In person	Meeting of VB Kitchen with Judy Trapper for possible kitchen and housekeeping contract			
Joshua Blacksmith	2022-03-25	Email	Consultation regarding the drilling program on the Desmaraisville property (Category II)			
Waswanipi Chief hockey club	2022-04-06	Email	Sponsorship request for a hockey tournament in Gatineau granted by Bonterra		No	N/A
Waswanipi education funding	2022-04-06	Email	Bonterra wants to send the education funding as per Bachelor IBA		No	N/A
Joshua Blacksmith	2022-04-06	Email	Bonterra would like to have the information of the contact with the Grant family to discuss the Barry-Gladiator road project		Yes	N/A
Atikamekw Council	2022-04-06	Email	Resend request to meet for discussion and consultation on Barry-Gladiator Road project		No	N/A
Atikamekw Council	2022-04-06	Email	Back to the email reminder of the application indicating that Sandra was going to check it out			
Joshua Blacksmith + Maggie + Emily Blacksmith	2022-04-14	Email	Joshua was the one who contacted Bonterra on behalf of Maggie and Emily to see if it was possible to move up the monthly payment to Maggie and Emily to get ready for the goosebreak - Bonterra agreed		No	N/A
Atikamekw Council	2022-05-18	Email	Bonterra still hasn't heard back on request proposes new date of May 24-26			
Atikamekw Council	2022-05-18	Email	Acknowledgment of receipt of the message of May 18 sent to Sandra			
Joshua Blacksmith + StevenBlacksmith + Ronnie Ottereyes	2022-05-24	Email	Request for an emergency meeting on tallyman W25B's refusal to allow the barge drilling season to start.	Request more contracts with his affiliate company to do drilling (G4) + request fish study for the impact of drilling on the barge, but without drilling we can't do a study	No	N/A
Ronnie Nayasit	en mai ou juin 2022	Focused meeting - In person	Hiring of Tallyman Ronnie Nayasit as carpenter in Barry			
Ronnie Ottereyes + Joshua Blacksmith + Marshall Icebond	2022-06-01	Focused meeting - Videoconference	Emergency meeting to discuss Marshall's concerns about the barge drilling season. Turns out Marshall was using this to try to force Bonterra to give contracts to G4 who is affiliated with Marshall. Marshall fishes for sturgeon near an island and he didn't want a barge there. Bonterra agreed to this compromise and the agreement to start the campaign was granted.	No barge on sturgeon spawning grounds	No	Recorded meeting
Ronnie Ottereyes	2022-06-04	Email	Received date from Ronnie for planning IBA negotiations.			
W25B	2022-06-14	Email	Approval on W25B mitigating project	Amount to be determined due to overpayment in 2021		
Miyuukaa Corporation + ADC	2022-06-20	Focused meeting - In person	Meeting regarding renewal of contracts for maintenance and kitchen services			
Willy Icebond	2022-06-21	Post réseaux sociaux	Willie Icebond put a post on Facebook indicating that he had removed orange drilling marker buoys on fish habitat. However, we had the OK from Marshall and the band council and the buoys were safety markers to avoid rocks and such on the bottom.	Drilling on fish habitat	No	N/A
Joshua Blacksmith	2022-06-20	Email	W24A did not receive their funds yet. Transfer this to Johnny to be rectified.		No	N/A
Joshua Blacksmith	2022-06-22	phone	Steve G. called Josh on 2022-06-22 to schedule meetings with the Grant family, harmonization committee and discuss his request for sponsorship for the field hockey club.	No barge on sturgeon spawning grounds	No	N/A

Contacted people and function	Date of consultation	Mean of communication	Summary of meeting or communication	Concerns raised	Follow-up needed	Official report completed
Waswanipi	2022-06-24	Focused meeting - In person	Visit of Waswanipi by Marc-Andre Pelletier with John Kitchen			
Miyuukaa Corporation + Fournier	2022-06-27	Focused meeting - In person	Discussion of upcoming contract + discussion with Miyuukaa Corporation regarding a possible MOU and IBA global			
Waswanipi Band Council	2022-07-04	Email	25,000 commitment from Bonterra to support CFNW for upcoming consultations			
Waswanipi Band Council	2022-07-05	Email	Received a letter of support for the Waswanipi Band Council's Executive Committee for the Bachelor site expansion project			
Stakeholders	2022-07-06	Email	Letter sent to CFNW, LSQ, Chapais, Chibougamau, Val-d'Or concerning the restructuring at the Bachelor mine and the Gladiator project			
Visit to Waswanipi	2022-07-07	Focused meeting - In person	Visit and discussion with Waswanipi stakeholders (Steven B, Matthew B, Ronnie O, + visit the band office)		No	N/A
Joshua Blacksmith + Matthew Blacksmith + Allan Saganash	2022-07-12	Focused meeting - Videoconference	Consultation with W24A about whether there were changes near Bachelor and the road to Barry to answer a question from COMEX + asked W24A if there are any wetland and water compensation projects that Bonterra could contribute to compensate for the 8 ha of the PARB expansion		No	Recorded meeting
Hamonization Committee	2022-07-18	Focused meeting - In person	First meeting of the Alignment Committee since 2018 or 2019.	Refer to minutes	Yes	Done
MOU draft	2022-07-19	Email	Received an MOU via email regarding upcoming negotiations for the IBA	N/A		
VLSQ Maximization Committee	2022-07-19	Focused meeting - In person	Met with Town of Lebel-sur-Quévillon stakeholders in person with Gilles Landry	Refer to minutes	Yes	Done
Inform tallymen of effluent problems at Barry and Gladiator	2022-07-21	Focused meeting - In person	Hugues Bordeleau spoke to Tallyman Marshall		Yes	N/A
Inform tallymen of sceptic effluent problems at Barry and Gladiator	2022-07-21	phone	Hugues Bordeleau spoke to Tallyman Ronnie		Yes	N/A
Donation of $5,000 for the Old Post Fish Derby	2022-07-25	Email	Informed Josh that BTR would donate $5,000		No	N/A
Meeting with Myuukaa and Fournier	2022-07-26	Focused meeting - In person	Presentation of the Barry project and upcoming contracts	Documents will be sent to Fournier	No	N/A
Sent letter regarding sceptic effluent issues to Barry and Gladiator	2022-07-26	Email	Action plan in place to deal with the situation		Yes	Done
Letter sent to Harmonization Committee requesting consultation	2022-07-26	Email	Request for consultation with CFNW	To Harmonization Committee	Yes	Done
Michael Sandepen VLSQ	2022-07-26	Email	Sent backlog as requested	To Maximization Committee	No	Done
Anik Racicot VLSQ	2022-07-26	Email	Received letter of support from the VLSQ	Don't know how to contact them	Yes	To do
Meeting with Myuukaa and Fournier	2022-07-26	Focused meeting - In person	Presentation of Barry project to Fournier and Myuukaa	Documents given to Fournier	No	Done
Michael Sandepen VLSQ	2022-08-03	Email	Request info contact from LSQ professional center		Yes	Done
Meeting with Steven Blacksmith in Waswanipi	2022-08-07	Focused meeting - In person	Donation of $600 for the Old Fish Derby, discussion and update on various projects	Bonterra has never applied on the electrical side	No	To do
Harmonization Committee with Marshall and Judy and Josh	2022-08-11	Focused meeting - In person	Donation of $300 for the Old Fish Derby, discussion and update on various projects	See minutes	Yes	To do

Contacted people and function	Date of consultation	Mean of communication	Summary of meeting or communication	Concerns raised	Follow-up needed	Official report completed
Virtual call with the people of the Northern Plan	2022-08-11	Focused meeting - Videoconference	Update on Bonterra operations. Plan North offers many opportunities	See minutes	No	
Meeting with Myuukaa-Fournier in Val-d'Or	2022-08-11	Focused meeting - Videoconference	Myuukaa-Fournier meeting in Val-d'Or		No	
Harmonization Committee with Maggie Blacksmith and Ronnie Nayassit	2022-08-17	Focused meeting - In person	Harmonization Committee with Maggie Blacksmith and Ronnie Nayassit	See minutes	Yes	
Meeting with VLSQ (Michael and Mrs. Racicot). Verbal update	2022-08-17	Focused meeting - In person	Meeting with VLSQ (Michael and Mrs. Racicot). Verbal update		No	
Sent a letter to Chief Happyjack regarding future electrical needs	2022-08-30	Email	Need for electricity for Barry and Gladiator	See letter	No	
Received text from Steven Blacksmith regarding election results	2022-08-31	phone	New leader elected (Irene Neeposh)	See text message	No	
Email from Simon Britt. Wants to know the GPS coordinates of Barry and Gladiator	2022-08-31	Email	Sent on September 6th	See email	No	
Call from John Kitchen regarding election results	2022-09-01	phone	New Chief elected (Irene Neeposh), no change for John with Myuukaa		No	
CFPBJ visit and meeting in Chibougamau	2022-09-02	Focused meeting - In person	Information exchanged about our respective needs	We will receive their presentation soon	Yes	
Myuukaa-John Kitchen	2022-09-21	phone	Request from Myuukaa for 40 rooms at the Bachelor site for the construction of the new power line for mid October for 9 months		Yes	No
Waswanipi Community - John Kitchen and Simon Britts	2022-09-23	Focused meeting - In person	Discussion of the power line project between Waswanipi and the Windfall project. Myuukaa is looking for housing for the construction of the power line in 2023. This line will be built 120 kV to eventually provide power to the Gladiator and Barry projects. There was discussion about purchasing diesel from Harnois who has a partnership with Osisko Mining. Also discussed was the ongoing tender for the Barry pit operations, the road and the tailings facility expansion.	Need rooms. Gilles will look into it. The price would be at cost +.	Yes	No
Community of Waswanipi -Chief Neeposh	2022-09-24	Email	Letter sent to congratulate the new Chief of the Cree Nation of Waswanipi	Negotiations to come for the IBA	No	Yes
Société du Plan Nord -Stéphane Mackenzie, Martin Loiselle, Myriam Blais, Marc Morin (SPN), Francois Belle-Isle (MERN), Steve Cadet	2022-09-02	Focused meeting - Videoconference	Update on BTR's needs for the infrastructure project (road between Barry and Bachelor) and the power line	Forest Road Grant Program ends in March 2023. We would like to see this program brought back. SPN mentioned that a loan could be given.	No	No
Community of Waswanipi	2022-09-30	Email	Recognition of the Day of Truth and Reconciliation. A copy of the internal communication was sent to Steven and Josh Blacksmith and John Kitchen		No	No
Community of Waswanipi-John Kitchen (CEO Myuukaa)	2022-10-04	phone	No gasoline available in Waswanipi. BTR offered gas to John Kitchen. He came to Bachelor to fill up.		No	No

The Cree First Nation of Waswanipi
Office of Chief Marcel Happyjack

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TEL: **(819)753-2587**
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July 5th 2022

Mr. Luc Lainé, Chairperson
Environmental Impact assessment Committee (COMEX)
Édifice Marie-Guyart, 6th floor, Box 83
675 René-Lévesque Blvd East
Québec (Québec)
G1R 5V7

Subject: Management change, Harmonization committee resumption and new Impacts and Benefits Agreement

Dear Mr. Luc Lainé,

The Cree First Nation of Waswanipi ("CFNW") hereby writes this letter to inform and highlight the distinct improvement in communications between the Natural Resources Department of the CFNW and Bonterra Resources Inc. ("Bonterra") since their management change, effective last January.

The Harmonization committee meetings have resumed, and we have started high level discussions on a new Impacts and Benefits Agreement which will provide for socio-economic participation in the Moroy (formerly Bachelor), Barry and Gladiator deposits.

Although our land users have always been consulted, the socio-economic participation has been insufficient for over a decade. We are encouraged by the exemplary approach taken by the new management and are looking forward to a brighter future where Bonterra supports the socio-economic advancement of our members through the development of natural resources within our Traditional Lands.

Should you have any question, please contact Deputy Chief Ronnie Ottereyes at 1-819-753-7391 or at ronnie.ottereyes@cfnw.ca for IBA negotiations and Joshua Blacksmith at 819-753-2587 ext. 340 for Harmonization Committee.

Sincerely,

Chief Marcel Happyjack
Cree First Nation of Waswanipi

CC: Mr. Marc-André Pelletier, President and CEO Bonterra Resources Inc.
Ronnie Ottereyes, Deputy Chief, Cree First nation of Waswanipi
Steven Blacksmith, Director of Natural Resources, Cree First Nation of Waswanipi

Lebel-sur-Quévillon
Le cœur de la Jamésie
DIRECTION GÉNÉRALE

Lebel-sur-Quévillon, 26 juillet 2022

Par courriel : mapelletier@btrgold.com

N.D./DG-2022-07-178-10098

M. Marc-André Pelletier
Président & CEO
Bonterra
2872, chemin Sullivan, suite 2
Val-d'Or, QC, J9P 0B9

Objet : APPUI PROJET D'AGRANDISSEMENT DE L'USINE ET DU PARC À RÉDISUS-BACHELOR

Monsieur,

La présente fait suite à votre correspondance du 6 juillet dernier dans laquelle vous demandiez l'appui de la Ville de Lebel-sur-Quévillon pour votre projet d'agrandissement de l'usine Urban-Barry et du parc à résidus situés à Bachelor (Desmaraisville) en vue de le déposer au COMEX.

Considérant que lors de notre rencontre le 19 juillet dernier à Lebel-sur-Quévillon pendant laquelle vous nous avez présenté vos projets et transmis toutes les informations pertinentes, nous vous confirmons l'appui de la municipalité de Lebel-sur-Quévillon pour vos projets mentionnés en objet. Nous sommes d'accords et nous recommandons le dépôt de vos projets auprès du COMEX.

Espérant le tout à votre entière satisfaction, recevez, Monsieur, nos sincères salutations.

Guy Lafrenière, maire
Ville de Lebel-sur-Quévillon

C.C. Directeur intérimaire du développement économique, M. Michael Sandapen

APPENDIX 4

TABLE OF COMMITMENTS

List of actions to be taken by Bonterra as part of the 1st round of responses to COMEX questions

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-2	Bonterra undertakes to send the technical report NI-43-101 including the mining plan to the administrator, when it becomes available.	-Send the NI-43-101 technical report to the administrator.	1			MELCC		
QC-3	In accordance with Section 241 of the Mining Act, Bonterra Resources will obtain an authorisation for the location of the expansion of the tailings management area.	-Obtain authorisation for the location of the BTMA (Sec.241).	2			MELCC		X
QC-5	Bonterra will ensure that obsolete equipment that will be dismantled as part of the mill redevelopment work is disposed of in an authorised location rather than being stored on site and managed when it closes. Bonterra will continue with the revaluation of wood materials (waste wood) on the site. Wood residues will be stored on the surface and then crushed so that it can be used for revitalization purposes. Bonterra will work with the communities of Waswanipi, Desmairaisville and Lebel-sur-Quévillon (LSQ) defined a compensation project. (In connection with the request of the QC-74)	-Dispose of obsolete equipment that will be dismantled. Continue with the revaluation of wood materials (waste wood). -Work to find a compensation project.	3			MELCC		
QC-7	The proponent will review the structure of its communication plan to adjust it to the respective needs of the communities in the area involved in the project. The Bonterra website is updated on a regular basis. The site will be updated once again to integrate basic information about the environment and communities in the project's area of influence. The site will also have links and contact information to facilitate communication with stakeholders. Periodic information about the project on the website and appropriate communication tools will also be developed as part of the upcoming consultation activities in each of the localities. The creation of a Facebook page is currently under consideration, as well as the design of information platforms via LinkedIn.	-Review the communication plan. -Improve the website. -Add links and contact information on the website. -Develop periodic newsletters to be added to the website. -Study the possibility of setting up an information platform on social networks.	4			MELCC		

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-9	The Bonterra Consultation and Communication Plan will be updated and adjusted to reflect the issues and expectations or concerns expressed in each of the localities. A meeting schedule and appropriate communication tools will be implemented. Information sessions will be held in the CFNW, including the General Assemblies and, if necessary, targeted meetings or presentations will be held with the CCFNW or members of the community directly affected by the project. -Given that the work of the discussion and harmonization committees will soon resume, it is expected that the methods of monitoring the impacts of the project and the concerns expressed by citizens will be discussed. -The CFNW will also be asked to participate in defining the parameters for the Consultation Plan and for monitoring the social and land-use impacts. Requests or concerns are generally dealt with on an ad hoc basis as soon as the information is received by the proponent.	-Review the communication plan. -Set up a calendar of meetings. -Hold information sessions in the CFNW. -Continue discussions on the methods of monitoring the impacts of the project and the concerns expressed (Work of the exchange and harmonization committees). -Invite the CFNW to participate in defining the parameters for the Consultation Plan and the monitoring the social and land-use impacts. -Handle requests on an ad hoc basis as soon as they are received.	5			MELCC		
QC-12	The collaboration agreement is being renegotiated with the Waswanipi First Nation and the Cree Nation Government. The proposed agendas are sent to committee members before each meeting and minutes are drafted and sent to members afterwards.	-Send agendas are sent to committee members before each meeting, as well as minutes thereafter.	6			MELCC		
QC-15	A full report is planned as part of the detailed engineering, Bonterra is committed to providing it to the COMEX when it becomes available.	-Send the dike stability study.	7			MELCC		
QC-16	Bonterra will have the location of the tailings management area approved under Section 241 of the Mining Act and will obtain a lease for use of the public land.	-Obtain an authorisation for the location of the BTMA (Art.241)- Obtain a public land use lease for the BTMA	8			MELCC		X
QC-18	It should be noted that the sectors to the east of the site were not included in the hydrogeological study given that the tailings management area footprint was different from that proposed by BBA. In this context, additional geotechnical characterization studies will be carried out to properly document the nature of the unconsolidated deposits and possibly to define the percolation rates of these sectors. The construction and upgrading plans for the tailings management area will take the flows modelled in the hydrogeological study into consideration. A geomembrane will line areas where there is insufficient clay cover to increase the degree of soil permeability.	-Carry out a complementary geotechnical characterization study (sector to the east). -Place a geomembrane in the bottom of the BTMA expansion.	9			MELCC		X
QC-19	Should the quantities of materials resulting from these three sources (tailings, waste rock and borrow pits), Bonterra will request a modification to the certificate of authorisation issued under Section 164 of the EQA.	-Submit a CA application (Sec.164) (if needed).	10			MELCC		

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-20	Monitoring and maintenance that is planned for bridges and culverts; inspections will be made on an as-needed basis.	-Conduct spot inspections of bridges and culverts as required.	11			MELCC		
QC-22	The radio frequency used for transportation will be accessible to other users and roadside signs will inform users of the frequency used by the mine.	-Put up signs indicating the radio frequency used.	12			MELCC		
QC-23	Bonterra is committed to making the road compliant with the regulations on sustainable forest management (RADF) and safe for users.	-Put up the signs recommended by Horizon SF.	13			MELCC		
QC-25	Bonterra agrees to present the road signs report prepared by Horizon SF to the tallyman and to discuss their satisfaction with road safety measures to be implemented by Bonterra with them.	-Submit the road sign report to the tallyman. -Discuss, with the tallymen, their satisfaction with the planned road safety measures.	14			MELCC		
QC-26	With regard to the safety of users whose camps are near the road, several measures are planned, including the installation of signs to reduce speeds and indicate the presence of camps, among others. With regard to the disturbances caused to small and large game, as well as to geese during hunting periods, agreements will be discussed within the framework of negotiations of the Harmonization Committee to determine the timing and operation of the mine during hunting periods.	-Put up signs indicating the presence of camps. -Discuss with land users the timing and operation of the mine during hunting season.	15			MELCC		X
QC-27	Bonterra is committed to making the road compliant and safe for users.	-Put up the signs recommended by Horizon SF.	16			MELCC		
QC-28	Bonterra will evaluate options for the reclamation of construction and demolition debris according to the criteria in the Lignes directrices relatives à la gestion de béton, de brique et d'asphalte issus des travaux de construction et de démolition et des résidus du secteur de la pierre de taille (guidelines for the management of concrete, brick and asphalt from construction and demolition work and tailings from the stone sector).	-Evaluate options for reclamation of construction debris.	17			MELCC		X
QC-33	Bonterra will also assess the possibility of an academic collaboration for a research project on reusing compost.	-Evaluate the possibility of a university research project on the use of compost.	18			MELCC		
QC-35	Bonterra confirms that only products certified by the Bureau de normalization du Québec to the BNQ 2410-300 standard will be used to reduce dust.	Only products certified under the BNQ 2410-300 standard will be used to reduce dust.	19			MELCC		X

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-36	During the mine closure period, Bonterra will refer to the most recent version of the Guide de bonnes pratiques pour la gestion des matériaux de démantèlement (guide on good practices for managing dismantlement materials).	-Refer to the most recent version of the Guide de bonnes pratiques pour la gestion des matériaux de démantèlement (guide on good practices for managing dismantlement materials) (During the closure period).	20			MELCC		X
QC-40	The water management plan provides that 100% of the water that contains cyanide will pass through the cyanide destruction plant before being sent to the sedimentation pond and discharged to the final effluent, which will ensure the compliance of the effluent.	-Pass all water containing cyanide through the cyanide destruction plant.	21			MELCC		X
QC-42	The report entitled "Assessment of design water balances - Detailed engineering of tailings management area at the mining site" prepared by BBA inc. (BBA) attached to Appendix Q42 of this document presents the calculation methodology in detail, the results obtained as well as the overall water balance for the design of the park and the predictive operation reports. The report highlights the assumptions considered regarding the risk associated with climate change.	-A review of the water balance and water management concept will be required by BBA. BBA had considered direct discharge to the final effluent of the wastewater during the period of the project. This is not permitted by the ministries, so this water must be contained somewhere or treated before it is discharged to the effluent. GCM has evaluated some solutions in a trade off. In addition, the assumption used by BBA (see response QC-70) for the consideration of water supply in relation to climate change is questionable. It will be desirable for the water balance and design of the TMA to consider an additional 18% of water.	22			MELCC		
QC-43	Several projects to optimize the water treatment plant have been carried out by Bonterra with the purpose of minimizing the concentrations of contaminants in the effluent and thus complying with the EDOs. Efforts in this direction will continue with the new project. Fluorine monitoring will continue as mentioned in the 2019 annual report presented to the MELCC (Bonterra, 2020).	-Continue efforts to optimise the water treatment plant. -Continue to monitor fluoride.	23			MELCC		
QC-52	During operations, a tailings sprinkler system will limit wind erosion.	Make sure of availability of a tailings sprinkler system.	24			MELCC		X
QC-53	Bonterra would therefore like to postpone the soil characterization work until 2021. Before the work is started, a soil characterization plan in accordance with the Characterization Guide will be submitted to the Ministère for approval. Bonterra agrees to transmit the characterization report to the MELCC as part of the authorisation request in accordance with Section 22.	-Carry out soil characterization (in areas deemed risky according to phase 1 and targeted by the work). -Submit a characterization plan to the ministry. Transmit the characterization report to the MELCC.	25			MELCC		

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-54	Bonterra agrees to ensure that the soils are managed in such a way as to respect the contamination ranges, the provisions of the Guide d'intervention, du Règlement sur la protection et la réhabilitation des terrains (Q-2, r. 37) and the Règlement sur le stockage et les centres de transfert de sols contaminés (Q-2, r. 46). If soil is excavated, Bonterra will have the C10 C50 content evaluated. If there are no petroleum hydrocarbons, Bonterra will transport the excess soil to the tailings management area. If C10 C50s are detected, the soils will be transported to an authorised location and a characterization of the excavation walls will be carried out to ensure the quality of the soils.	-Manage soils in accordance with the Guide d'intervention.	26			MELCC		
QC-55	First, Bonterra will analyze the groundwater flow map and existing observation wells, then assess the possibility of using observation wells already in place upstream of the mine site. If necessary, Bonterra will set up new wells at the head of the watershed to be able to complete the assessment of bottom grades.	Perform a background level study in the groundwater. -If necessary, install new POs upstream of the BTMA.	27			MELCC		
QC-66	Bonterra will notify the Ministère de la culture et des communications, the Aanischaaukamikw Cree Cultural Institute and the Waswanipi Band Council of any possible discovery of archaeological property or site.	-Notify the Ministère de la culture et des communications, the Cree Cultural Institute and the Waswanipi Band Council of any archaeological discovery.	28			MELCC		X
QC-71	Therefore, the BTMA will respect the percolation rate prescribed in Directive 019.	-Take measures to ensure that the percolation rate is respected at the BTMA (geomembrane).	29			MELCC		X
QC-74	As mentioned in the answer to the previous question, the conservation of the water body in the tailings management area was not selected as a restoration scenario. Bonterra will work with the communities of Waswanipi, Desmairaisville and Lebel sur Quévillon to find a wetland compensation project. In addition, preliminary steps have been taken to identify the potential of closed borrow pits for the creation of wetlands in the Waswanipi sector. Project sheets will be presented as part of the vegetation characterization report in the effluent sector.	-Work with the Waswanipi community to find a compensation project. -Present project sheets (as part of the vegetation characterization report in the effluent sector).	30			MELCC		X

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-75	Table 75-1 shows the measures that will be taken by Bonterra to ensure the effectiveness of each of the proposed mitigation measures, in order to limit as much as possible the impacts associated with the increase of traffic on the Bachelor-Barry road.	-Improve the road signs according to the recommendations of Horizon SF. -Include a road inspection schedule in the monitoring and follow-up program -Keep a register of complaints or comments with the date, nature and source of the complaint or comment as well as the action taken to follow up in a log. -Keep a log of the number of incidents, the incidents themselves, the users involved and the corrections made. -Designate problem areas (if necessary). -Take corrective actions (if necessary). -Educate workers on road safety during the welcome training at the mine site as well as during the monthly meeting on occupational health and safety. -Address road safety in the annual monitoring report. -Discuss issues related to traffic and users in the context of meetings with stakeholders.	31			MELCC		
QC-76	Bonterra plans to put up signs at the main entrances to the territory. These signs will display messages similar to the following: "Trucking in progress" and "Convoy of trucks every 15 minutes".	-Improve the road signs according to the recommendations of Horizon SF.	32			MELCC		X
QC-77	Bonterra considered setting up automated road convoys of up to four trucks, of which only the first would be driven by one individual. Trucks travelling in groups would decrease the frequency and reduce the impact on the use of land along the road. However, given that this technology is currently poorly documented, not used much in the region, and because the road safety of land users could be at stake, Bonterra has abandoned this project for now. Bonterra will however keep this possibility in mind for the future, and when the proper functioning of this technology can be demonstrated, Bonterra will consult the various land users to discuss this new trucking technique and will present the results in a request for modification to the ministries.	-In the event that the automatedtruckingproject is resumed, consult with land users and submit a request for modification to the ministries.	33			MELCC		X

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-79	The proponent must report on the discussions that took place with the owners of the two camps near the road to demonstrate that a solution acceptable to the owners has been found. Specific measures will be defined in concert with the two owners of the camps, in particular within the framework of the program for monitoring the impacts on Cree use of the territory.	-Define specific measures in conjunction with the two camp owners near the transportation route.	34			MELCC		X
QC-80	Bonterra plans to suspend truck traffic on the Barry-Bachelor road for two weeks in the spring during the thaw period that coincides with the arrival of geese and the start of the hunting season. Bonterra also predicts a decrease in truck traffic on the Barry-Bachelor road by at least 25% in the fall during moose hunting season.	-Suspend truck traffic for 2 weeks in the spring during the goose hunting season. -Reduce truck traffic by at least 25% in the fall during moose hunting season.	35			MELCC		
QC-82	The environmental emergency response plan (EERP) will soon be presented to the people concerned in Waswanipi and to the Cree Board of Health and Social Services of James Bay. This EERP will be updated annually and the changes will be presented to those concerned. To ensure that the EERP is adequate, an environmental emergency exercise will take place annually and the required post-mortem actions will be incorporated into updates to the EERP. In addition, the main organizations concerned will be questioned during testing to confirm the effectiveness of the plan.	-Present the EERP to the people concerned in Waswanipi and to the Cree Board of Health and Social Services of James Bay. -Update the EERP annually and present it to the people concerned. -Conduct an environmental emergency exercise annually and engage key agencies during the test.	36			MELCC		
QC-88	Bonterra agrees to include all of the physicochemical parameters that will be included in the EDO as well as chronic toxicity in the preliminary program for monitoring the final effluent. The physicochemical parameters will be monitored quarterly over the release period and the acute toxicity will be monitored monthly. Bonterra agrees to submit an analysis report with the monitoring data on the quality of its effluent after 3 years and every 5 years thereafter to the Provincial Administrator. This report will contain a comparison between the EDOs and the results obtained in the effluent according to the principles of the Lignes directrices pour l'utilisation des objectifs environnementaux de rejet relatifs aux rejets industriels dans le milieu aquatique (guidelines for the use of environmental discharge objectives relating to industrial discharges into the aquatic environment (MDDEP, 2008) and its addendum Comparaison entre les concentrations mesurées à l'effluent et les objectifs environnementaux de rejet (OER) pour les entreprises existantes (comparison between the concentrations measured in the effluent and the environmental discharge objectives (EDO) for existing companies (MDDELCC, 2017). If EDO overruns are observed, Bonterra will describe the cause of these overruns and the methods it intends to implement to comply with them or come as close as possible to them in its analysis report.	- Include all of the physicochemical parameters that will be included in the EDO as well as chronic toxicity in the preliminary program for monitoring the final effluent. -Monitor the physicochemical parameters on a quarterly basis and the acute toxicity on a monthly basis. -Submit an analysis report with the monitoring data on the quality of its effluent after 3 years and every 5 years thereafter to the Provincial Administrator. -Ensure that the submitted report is in line with the requirements of the MDDEP (2008) and MDDELCC (2017). -Present, in its analysis report, the cause of these overruns and the methods implemented to comply with them or come as close as possible to them.	37			MELCC		

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC-89	The physical and structural stability study of the dikes for the entire tailings management area including the water management ponds will be completed during detailed engineering. Bonterra agrees to forward this study to the administrator with the next revision of its restoration plan.	-Send the dike stability study.	38			MELCC		
QC-125	To maintain the capture efficiency of the S4 dust collector, a preventive maintenance and inspection program based on the manufacturer's recommendations will be set up. The results of maintenance and inspections will also be recorded in a log. The dust recovered by the dust collector will be handled and managed in such a way as to limit the risk of dust reemission into the atmosphere. The dust collector will also be equipped with a passive leak detector.	-Develop a maintenance and inspection program for the lime silo dust collector. -Record the results of maintenance and inspections in a log. -Ensure that the dust collector will be equipped with a leak detector.	39			MELCC		

List of actions to be taken by Bonterra as part of the 2nd round of responses to COMEX questions

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC2-1	An update of the preliminary monitoring and follow-up program **will be conducted** as part of the Section 22 authorisation request and will document the instrumentation and control measures that will be put in place to ensure effective process control, notably with regard to pH.	Update the preliminary surveillance and monitoring program.	1	Once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC	The program will document the instrumentation and control measures that will be put in place to ensure effective process control, notably with regard to pH.	
QC2-2	The proponent **undertakes to** maintain this efficiency at all times on these segments, with the application of a flow greater than 2 litres/m2/h.	Maintain efficiency higher than 2 litres/m2/h.	2	Continuous	Continuous	MELCC	An adjustment factor of 25 % (75 % reduction) was applied to loader road segments between May and October. The same adjustment factor was applied between November and April to take into account the winter period, at the suggestion of the MELCC.	
QC2-5	As part of the Dust Management Plan, Bonterra **undertakes** to conduct a particulate emission sampling program at the furnace chimney every three years.	Sampling report completed in the manner prescribed in the Book 4 of the CAR Sampling Guide of the Sampling program for particulate emissions at the furnace chimney	3	every 3 years	120 days following the end of the sampling campaign	MELCC	If the analysis reveals that a limit value or other emission standard established by regulation is exceeded, this will be mentioned in the report along with the corrective measures taken to remedy the situation	
QC2-9	Bonterra **undertakes** to comply with the note d’instruction *Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent* (NI 98-01). It also **undertakes** to consider noise mitigation measures during construction and to comply with the measures identified in the impact assessment.	Respect the measures identified in the impact assessment in terms of noise and take into consideration: - The note d’instruction Traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent (NI 98-01); - Noise mitigation measures during construction.	4	During operations and work.	As of now but also to be reiterated in the CA application under Sec. 22 of the EQA	MELCC		
QC2-10	Bonterra **undertakes** to carry out a study to assess the noise level in accordance with section 2.4.1. of the Directive 019 on the mining industry and in the same way, according to the requirements of Note d’instructions 98-01.	Conduct a noise level study that will include, but not be limited to, the identification of fixed, mobile, permanent and temporary noise sources, their location and duration and hours of operation.	5	once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC	The measured sound levels must comply with the sound levels established according to the instructions of Note d’instructions 98-01 (traitement des plaintes sur le bruit et exigences aux entreprises qui le génèrent).	

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC2-11	In section 3.8.2.2.7 of the document “Impact Assessment – Volume I: Main Report” (Wood, 2019), Bonterra **has undertaken** to waterproof the portions of the tailings management area that will not meet the percolation flow criterion of 3.3 L/m²/day (s. 2.9.4 – Directive 019) and mentions that it “will line the areas where the clay cover is insufficient using a layer of clay or a “Bentoflix”-type geomembrane intended to increase the degree of impermeability of the soil in the area.”	Ensure the impermeability of the area identified on the construction plan INF0784-55001.	6	once	During the construction of the tailings management area.	MELCC	Bonterra must consider the results of the modelling under pessimistic conditions to compensate for the sources of uncertainty in the hydrogeological modelling (delimitation of unconsolidated deposits, hydraulic conductivities based on a geometric mean, etc.) during waterproofing work in areas where the clay cover is insufficient.	
QC2-12	Bonterra **s’engage** à aménager des puits d’observation minimalement aux sites des puits virtuels OBS-1, OBS-3 et OBS-5 et ajoutés aux puits retenus dans le programme de suivi environnemental.	Set up at least three observation wells (at the sight of the virtual wells OBS-1, OBS-3 and OBS-5), at two levels (drilled in the unconsolidated deposits and in the bedrock) and added to the wells retained in the environmental monitoring program. The analysis of the results on the quality of groundwater as part of the environmental monitoring must be based on the content of the information file "Analysis of groundwater quality monitoring results, relating to groundwater quality monitoring" available on the Ministry’s website.	7	Continuous	Continuous	MELCC	Sec. 2.3.2 - Directive 019 The operator must install a groundwater monitoring network around developments at risk as defined in Section 2.3.1.1, except in the case where all underlying hydrogeologic formations are Class III without hydraulic connection. In the presence of a tailings accumulation area with Level A or Level B sealing measures, the operator must install a groundwater monitoring network in all cases, without exception.	
QC2-13	Bonterra **undertakes** to use the recommended method for the calculation of background levels of substances in groundwater, "*Guide de caractérisation physicochimique de l’état initial des eaux souterraines avant l’implantation d’un projet industriel*", once it has been made available by the ministry.	Conduct study on the background levels in groundwater circulating within the site's right-of-way using the method recommended by the Ministry (depending on the method available at the time of the study)	8	once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC		

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC2-14	As mentioned in the answers to the previous questions, a final version of the surveillance and monitoring program will be submitted when applying for a certificate of authorization under section 22 of the EQA of the MELCC. This **will be revised** to include the additional monitoring procedures to which Bonterra **committed** in Round 2 of the COMEX questions and to improve the elements related to the control of risks and consequences of a dike failure.	Revise the surveillance and monitoring program by considering the Mining Association of Canada's *Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities* , the additional monitoring procedures in connection with the 2nd round of answers to COMEX questions, and to improve the elements related to the control of risks and consequences of a dike failure.	9	once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC	The surveillance and monitoring program must include the drafting of an Operation, Maintenance, and Surveillance Manual for Tailings and Water Management Facilities based on the Guide produced by the Mining Association of Canada.	
QC2-15	Bonterra **undertakes** to resume this geochemical monitoring program as soon as the Bachelor mill resumes operations.	Carry out geochemical monitoring of tailings. Carry out weekly monitoring and produce an annual report.	10	Sampling once a week	Annually	the Administrator	A geochemical characterization report of the ore and waste rock from the two mining sites as well as the Bachelor mine tailings was carried out by Wood in 2019. According to this report, limited volumes of tailings produced during the milling of Bachelor and Moroy ores could have a neutralization potential ratio (NPR) between 1.5 and 3.	
QC2-16	Bonterra understands that a characterization of these tailings is required in order to validate whether the tailings produced in the future will be acid generating or not.	Carry out a geochemical characterization.	11	Once	2022 **and** to be provided as an addendum to the rehabilitation and restoration plan submitted to the MERN in March 2021.	the Administrator **and** MERN	It is necessary to validate whether the tailings produced in the future will be acid generating or not.	
QC2-23	Bonterra will also **ensure** that the existing regulations are respected throughout the process (declaration, storage of contaminated soil, etc.). In addition, in the event that olfactory or visual signs of contamination are discovered during excavation work, Bonterra will carry out analyses and dispose of hydrocarbon-contaminated soils at an authorized location.	Ensure compliance with current regulations on the management of contaminated soil during excavation work. In the event that signs (olfactory, visual) of contamination are discovered, a soil analysis is to be done and soil management must be carried out accordingly.	12	Continuous	During the work			

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC2-26	A characterization of the backfill **will be performed** prior to the work, so as to cover the risks of soil and airborne contamination. The following parameters **will be analysed**: metals, HP C10-C50, PAH, sulphur, cyanides. Areas of potential contamination (backfill and airborne) will be mapped in the characterization report.	Carry out a characterization of the backfill (minimum parameters: metals, HP C10-C50, PAH, sulphur, cyanides) and produce a map of the risk areas associated with the presence of backfill or airborne contamination.	13	Once	Before the end of the work		Backfill is at risk of containing metal contaminants. Unless a justification on the source of the backfill is provided, these must at least be analyzed for metals, HP C10-C50 and PAH.	
QC2-34	Bonterra **undertakes** to provide the new Bachelor/Moroy *Emergency Response Plan* with the application for a certificate of authorisation under Section 22 of EQA.	Develop an Emergency response plan that includes a fire procedure for Bachelor	14	Once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC		
QC2-35	Instead of including a list of all Material Safety Data Sheets for products used in their activities in its *Environmental Emergency Plan* , Bonterra **undertakes** to include a list of its products used in its *Environmental Emergency Plan* and to consolidate the MSDS for the products listed in the list in binders accessible to employees.	Include the list of products used in their activities in the *Environmental Emergency Plan* and consolidate the Material Safety Data Sheets (MSDS) for the products listed in the list in binders accessible to employees.	15	Once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC		
QC2-37	Bonterra is committed to compliance with the requirements of Natural Resources Canada.		16					

Question number	Excerpt from the response to COMEX	Action to be taken	action #	Frequency	Deadline	Recipient	Purpose	Status
QC2-39	Bonterra **undertakes** to submit a complete compensation plan for wetlands and bodies of water, for approval, within a maximum period of one year following the authorisation of the project.	Produce a compensation plan for wetlands and bodies of water	17	once	1 year after project authorisation	MELCC	To compensate for the loss of wetlands and bodies of water associated with its project, the proponent proposes to create a wetland in an impacted environment near an existing borrow pit. The proposed development covers only a small area compared to the anticipated loss of wetlands.	
QC2-40	Bonterra **undertakes** to provide the volume of material available for all active BNEs on the Barry and Moroy projects, acquire additional BNEs if volumes are insufficient, and file an application for authorisation if it plans to take material from BNEs for anything other than road construction, if applicable.	Carry out a survey study on the active Bachelor/Moroy BNEs.	18	Once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC	To the extent that current volumes of active BNEs are insufficient for road construction, Bonterra will need to obtain additional BNEs.	
QC2-41	A registry to monitor wildlife and user safety **will be created** in 2022 and communicated to the Environment Department as the custodian.	Create and implement a wildlife and user safety monitoring log, record observations and accidents related to local wildlife, and incorporate the results into the annual report.	19	Annually	2022, then annually	COMEX **and** Harmonization committee with Waswanipi	Each accident with an animal will be reported to the environment department that will make an event report following the analysis of the situation. Recommendations will be made to management that will take the necessary measures to avoid or reduce the repetition of the same event. In the event of a high number of complaints from land users or a high number of wildlife-related incidents, the proponent will arrange a meeting with the Harmonization committee and the GIR table of the appropriate sector, in order to discuss the strategy to be adopted to resolve this issue.	
QC2-43	A protocol for the evacuation and transport of injured persons **will be produced** and appended to the Emergency Response Plan for each Bonterra site.	Produce a protocol for the evacuation and transport of injured persons for Bachelor/Moroy.	20	Once	To be submitted as part of the CA application under Sec. 22 of the EQA	MELCC		

QC2-1: MODELLING OF ATMOSPHERIC DISPERSION ATMOSPHÉRIQUE OF CONTAMINANTS REVISION 1, (IMAUSAR, 2022)

REPORT

MODELLING OF ATMOSPHERIC DISPERSON OF CONTAMINANTS STUDY
(Revision 1 for the MELCC)

BONTERRA RESOURCES INC.
200 Chemin de la Mine
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Docket No.: IBTER-2009-01

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SUMMARY

A revised atmospheric dispersion modelling study was conducted in the context of the impact assessment for processing of gold ore from the Barry and Moroy projects and the increase in the milling rate at the Bachelor site in Desmaraisville of Bonterra Resources Inc., about 165 km southwest of Chibougamau, in the Nord-du-Québec region, in territory governed by the James Bay and Northern Québec Agreement (JBNQA). The Ministère de l'Environnement (MELCC), on its list of questions relating to the revised impact assessment by GCM Consultants deposited at the beginning of 2021, raised several points in the modelling study necessitating its revision. It should be noted that modifications and optimizations have been made to the project since the impact study was submitted by Wood (2019). The main change is the withdrawal of the Moroy project, which will increase ore processing from 800 to 1,800 tonnes per day instead of 2,400 tonnes per day, as was initially foreseen. Moreover, optimizations were also carried out to improve the environmental and technical control of operations and result from the progress of the concept engineering stages. They were integrated into the revision of the modelling study.

Following the revision of the modelling of atmospheric dispersion of contaminants with a model approved by the MELCC (AERMOD model), we compared the results obtained with the standards and criteria corresponding to each modelled period (4 minutes, 1 hour, 8 hours, 24 hours or 1 year, all depending on the contaminants). It is proved that, at maximum production, the limit values applicable for certain contaminants are exceeded at the limit of the zone 300 metres or less from the limits of the mining lease:

- The annual hydrogen cyanide criterion;
- The hourly and annual crystalline silica criteria;
- The annual manganese criterion;
- The annual PRAT for sodium tetraborate;
- The annual PRAT for calcium oxide;
- The hourly nitrogen dioxide standard.

However, the areas where the exceedances occur are mostly located near the 300-metre limit around the mine site and no exceedance occurred on a sensitive pinpoint receptor. The impact of these exceedances is therefore considered minor.

Finally, the passage of ore transport trucks does not cause exceedances of the standards applicable to the Indigenous camp closest to the public road. Bonterra Resources also plans to suspend ore transport for two weeks in spring during the snow goose hunting period, and reduce ore transport by at least 25% in the fall during the moose hunt, in order to limit the nuisances for the users of the territory.

1 CORRECTIONS TO BE MADE TO THE LAST MODELLING STUDY

According to the COMEX Questions and Comments dated November 26, 2021, some points must be corrected in the study dated January 20, 2021. The following table presents each point and how this study remedied it.

Table 1.1 Table of Corrections to the Study Dated January 20, 2021

Points to be corrected	Answer
QC2-1. Modelling of hydrogen cyanide (HCN) emissions from the mill shows that the annual criterion is met at all sensitive receptors. On the other hand, the modelling also shows that the annual criterion is exceeded, at a distance of more than 300 metres from the project facilities. The maximum modelled concentration, 300 metres north of the mill, would be 0.32 µg/m³, which corresponds to a 200% exceedance of the applicable annual criterion for HCN, which is 0.16 µg/m³. Consequently, the proponent must submit mitigation measures to control HCN emissions from the mill's eight vents and three outdoor leaching tanks, in addition to the supernatant and recirculation ponds located in the tailings management area. The proposed measures must be integrated into the modelling to demonstrate their impact on the reduction of HCN concentrations in the ambient air. The proponent must also present in its preliminary monitoring and follow-up program how it intends to monitor and ensure the effectiveness of the measures that will be implemented.	A Teams meeting was held last March 9, attended by Ms. Martine Proulx and Mr. Jean-Sébastien Dupont, MELCC experts in Québec. Since the modelled exceedances are limited to a restricted area northwest of the site and no exceedance of the annual hydrogen cyanide criterion occurs at a sensitive receptor located outside the 300 metre zone around the limits of the mining lease, Resources Bonterra Resources must demonstrate that basic mitigation measures have been applied. Thus, Bonterra Resources will ensure to rigorously monitor the process, particularly with regard to the pH maintained in the outdoor leaching tanks, as well as those located in the mill, in order to limit cyanide emissions into the atmosphere. In addition, optimizations are planned for the gas evacuation system in the refinery plant building, which will improve gas dispersion. It is also important to remember that the modelling scenario used, which assumes a concentration of 4 ppm of cyanides at all times in the plant, is very pessimistic and conservative. This value is just below the alarm threshold set in the plant of 5 ppm, the concentration corresponding to the weighted average exposure value (WAEV) for cyanides according to the Regulation respecting health and safety at work, and does not represent normal operating conditions. An update of the preliminary monitoring and follow-up program will be completed as part of the section 22 authorization application and will document the instrumentation and control measures that will be implemented to ensure the effectiveness of process control, particularly with respect to pH.

Points to be corrected	Answer
QC2-2. The proponent presents the operating period of each source only in the emission rate calculation file appended to the modelling report, without specifying whether these are the conditions that were retained in the model. Also, sources S1 (refinery chimney), S2 (Coal furnace chimney), S4 (Lime silo chimney), S6A to S6C (New ore stockpiling activity 1A, 1B 1C), S7 (Secondary ore stockpiling activity), S131 (Loader emissions related to Ore Stockpile 1), S131A to S131C (Loader emissions related to new ore stockpile 1A, 1b and 1C), S132 (Loader emissions related to Ore Stockpile 2), TBB1 (Truck emissions related to Barry ore (1.04 km on active site)) and TBB2 (Truck emissions related to Barry ore (5.92 km off active site)) do not continuously emit particles into the atmosphere. For modelling purposes, a maximum and continuous emission from each of these sources must be considered, i.e. 24 hours a day, 7 days a week, 52 weeks a year, if the daily schedule for these sources is not set, in order to be able to determine the maximum concentrations likely to occur if all the possible sources of dust were in operation simultaneously. Otherwise, the proponent must adjust the modelling according to the daily and annual operating hours of each source. More specifically, the proponent must specify certain information presented in the Excel spreadsheets GI-IBTER-01 - Calculation of emission rate 2021-01-19 and account for the following factor:	
• **Source S1** The proponent indicates that the furnace is powered once a week and operates for a period of six hours at an unspecified time. The proponent must specify how the emission rates were applied in the model.	This is the minimum rate possible over 24 hours, applied 24/24, 365 days/year in the model. The rate is calculated by dividing the maximum quantity of particles emitted during the 6 hours of operation of the furnace by 24 hours and posting the result in g/s. The quantities of materials supplied at the time to the furnace will be reduced relative to the previous version of the study.
• **Source S2** The operating schedule for the coal furnace chimney provided in the spreadsheet is 24 hours per week, up to 3 days per week, at non-specific times. From the information provided, it is not possible to verify that the maximum emission rate of particles per day has been considered in the model. The proponent must specify the operation of the coal furnace, in particular if the furnace is used for eight consecutive hours per day and how the emission rates were applied in the model.	The emission rate is applied 24 hours a day, 365 days a year in the model. It should be noted that the operating schedule of the furnace will be two days a week.
• **Source S4** The proponent assumes that this source produces emissions during the day, from 7:00 a.m. to 5:00 p.m., during the week. However, the emission rate was weighted over a 24-hour period. As indicated in question QC2-2, the emission rate should have been weighted over a period of 10 hours, rather than 24 hours, and applied in the modelling during the hours concerned, 7 days a week. The proponent must explain its choice of weighting over a 24-hour period and specify whether the filling of the lime silo can be carried out at any time of the day.	The emission rates were corrected by weighting them over 10 hours instead of 24 hours and were applied between 7:00 a.m. and 5:00 p.m., 365 days/year in the model. Moreover, by examining the EPA reference used to approximate the efficiency of the dust collector, that of a dust collector of the same type as the one used ("fabric filter") is a minimum of 99%. We therefore applied this efficiency to the calculation of the emission rate. Modelling of this source was repeated. The operating schedule will be twice a month instead of 3 times a month.

Points to be corrected	Answer
- **Sources S6A, S6B and S6C** The proponent must indicate how the emission rates were applied in the model; according to our understanding, the emission rates have been applied to each of the ore stockpiles, which means that the three stockpiles receive material every day.	The proponent changed the projected layout for stockpiling raw ore. It will be stored instead in a stockpile separated in two, one third on one side and two thirds on the other. The emission rates were applied to each of the two piles, which means it is assumed that the two piles receive material every day in proportion to their size. Henceforth there are two sources, S6A and S6B.
- **Sources S9A, S9B, S9C, S10, S19 and S26** Calculations of emission rates generated by wind erosion of particles while stockpiling must be carried out as specified in section 3.10.2.5 of the *Guide d'instructions, préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques – Projets miniers* [Instructional guide, preparation and realization of a modelling of the dispersion of atmospheric emissions – Mining projects]. The equation resulting from the method recommended by the Ministère specifies that the hourly emission factor obtained is in g/m².s [EF (g/m².s) = 1.52 x 10-5 x J x s]. There is therefore no weighting to do with time. However, according to the indications of the spreadsheet, the proponent used the units kg/m² instead. The proponent must correct the emission rates for all the sources concerned and resume the modelling.	An error occurred in the calculations for the emission rates of these sources. The calculations were corrected and modelling of these sources was repeated. Because there will be two raw ore piles from now on, source S9C no longer exists. Moreover, source S26 will no longer exist, because the abandonment of operation of the Moroy deposit means waste rock will no longer be generated.

Points to be corrected	Answer
- **Source S13A** To calculate the emission rates related to transportation, the proponent successively applied two adjustment factors for the unpaved segments, namely the mitigation measure related to the regular watering of the roads (70%) and a mitigation of 44% linked to a 40 km/h speed limit for all transport trucks. This method is not accepted by the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC). It is considered that a reduction in speed generates a reduction in atmospheric emissions, but it will necessarily be less than the value put forward (44%) when the reduction in speed is carried out on a road segment on which there has been spreading of water or dust suppressant. Only one mitigation measure can be considered in the modelling. As a reference, the *National Pollutant Inventory (NPi), Emission Estimation Technique Manual for Mining, Version 3.1* (Australian Government, January 2012) indicates a 75% reduction in emissions for watering with a flow rate greater than 2 litres/m²/h in Table 4 - *Estimated control factors for various mining operations*. In the event that the proponent chooses to apply this mitigation rate, it must commit to maintaining this efficiency at all times. The proponent must also correct the emission rates and resume the modelling. It is considered that, even in winter, different materials will be deposited on the road segments even if the ground is frozen. Particles will then be resuspended during the passage of mining vehicles. The assumption made by the proponent, namely that the emissions of contaminants into the atmosphere are nil for the period from November to April, is not representative. The proponent must consider emissions related to transportation with a mitigation rate similar to that related to the spreading of water or dust suppressant in order to have a more conservative approach.	We made the following corrections in the calculations of the emissions rates of these sources: - A 25% adjustment factor (75% reduction) was applied to the road sectors of the loaders and trucks on the site, between May and October. The same adjustment factor was applied between November and April to account for the winter period, at the suggestion of the MELCC. The proponent undertakes to maintain this efficiency at all times on these segments, with the application of a flow greater than 2 litres/m^2/h. - No speed limit is necessary on road segment TBB1 due to optimization of transportation activities. The 56% optimization factor (44% reduction) between May and October therefore was withdrawn. However, an adjustment factor of 25% (75% reduction) was applied between November and April to take into account the winter period, at the suggestion of the MELCC. Finally, during the Teams call with the MELCC representatives, we clarified the status of road segment TBB2, which had been included in the model. Because this is a road segment of a public road, despite the fact that the proponent maintains this segment to make it safe for ore haulage trucks, it was removed from the model due to its public road status. The rearrangement of the raw ore piles triggered changes in the routes of the trucks and the loader on the site. Moreover, the route of road segment TBB1 was changed slightly. Modelling of these sources was repeated with these changes.

Points to be corrected	Answer
- **Sources S13B and S27B** Schedule H of the *Clean Air Regulation* (CAR) states: “The modeling scenarios must make it possible to reproduce the worst concentrations of contaminants expected according to the period of application of the limit value. (…)” Thus, the scenario chosen to verify compliance with emission standards based on durations of 24 hours or less must take into account the cycle that will have the worst expected contaminant concentrations. According to this reasoning, it should be during the 30-day cycle. Diesel consumption used to calculate contaminant emission rates should be based on daily consumption for operating conditions that occur during the 30-day cycle rather than annual consumption. The same reasoning applies to the calculation of emissions related to gasoline consumption. The proponent must therefore recalculate the emission rates with the daily consumption of diesel and gasoline. The proponent shows in its spreadsheet that it considered three different sources to establish the contaminant emission rates from the combustion of diesel and gasoline. It should be noted that comparison 1 and comparison 3 come from the same source since the NPRI uses the rates of section 3.3 of AP-42 (Stationary Internal Combustion Sources, Gasoline and Diesel Industrial Engines). The choice of contaminant emission rates for diesel is conservative. Section 3.3 of the EPA, dated 1996, refers to higher emission rates than those of the second reference (comparable 2), dated 2016. For information, the emission rates from this reference (Comparison 2) for diesel combustion are considered to be representative for a certain period of use, as mentioned in note b of the document. Volume I of the main project impact study report states that the project aims to process ore at the Bachelor complex over a period of 10 years. There is another reference from the US EPA which proposes a method that takes into account the use of engines in transient state and the assumption of deterioration of emissions over time (US EPA, *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling – Compression Ignition*, Report No. NR-009d, July 2010).	For source S13B, as mentioned for source 13A, road segment TBB2 was removed from the model, because it is part of a public road. The diesel combustion gas emission calculations thus were adjusted accordingly to account for this removal. For sources S13B and S27B, initially, the modelling considered 30-day cycles followed by a 30-day interruption, which was not realistic for transport. Ore therefore will be transported continuously at a daily tonnage lower than was forecast in the initial modelling. Moreover, the maximum weight of the ore transported by truck was reduced from 50 to 42 tonnes. Finally, we corrected an error that had slipped into the previous study. Although the maximum production forecast was previously 2,400 tonnes/day, the maximum tonnage from Barry was always 1,800 tonnes/day. The emission rate calculations due to routing of segment TBB1 were therefore corrected to a maximum tonnage transported of 1,800 tonnes/day. Emission rate calculations related to diesel combustion have been modified to take this into account. Fuel consumption was also evenly distributed over 365 days/year. We retained the three references regarding the emission factors. We added the factor to the second reference to account for the transitional regime and the deterioration over time. The emission factors chosen for the emission rate calculations is the most conservative of the three. As mentioned previously, the rearrangement of the raw ore piles triggered changes in the routes of the trucks and the loader on the site. Moreover, the route of road segment TBB1 was changed slightly. Modelling of these sources was repeated with the new emission rates calculated.

Points to be corrected	Answer
• **Source S14** The emission rates obtained on an hourly basis must be used in the modelling of the atmospheric dispersion of contaminants. The proponent should refer to Schedule H of the CAR for verification of compliance with emission standards based on different time periods. The proponent must provide the two references cited in the spreadsheet regarding data on crystalline silica emissions generated by underground operations.	This source will no longer exist for this project, because operation of the Moroy deposit is abandoned.
• **Sources S15 and S16** The calculator developed by Colorado, available as an Excel file, is not an official publication. It was not possible to verify the origin of all the information contained in it, in particular, the mass percentage of contaminants contained in the emissions from the vent of the gasoline and diesel tanks. The proponent must provide the source of these percentages or refer to another publication.	We found the link to download the calculator. A copy of this link is in Appendix G: https://oitco.hylandcloud.com/POP/DocPop/DocPop.aspx?docid=7055891 It turns out that the reference used for this calculator comes from EPA database AP-42, Table 5.2-5. No change was made to the emission rates already calculated.
• **Sources S20A to S20G** The first alarm threshold for the cyanide concentration being at 5 ppm, a cyanide concentration of 4 ppm should be considered (instead of 1 ppm) in order to obtain the most conservative scenario.	Following the Teams call with the MELCC experts, the modelling will be done by assuming a concentration of 4 ppm in the ambient air of the mill, both for verification compliance with the 4-minute and annual hydrogen cyanide criteria. Obviously, this is a very conservative value, because the alarm threshold is set at 5 ppm, which corresponds to the weighted average exposure value over 8 hours (WAEV) in Schedule 1 of the *Regulation respecting occupational health and safety (ROHS).* The modelling of this source has been resumed with the new emission rates calculated.
• **Sources S21A to S21C** The molar mass ratio (MWCN/MWHCN) seems to have been applied twice, rather than once, in the equation. If this is not the case, the proponent must provide more detail regarding its calculation.	Effectively, this had been applied twice a year. The calculation was corrected and modelling of these sources was repeated.

Points to be corrected	Answer
- **Source S27A** Even in winter, different materials will be deposited on the road segments even if the ground is frozen. Particles will then be resuspended during the passage of mining vehicles. The assumption made by the proponent, namely that the emissions of contaminants into the atmosphere are nil for the period from November to April, is not representative. The proponent must consider emissions related to transportation with a mitigation rate similar to that related to the spreading of water or dust suppressant in order to have a more conservative approach.	A 25% adjustment factor (75% reduction) was applied to the road segment between November and April, similar to the one related to spreading of water or dust suppressant. No adjustment factor was used between May and October. As mentioned previously, changes were made for the calculation of the emission rate of road segment TBB1 in order to reflect the maximum tonnage from Barry, which was always 1,800 tonnes/day. The calculations were corrected and modelling of this source was repeated.
QC2-3. In Table 5.2.1 of the modelling of atmospheric dispersion of contaminants study (Appendix 12), the emission heights from the mill roof vents (S20A to S20G), from the laboratory dust collector chimney (S22) and from the explosives bags kiln chimney (S23) differ from the information presented in the emission rate calculation file appended to the report. These elements must be checked and corrected, if necessary. In addition, in the case of source S23, given that it is positioned on the dry tailings impoundment areas covered with waste rock (S26), the base elevation must include the height corresponding to the pile of materials that will be stored under it.	Transcription errors occurred in Table 5.2.1. They are corrected in this revised report. Source S23 will no longer be used, because the abandonment of operation of the Moroy deposit means abandonment of the use of explosives. As mentioned previously, source S26 will also no longer exist, because waste rock will no longer be generated.

Points to be corrected	Answer
QC2-4. Given that the application for authorization concerns an increase in the production capacity of the ore processing mill from 800 to 2,400 tonnes per day as well as the expansion of the tailings management area, compliance with section 197 of the CAR must be demonstrated. Thus, if the projected situation still shows exceedances of the standard for total particles and of the annual atmospheric quality criterion for hydrogen cyanide (HCN) following the revision of the modelling, the proponent must present a modelling scenario corresponding to the currently authorized situation and a scenario of the projected situation. The scenarios should be carried out using the same methodology. In particular, the proponent must ensure that the version of the AERMOD model, the meteorological data and the characteristics of each source that are not affected by the project are identical. This should make it possible to assess the impact of the new project on ambient air quality and determine whether it leads to an increase in the concentration of contaminants for which exceedances were observed in the currently authorized situation.	In the attached revised calculation file of emission rates, the emission rates for total particulate matter and HCN were calculated according to the current situation, with ore processing mill production of 800 tonnes per day. The details were added in green to each tab of the file. To be able to represent current emission sources properly and calculate their rates, we used two documents: - Genivar, *Modélisation de la dispersion atmosphérique des particules dans l'air ambiant* (Modelling of atmospheric dispersion of particles in the ambient air), report dated November 2011; - Wood, *Étude des impacts, Traitement de minerai aurifère des projets Barry et Moroy au site Bachelor et augmentation du taux d'usinage (Impact Statement, Processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase in the milling rate), Desmaraisville, Québec, TX17021601-000-REI-0001-0*, September 26, 2019. Modelling of these two parameters, according to the emission rates equivalent to the current processing production of 800 tonnes/day, was done. Finally, we note that the maximum production concerned now decreases from 2,400 to 1,800 tonnes/day.

Since the modelling study dated January 20, 2021 was issued, Bonterra has made some optimizations to the project. All of them were integrated into this revision of the study. Here is the list:

- Operation of the Moroy deposit is abandoned. The site will only be used to process ore from the Barry site. Consequently, the ore processing capacity was revised downward from 2,400 to 1,800 tonnes/day;
- An annex will be constructed and attached to the mill, in which the future semi-autogenous grinding mill will be installed;
- The future thickeners and 3 cyanidation tanks will be surrounded by an enclosure serving as retention volume. The dimensions of the tanks have changed. Their diameter will be about 40 feet (38 feet in reality, but the modelling accounted for a value of 40 feet to be more conservative);
- The ventilation of the current building where the cyanidation tanks are located will be modified. Three chimneys will be installed on the roof of the mill to discharge air from the mill at a flow equivalent to 1 air change per hour, which is the minimum required according to the Regulation respecting occupational health and safety (ROHS);
- The roof heights of the current building were changed in the model to represent the reality better according to the plans obtained from the client. This resulted in height changes for certain emission sources;

- A new building will be constructed to accommodate the future primary crusher. The building will be completely closed and a dust collector equivalent to the one used for the current crusher building will be attached to it;
- The current crusher building will no longer be used for this purpose;
- A dome, closed on three sides, will be installed on the site downstream from the future crusher building to store the crushed material temporarily. A closed conveyor system will transport the crushed material to this dome. Another closed conveyor system will transport the material from the dome to the mill. The material stockpile under this dome does not represent a new source;
- The raw ore stockpiling layout has changed. An ore stockpile with a capacity of 55,000 tonnes, separated into two sections of 1/3-2/3 for the new primary crusher building, will be developed, instead of the three stockpiles with a respective capacity of 15,000 tonnes previously planned;
- The secondary ore stockpile will no longer be present on the site.
- There will no longer be waste rock piles on the site because only the Berry ore will be milled;
- The stockpiling area to the northwest will no longer be expanded;
- The route of the southwest access road (source TBB1) was modified slightly.

These modifications also led to changes to the road routes on the site, which were also integrated into the revision of the study. All the modifications and annotations in the revised calculation file of emission rates in Appendix G appear in red for easier understanding.

2 ATMOSPHERIC MODELLING

To predict the potential concentrations of atmospheric contaminants around the mine site and especially at the closest sensitive receptors, atmospheric dispersion of the contaminants was modelled with the *AERMOD* Level 2 model included in the *AERMOD View* software from *Lakes Environmental*, version 11.0.0. This version of the software corresponds to version 22112 of the EPA's *AERMOD* model.

2.1 MODELLED CONTAMINANTS

Depending on the activities planned on the mine site and the MELCC's requirements, 33 contaminants must be modelled. These contaminants are released into the atmosphere through the emission points mentioned in section 2.2.

Table 2.1.1 Modelled Contaminants

Contaminant	CAS number	State of the contaminant
Antimony (Sb)	7440-36-0	Non volatile
Arsenic (As)	7440-38-2	Non volatile
Barium (Ba)	7440-39-3	Non volatile
Beryllium (Be)	7440-41-7	Non volatile
Cadmium (Cd)	7440-43-9	Non volatile
Chromium (Cr)	7440-47-3	Non volatile
Copper (Cu)	7440-50-8	Non volatile
Mercury (Hg)	7439-97-6	Non volatile
Nickel (Ni) (in PM_{10})	7440-02-0	Non volatile
Lead (Pb)	7439-92-1	Non volatile
Vanadium (V)	7440-62-2	Non volatile
Zinc (Zn)	7440-66-6	Non volatile
Silver (Ag)	7440-22-4	Non volatile
Cobalt (Co)	7440-48-4	Non volatile
Manganese (Mn) (in PM_{10})	7439-96-5	Non volatile
Selenium (Se)	7782-49-2	Non volatile
Tin (Sn)	7440-31-5	Non volatile
Tellurium (Te)	13494-80-9	Non volatile
Titanium (Ti) (in PM_{10})	7440-32-6	Non volatile
Sodium tetraborate	1330-43-4	Non volatile
Hydrogen cyanide (HCN)	74-90-8	Volatile
Calcium oxide (CaO)	1305-78-8	Non volatile
Benzene	71-43-2	Volatile
Hexane	110-54-3	Volatile
Toluene	108-88-3	Volatile
Ethylbenzene	100-41-4	Volatile
Xylenes	1330-20-7	Volatile

Contaminant	CAS number	State of the contaminant
Fine particulate matter ($PM_{2.5}$)	-	Non volatile
Total particulate matter (TPM)	-	Non volatile
Crystalline silica	14808-60-7	Non volatile
Nitrogen dioxide (NO_2)	10102-44-0	Volatile
Sulphur dioxide (SO_2)	7446-09-05	Volatile
Carbon monoxide (CO)	630-08-0	Volatile

The atmospheric modelling was performed in accordance with the provisions of the *Guide de la modélisation de la dispersion atmosphérique* (Atmospheric dispersion modelling guide), April 2005, the form *Devis de modélisation de la dispersion atmosphérique (modélisation de niveau 2)* (Atmospheric dispersion modelling specifications (Level 2 modelling), February 2009 and the *Guide d'instructions, Préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques, Projets miniers* (Instruction guide, Preparation and completion of modelling of the dispersion of atmospheric emissions, Mining projects), February 2017.

2.2 EMISSION SOURCES

You will find the details concerning the emission sources in the calculation file in Appendix G, including the assumptions and calculations produced for the emission rates. Compared to the April 2019 study, changes were made to the characteristics of certain sources and some sources were added. Some of these changes were made according to the notice provided by the MELCC, and others as corrections to represent the reality better.

2.2.1 FUTURE SITUATION

The following tables show the 26 emission sources used for atmospheric modelling, according to the future situation. The changes made in relation to the previous report of January 2021 are in underlined bold italics.

Table 2.2.1.1 **Pinpoint Sources**

Source: (S1)	Refinery chimney	**Contaminants:**	PM, $PM_{2.5}$, metals, $Na_2B_4O_7$	**UTM coordinates:**	**X (m):**	416,969.42
				Y (m):		5,483,464.15
Emission height (m):	4.88	**Equivalent diameter (m) :**		0.61	**Emission speed (m/s) :**	Close to 0°F
Temperature (K):	1866	**Emission rate (g/s):**		See Appendix G	**Reference:**	
Source: (S2)	Coal furnace chimney	**Contaminants:**	PM, $PM_{2.5}$	**UTM coordinates:**	**X (m):**	416,977.66
				Y (m):		5,483,442.86
Emission height (m):	12.88	**Equivalent diameter (m) :**		0.203	**Emission speed (m/s) :**	11.4
Temperature (K):	973	**Emission rate (g/s):**		See Appendix G	**Reference:**	F

Table 2.2.1.1 Pinpoint Sources (continued)

Source:	Dust collector chimney New crusher building (S3)	**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,064.34
					Y (m):	5,483,626.04
Emission height (m):	15.77	**Equivalent diameter (m)** :	0.34	**Emission speed (m/s)** :		46.78
Temperature (K):	293	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Lime silo chimney (S4)	**Contaminants:**	PM, $PM_{2.5}$, CaO	**UTM coordinates:**	**X (m):**	417,014.2
					Y (m):	5,483,488.5
Emission height (m):	24.77	**Equivalent diameter (m)** :	0.152	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
~~**Source:**~~	~~Discharge shaft (S14)~~	~~**Contaminants:**~~	~~CO, NO_x, SO_2, PM, $PM_{2.5}$, metals~~	~~**UTM coordinates:**~~	~~**X (m):**~~	~~417,137.55~~
					~~**Y (m) :**~~	~~5,483,607.32~~
~~**Emission height (m):**~~	~~38.1~~	~~**Equivalent diameter (m) :**~~	~~2.43~~	~~**Emission speed (m/s) :**~~		~~6.82~~
~~**Temperature (K):**~~	~~Amb.~~	~~**Emission rate (g/s):**~~	~~See Appendix G~~	~~**Reference :**~~		~~F~~
Source:	Diesel tank vent (S15)	**Contaminants:**	VOC	**UTM coordinates:**	**X (m):**	416,933.67
					Y (m):	5,483,601.68
Emission height (m):	1	**Equivalent diameter (m)** :	0.1	**Emission speed (m/s)** :		Close to 0
Temperature (K):	Amb.	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Gasoline tank vent (S16)	**Contaminants:**	VOC	**UTM coordinates:**	**X (m):**	416,940
					Y (m):	5,483,596.64
Emission height (m):	1	**Equivalent diameter (m)** :	0.1	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Future roof chimney Mill (S20H)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,979.38
					Y (m):	5,483,441.21
Emission height (m):	17.88	**Equivalent diameter (m)** :	0.33	**Emission speed (m/s)** :		16.74
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Future roof chimney Mill (S20I)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,987.43
					Y (m):	5,483,451.95
Emission height (m):	17.88	**Equivalent diameter (m)** :	0.33	**Emission speed (m/s)** :		16.74
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Future roof chimney Mill (S20J)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,993.89
					Y (m):	5,483,461.01
Emission height (m):	17.88	**Equivalent diameter (m)** :	0.33	**Emission speed (m/s)** :		16.74
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Dust collector chimney Laboratory (S22)	**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):**	416,968.83
					Y (m):	5,483,446.33
Emission height (m):	12.88	**Equivalent diameter (m)** :	0.3048	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
~~**Source:**~~	~~Kiln chimney - explosives bags (S23)~~	~~**Contaminants:**~~	~~CO, NO_x, PM,~~ PM~~$_{2.5}$~~, COV	~~**UTM coordinates:**~~	~~**X (m):**~~	~~417,181.21~~
					~~**Y (m):**~~	~~5,483,408.52~~
~~**Emission height (m):**~~	~~1.37~~	~~**Equivalent diameter (m) :**~~	~~0.1524~~	~~**Emission speed (m/s) :**~~		~~Close to 0~~
~~**Temperature (K):**~~	~~873.15~~	~~**Emission rate (g/s):**~~	~~See Appendix G~~	~~**Reference :**~~		~~F~~

Table 2.2.1.2 Volume Sources

Source:	Secondary ore stockpiling 1A (S6A)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):**417,043.83 **Y (m):**5,483,722.01
Emission height (m):	2	**Source length (m)** :	1	**Source thickness (m)** :	3
σy: 0.47	**σz:** 0.7	**Emission rate (g/s):**	See Appendix G	**Reference:**	F
Source:	Secondary ore stockpiling 1B (S6B)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):**416,933.80 **Y (m):**5,483,672.23
Emission height (m):	2	**Source length (m)** :	1	**Source thickness (m)** :	3
σy: 0.47	**σz:** 0.7	**Emission rate (g/s):**	See Appendix G	**Reference:**	F

Table 2.2.1.3 Surface Sources

Source:	Loading - future exterior hopper (S5)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):** 417,054.12 **Y (m):** 5,483,634.34
Emission height (m):	1.22	**Source length (m)** :	4.37	**Source width (m)** :	5.82
σz:	n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**	F
Source:	Erosion - topsoil and overburden stockpile (S19)	**Contaminants:**	PM, PM$_{2.5}$	**UTM coordinates:**	**X (m):** 417,762.96 **Y (m):** 5,483,339.82
Emission height (m):	4.5	**Source length (m)** :	148.4	**Source width**:	220
σz:	n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**	F

Source S12, which corresponded to wind erosion of a dry portion of the tailings management area (about 10% of the area) is no longer taken into account. According to Bonterra, the tailings management area will be kept wet at all times to prevent particulates matter from being carried away by the wind. The precise details of the means that will be used to keep the tailings management area wet at all times will be described in the detailed engineering of the tailings management area, which still has to be done.

Table 2.2.1.4 Circular Surface Sources

Source:	Exterior tank Leaching #1 (S21A)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):** 416,991.63 **Y (m):** 5,483,422.07
Emission height (m):	14.9	**Diameter of the source (m)** :	6.1	**Number of peaks:**	20
σz:	n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**	F
Source:	Exterior tank Leaching #2 (S21B)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):** 417,003.03 **Y (m):** 5,483,413.74
Emission height (m):	14.9	**Diameter of the source (m)** :	6.1	**Number of peaks:**	20
σz:	n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**	F
Source:	Exterior tank Leaching #3 (S21C)	**Contaminants:**	PM, PM$_{2.5}$, metals, HCN	**UTM coordinates:**	**X (m):** 417,012.76 **Y (m):** 5,483,425.64
Emission height (m):	14.9	**Diameter of the source (m)** :	6.1	**Number of peaks:**	20
σz:	n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**	F

Table 2.2.1.5 Polygonal Surface Sources

Source:	Ore stockpile erosion 1A (S9A)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,296.88
					Y (m):	5,483,293.75
Emission height (m):	2	**Emission rate (g/m2/s):**	See Appendix G	**Reference:**		F
Area (m$_2$): 3346.4	**1**	**X (m):**	417,030.68	**7**	**X (m):**	417,116.79
		Y (m):	5,483,723.27		**Y (m):**	5,483,652.39
Peaks (11):	**2**	**X (m):**	417,034.11	**8**	**X (m):**	417,102.72
		Y (m):	5,483,730.04		**Y (m):**	5,483,637.84
	3	**X (m):**	417,080.49	**9**	**X (m):**	417,090.07
		Y (m):	5,483,698.18		**Y (m):**	5,483,640.26
	4	**X (m):**	417,090.28	**10**	**X (m):**	417,082.65
		Y (m):	5,483,697.38		**Y (m):**	5,483,647.78
	5	**X (m):**	417,101.49	**11**	**X (m):**	417,075.71
		Y (m):	5,483,689.87		**Y (m):**	5,483,650.22
	6	**X (m):**	417,121.43			
		Y (m):	5,483,670.53			

Source:	Ore stockpile erosion 1B (S9B)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,296.88
					Y (m):	5,483,293.75
Emission height (m):	2	**Emission rate (g/m2/s):**	See Appendix G	**Reference:**		F
Area (m$_2$): 6713.1	**1**	**X (m):**	416,924.27	**7**	**X (m):**	417,016.63
		Y (m):	5,483,664.26		**Y (m):**	5,483,621.76
Peaks (11):	**2**	**X (m):**	416,977.11	**8**	**X (m):**	416,998.32
		Y (m):	5,483,723.98		**Y (m):**	5,483,617.42
	3	**X (m):**	417,003.47	**9**	**X (m):**	416,984.48
		Y (m):	5,483,704.94		**Y (m):**	5,483,618.69
	4	**X (m):**	417,001.92	**10**	**X (m):**	416,950.03
		Y (m):	5,483,699.04		**Y (m):**	5,483,632.14
	5	**X (m):**	417,029.65	**11**	**X (m):**	416,944.40
		Y (m):	5,483,644.35		**Y (m):**	5,483,637.08
	6	**X (m):**	417,026.59			
		Y (m):	5,483,635.69			

Table 2.2.1.5 Polygonal Surface Sources (continued)

Source:	Supernatant pond (S24)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	417,296.88
					Y (m):	5,483,293.75
Emission height (m):	0	**Emission rate (g/m$_2$/s):**	See Appendix G	**Reference:**		F
Area (m$_2$): 638,712.6	**1**	**X (m):**	417,296.88	**14**	**X (m):**	416,857.71
		Y (m):	5,483,293.75		**Y (m):**	5,482,791.60
Peaks (25):	**2**	**X (m):**	417,259.38	**15**	**X (m):**	416,853.07
		Y (m):	5,483,193.75		**Y (m):**	5,482,785.53
	3	**X (m):**	417,181.25	**16**	**X (m):**	417,131.25
		Y (m):	5,483,115.63		**Y (m):**	5,482,590.63
	4	**X (m):**	417,128.13	**17**	**X (m):**	417,984.38
		Y (m):	5,483,200.00		**Y (m):**	5,482,750.00
	5	**X (m):**	417,050.00	**18**	**X (m):**	418,090.63
		Y (m):	5,483,293.75		**Y (m):**	5,482,837.50
	6	**X (m):**	416,990.63	**19**	**X (m):**	418,025.00
		Y (m):	5,483,343.75		**Y (m):**	5,483,150.00
	7	**X (m):**	416,925.00	**20**	**X (m):**	417,834.38
		Y (m):	5,483,300.00		**Y (m):**	5,483,212.50
	8	**X (m):**	416,850.00	**21**	**X (m):**	417,721.98
		Y (m):	5,483,025.00		**Y (m):**	5,483,215.86
	9	**X (m):**	416,859.38	**22**	**X (m):**	417,714.27
		Y (m):	5,482,987.50		**Y (m):**	5,483,013.99
	10	**X (m):**	416,906.25	**23**	**X (m):**	417,413.67
		Y (m):	5,482,946.88		**Y (m):**	5,483,024.80
	11	**X (m):**	416,925.00	**24**	**X (m):**	417,420.48
		Y (m):	5,482,862.50		**Y (m):**	5,483,230.37
	12	**X (m):**	416,881.25	**25**	**X (m):**	417,400.00
		Y (m):	5,482,800.00		**Y (m):**	5,483,231.25
	13	**X (m):**	416,864.28			
		Y (m):	5,482,789.54			

Table 2.2.1.5 Polygonal Surface Sources (continued)

Source:	Recirculation pond (S25)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	417,336.42
					Y (m):	5,483,274.47
Emission height (m):	0	**Emission rate (g/m2/s):**	See Appendix G	**Reference:**		F

Area (m$_2$): 92,968	**1**	**X (m):**	417,336.42	**7**	**X (m):**	417,718.28
		Y (m):	5,483,274.47		**Y (m):**	5,483,396.29
Peaks (11):	**2**	**X (m):**	417,407.71	**8**	**X (m):**	417,766.99
		Y (m):	5,483 478,05		**Y (m):**	5,483,318.79
	3	**X (m):**	417,655.11	**9**	**X (m):**	417,778.33
		Y (m):	5,483,476.34		**Y (m):**	5,483,270.51
	4	**X (m):**	417,708.36	**10**	**X (m):**	417,790.66
		Y (m):	5,483,460.73		**Y (m):**	5,483,217.31
	5	**X (m):**	417,698.45	**11**	**X (m):**	417,400.25
		Y (m):	5,483,440.08		**Y (m):**	5,483,233.45
	6	**X (m):**	417,697.90			
		Y (m):	5,483,415.57			

~~**Source:**~~	~~Dry tailings impoundment area covered with waste rock (S26)~~	~~**Contaminants:**~~	PM, PM$_{2.5}$, ~~metals~~	~~**UTM coordinates:**~~	~~**X (m):**~~	~~417,402.12~~
					~~**Y (m):**~~	~~5,483,472.73~~
~~**Emission height (m):**~~	~~3.25~~	**Emission rate (g/m2/s):**	~~See Appendix G~~	~~**Reference:**~~		~~F~~

Area (m$_2$): 107,309.9	~~**1**~~	~~**X (m):**~~	~~417,402.12~~	~~**13**~~	~~**X (m):**~~	~~417,008.80~~
		~~**Y (m):**~~	~~5,483,472.73~~		~~**Y (m):**~~	~~5,483,378.96~~
~~**Peaks (23):**~~	~~**2**~~	~~**X (m):**~~	~~417,335.99~~	~~**14**~~	~~**X (m):**~~	~~416,997.60~~
		~~**Y (m):**~~	~~5,483,527.55~~		~~**Y (m):**~~	~~5,483,338.90~~
	~~**3**~~	~~**X (m):**~~	~~417,298.57~~	~~**15**~~	~~**X (m):**~~	~~417,049.53~~
		~~**Y (m):**~~	~~5,483,559.74~~		~~**Y (m):**~~	~~5,483,294.80~~
	4	~~**X (m):**~~	~~417,261.15~~	~~**16**~~	~~**X (m):**~~	~~417,131.90~~
		~~**Y (m):**~~	~~5,483,579.75~~		~~**Y (m):**~~	~~5,483,196.62~~
	~~**5**~~	~~**X (m):**~~	~~417,224.61~~	~~**17**~~	~~**X (m):**~~	~~417,181.63~~
		~~**Y (m):**~~	~~5,483,594.55~~		~~**Y (m):**~~	~~5,483,116.28~~
	~~**6**~~	~~**X (m):**~~	~~417,180.23~~	~~**18**~~	~~**X (m):**~~	~~417,258.06~~
		~~**Y (m):**~~	~~5,483,608.47~~		~~**Y (m):**~~	~~5,483,193.51~~
	~~**7**~~	~~**X (m):**~~	~~417,166.31~~	~~**19**~~	~~**X (m):**~~	~~417,296.82~~
		~~**Y (m):**~~	~~5,483,582.37~~		~~**Y (m):**~~	~~5,483,294.62~~
	~~**8**~~	~~**X (m):**~~	~~417,148.91~~	~~**20**~~	~~**X (m):**~~	~~417,330.41~~
		~~**Y (m):**~~	~~5,483,543.21~~		~~**Y (m):**~~	~~5,483,275.29~~
	~~**9**~~	~~**X (m):**~~	~~417,107.14~~	~~**21**~~	~~**X (m):**~~	~~417,360.42~~
		~~**Y (m):**~~	~~5,483,478.82~~		~~**Y (m):**~~	~~5,483,360.31~~
	~~**10**~~	~~**X (m):**~~	~~417,092.97~~	~~**22**~~	~~**X (m):**~~	~~417,386.79~~
		~~**Y (m):**~~	~~5,483,481.81~~		~~**Y (m):**~~	~~5,483,451.24~~
	~~**11**~~	~~**X (m):**~~	~~417,085.44~~	~~**23**~~	~~**X (m):**~~	~~417,402.2436~~
		~~**Y (m):**~~	~~5,483,481.25~~		~~**Y (m):**~~	~~5,483,462.147~~
	~~**12**~~	~~**X (m):**~~	~~417,027.70~~			
		~~**Y (m):**~~	~~5,483,408.44~~			

Table 2.2.1.6 Volume Line Sources

Source: Truck unloading route (S131)* **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σ_y:** 4 **σ_z:** 2.53
Total length (m): 172.7 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	416,920.80	5,483,670.64
2	416,941.78	5,483,705.82
3	416,954.38	5,483,721.27
4	416,966.32	5,483,734.23
5	416,981.70	5,483,744.37
6	417,000.54	5,483,747.87
7	417,022.95	5,483,748.08
8	417,053.06	5,483,731.81

Source: Ore stockpile 1A (S131A)* **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σ_y:** 4 **σ_z:** 2.53
Total length (m): 52 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,049.86	5,483,693.07
2	417,053.99	5,483,641.26

Source: Ore stockpile 1B (S131B)* **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σ_y:** 4 **σ_z:** 2.53
Total length (m): 60 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,009.53	5,483,681.99
2	417,053.26	5,483,640.94

Table 2.2.1.6 Volume Line Sources (continued)

Source: Between TBB1 and S131 (S132)* **Configuration:** Adjacent **Max vehicle height (m):** 3.2

Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single

Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σ_y:** 4 **σ_z:** 2.53

Total length (m): 484 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,000.35	5,483,371.17
2	417,045.82	5,483,439.57
3	417,054.29	5,483,448.39
4	417,084.92	5,483,485.99
5	417,103.94	5,483,503.08
6	417,121.00	5,483,530.02
7	417,153.91	5,483,572.19
8	417,162.82	5,483,590.03
9	417,166.82	5,483,609.66
10	417,177.10	5,483,619.22
11	417,162.61	5,483,643.92
12	417,146.37	5,483,660.05
13	417,127.19	5,483,679.58
14	417,047.79	5,483,735.73

Table 2.2.1.6 **Volume Line Sources (continued)**

Source: Barry trucks (TBB1)* **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σ_y:** 4 **σ_z:** 2.53
Total length (m): 1178.4 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,000.35	5,483,371.15
2	416,900.00	5,483,323.00
3	416,871.00	5,483,260.00
4	416,833.00	5,483,094.00
5	416,840.00	5,483,000.00
6	416,836.77	5,482,984.35
7	416,830.55	5,482,974.19
8	416,815.94	5,482,971.85
9	416,800.00	5,482,971.00
10	416,773.30	5,482,965.53
11	416,748.68	5,482,957.59
12	416,723.73	5,482,949.59
13	416,700.00	5,482,938.00
14	416,690.11	5,482,923.81
15	416,683.67	5,482,904.06
16	416,674.00	5,482,800.00
17	416,674.00	5,482,713.00
18	416,684.86	5,482,674.10
19	416,708.00	5,482,642.00
20	416,908.00	5,482,477.00

*The configuration of this road segment has been changed since the 2019 study.

References: **C:** sampling campaign

N: nominal value provided by the manufacturer
F: emission factor (mention the reference)
E: estimate taken from the documentation (mention the reference)
A: other (specify)

2.2.2 CURRENT SITUATION

The following tables show the 26 emission sources used for atmospheric modelling, according to the current situation.

Table 2.2.2.1 Pinpoint Sources

Source:	Refinery chimney (S1)	**Contaminants:**	PM, $PM_{2.5}$, metals, Na2B4O7	**UTM coordinates:**	**X (m):**	416,972.84
					Y (m):	5,483,460.93
Emission height (m):	4.88	**Equivalent diameter (m)** :	0.61	**Emission speed (m/s)** : See		Close to 0
Temperature (K):	1866	**Emission rate (g/s):**	Appendix G	**Reference:**		F
Source:	Coal furnace chimney (S2)	**Contaminants:**	PM, PM2.5	**UTM coordinates:**	**X (m):**	416,977.66
					Y (m):	5,483,442.86
Emission height (m):	9.3	**Equivalent diameter (m)** :	0.203	**Emission speed (m/s)** :		11.4
Temperature (K):	973	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Dust collector chimney crusher building (S3)	**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,058.2
					Y (m):	5,483,533.7
Emission height (m):	12.2	**Equivalent diameter (m)** :	0.34	**Emission speed (m/s)** :		46.78
Temperature (K):	293	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Lime silo chimney (S4)	**Contaminants:**	PM, PM2.5, CaO	**UTM coordinates:**	**X (m):**	417,014.2
					Y (m):	5,483,488.5
Emission height (m):	20	**Equivalent diameter (m)** :	0.152	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Discharge shaft (S14)	**Contaminants:**	CO, NOx, SO2, PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,137.55
					Y (m):	5,483,607.32
Emission height (m):	38.1	**Equivalent diameter (m)** :	2.43	**Emission speed (m/s)** :		6.82
Temperature (K):	Amb.	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Diesel tank vent (S15)	**Contaminants:**	VOC	**UTM coordinates:**	**X (m):**	416,933.67
					Y (m):	5,483,601.68
Emission height (m):	1	**Equivalent diameter (m)** :	0.1	**Emission speed (m/s)** :		Close to 0
Temperature (K):	Amb.	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Gasoline tank vent (S16)	**Contaminants:**	VOC	**UTM coordinates:**	**X (m):**	416,940
					Y (m):	5,483,596.64
Emission height (m):	1	**Equivalent diameter (m)** :	0.1	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		F

Table 2.2.2.1 Pinpoint Sources (continued)

Source:	Mill roof vent (S20A)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,975.71
					Y (m):	5,483,435.87
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20B)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,980
					Y (m):	5,483,441.60
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20C)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,984.04
					Y (m):	5,483,447.40
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20D)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416987.74
					Y (m):	5,483,452.62
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	Amb.	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20E)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,991.27
					Y (m):	5,483,457.67
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20F)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,994.47
					Y (m):	5,483,462.55
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Mill roof vent (S20G)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	416,998.17
					Y (m):	5,483,467.17
Emission height (m):	9.3	**Equivalent diameter (m)** :	1.69	**Emission speed (m/s)** :		0.001
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		O
Source:	Dust collector chimney Laboratory (S22)	**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):**	416,969.3
					Y (m):	5,483,443.41
Emission height (m):	9.3	**Equivalent diameter (m)** :	0.3048	**Emission speed (m/s)** :		Close to 0
Temperature (K):	293.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Kiln chimney - explosives bags (S23)	**Contaminants:**	CO, NO_x, PM, PM2.5, VOC	**UTM coordinates:**	**X (m):**	417,181.21
					Y (m):	5,483,408.52
Emission height (m):	1.37	**Equivalent diameter (m)** :	0.1524	**Emission speed (m/s)** :		Close to 0
Temperature (K):	873.15	**Emission rate (g/s):**	See Appendix G	**Reference:**		F

Table 2.2.2.2 Volume Sources

Source:	Exterior conveyor loading (S5)			**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):** **Y (m):**	417,030.70 5,483,561.25
Emission height (m):			0	**Source length (m)** :	1.63	**Source thickness (m)** :		1
σy:	0.38	**σz:**	0.23	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Secondary ore stockpiling activity (S6)			**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):** **Y (m):**	417,073.03 5,483,631.94
Emission height (m):			7.5	**Source length (m)** :	1	**Source thickness (m)** :		15
σy:	0.23	**σz:**	0.7	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Secondary ore stockpiling activity (S7)			**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):** **Y (m):**	417,064.82 5,483,495.33
Emission height (m):			7.5	**Source length (m)** :	2.6	**Source thickness (m)** :		15
σy:	0.6	**σz:**	0.23	**Emission rate (g/s):**	See Appendix G	**Reference:**		F

Table 2.2.2.3 Surface Sources

Source:	Main ore stockpile erosion (S9)			**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):** **Y (m):**	417,037.97 5,483,645.46
Emission height (m):			7.5	**Source length (m)** :	70	**Source width (m)** :		40
σz:			n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**		F
Source:	Ore stockpile erosion secondary (S10)			**Contaminants:**	PM, $PM_{2.5}$, metals	**UTM coordinates:**	**X (m):** **Y (m):**	417,033.45 5,483,489.62
Emission height (m):			7.5	**Source length (m)** :	30	**Source width (m)** :		40
σz:			n/a	**Emission rate (g/s):**	See Appendix G	**Reference:**		F

Table 2.2.2.4 Polygonal Surface Sources

Source:	Supernatant pond (S24)	**Contaminants:**	HCN	**UTM coordinates:**	**X (m):**	417,420.94
					Y (m):	5,483,449.24
Emission height (m):	0	**Emission rate (g/m2/s):**	See Appendix G	**Reference:**		F
Area (m2): 340,011.3	**1**	**X (m):**	417,420.94	**24**	**X (m):**	417,171.83
		Y (m):	5,483,449.24		**Y (m):**	5,482,758.75
Peaks (45):	**2**	**X (m):**	417,413.63	**25**	**X (m):**	417,193.71
		Y (m):	5,483,441.51		**Y (m):**	5,482,759.08
	3	**X (m):**	417,397.84	**26**	**X (m):**	417,193.14
		Y (m):	5,483,438.52		**Y (m):**	5,482,661.95
	4	**X (m):**	417,359.11	**27**	**X (m):**	417,218.67
		Y (m):	5,483,293.51		**Y (m):**	5,482,664.99
	5	**X (m):**	417,309.75	**28**	**X (m):**	417,276.39
		Y (m):	5,483,125.11		**Y (m):**	5,482,700.54
	6	**X (m):**	417,191.25	**29**	**X (m):**	417,318.47
		Y (m):	5,483,060.81		**Y (m):**	5,482,703.05
	7	**X (m):**	417,216.74	**30**	**X (m):**	417,350.17
		Y (m):	5,482,995.47		**Y (m):**	5,482,695.79
	8	**X (m):**	417,171.48	**31**	**X (m):**	417,422.40
		Y (m):	5,482,905.26		**Y (m):**	5,482,702.99
	9	**X (m):**	417,147.60	**32**	**X (m):**	417,441.39
		Y (m):	5,482,868.34		**Y (m):**	5,482,717.06
	10	**X (m):**	417,132.64	**33**	**X (m):**	417,459.36
		Y (m):	5,482,843.50		**Y (m):**	5,482,719.54
	11	**X (m):**	417,112.69	**34**	**X (m):**	417,495.14
		Y (m):	5,482,819.76		**Y (m):**	5,482,729.96
	12	**X (m):**	417,082.37	**35**	**X (m):**	417,595.08
		Y (m):	5,482,800.00		**Y (m):**	5,482,735.00
	13	**X (m):**	417,066.76	**36**	**X (m):**	417,633.82
		Y (m):	5,482,785.46		**Y (m):**	5,482,755.93
	14	**X (m):**	417,056.80	**37**	**X (m):**	417,660.39
		Y (m):	5,482,745.39		**Y (m):**	5,482,761.62
	15	**X (m):**	417,048.07	**38**	**X (m):**	417,673.62
		Y (m):	5,482,719.63		**Y (m):**	5,482,809.56
	16	**X (m):**	417,050.39	**39**	**X (m):**	417,662.15
		Y (m):	5,482,700.37		**Y (m):**	5,482,908.99
	17	**X (m):**	417,068.96	**40**	**X (m):**	417,710.44
		Y (m):	5,482,666.74		**Y (m):**	5,482,992.14
	18	**X (m):**	417,078.78	**41**	**X (m):**	417,749.39
		Y (m):	5,482,653.93		**Y (m):**	5,483,162.72
	19	**X (m):**	417,091.60	**42**	**X (m):**	417,770.96
		Y (m):	5,482,650.01		**Y (m):**	5,483,189.93
	20	**X (m):**	417,123.86	**43**	**X (m):**	417,769.47
		Y (m):	5,482,653.68		**Y (m):**	5,483,230.37
	21	**X (m):**	417,127.89	**44**	**X (m):**	417,748.55
		Y (m):	5,482,690.74		**Y (m):**	5,483,275.77
	22	**X (m):**	417,145.23	**45**	**X (m):**	417,634.16
		Y (m):	5,482,700.34		**Y (m):**	5,483,451.00
	23	**X (m):**	417,164.24			
		Y (m):	5,482,697.02			

Table 2.2.2.4 Polygonal Surface Sources (continued)

Source:	Dry tailings impoundment area covered with waste rock (S26)	**Contaminants:**	PM, PM$_{2.5}$, metals	**UTM coordinates:**	**X (m):**	417,402.12
					Y (m):	5,483,472.73
Emission height (m):	3.25	**Emission rate (g/m2/s):**	See Appendix G	**Reference:**		F
Area (m2): 107,309.9	**1**	**X (m):**	417,402.12	**13**	**X (m):**	417,008.80
		Y (m):	5,483,472.73		**Y (m):**	5,483,378.96
Peaks (23):	**2**	**X (m):**	417,335.99	**14**	**X (m):**	416,997.60
		Y (m):	5,483,527.55		**Y (m):**	5,483,338.90
	3	**X (m):**	417,298.57	**15**	**X (m):**	417,049.53
		Y (m):	5,483,559.74		**Y (m):**	5,483,294.80
	4	**X (m):**	417,261.15	**16**	**X (m):**	417,131.90
		Y (m):	5,483,579.75		**Y (m):**	5,483,196.62
	5	**X (m):**	417,224.61	**17**	**X (m):**	417,181.63
		Y (m):	5,483,594.55		**Y (m):**	5,483,116.28
	6	**X (m):**	417,180.23	**18**	**X (m):**	417,258.06
		Y (m):	5,483,608.47		**Y (m):**	5,483,193.51
	7	**X (m):**	417,166.31	**19**	**X (m):**	417,296.82
		Y (m):	5,483,582.37		**Y (m):**	5,483,294.62
	8	**X (m):**	417,148.91	**20**	**X (m):**	417,330.41
		Y (m):	5,483,543.21		**Y (m):**	5,483,275.29
	9	**X (m):**	417,107.14	**21**	**X (m):**	417,360.42
		Y (m):	5,483,478.82		**Y (m):**	5,483,360.31
	10	**X (m):**	417,092.97	**22**	**X (m):**	417,386.79
		Y (m):	5,483,481.81		**Y (m):**	5,483,451.24
	11	**X (m):**	417,085.44	**23**	**X (m):**	417,402.24
		Y (m):	5,483,481.25		**Y (m):**	5,483,462.15
	12	**X (m):**	417,027.70			
		Y (m):	5,483,408.44			

Table 2.2.2.5 Volume Line Sources

Source: Segment A (SEGMENTA) **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σy:** 4 **σz:** 2.53
Total length (m): 25.4 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,048.39	5,483,584.86
2	417,035.45	5,483,563.00

Source: Segment B (SEGMENTB) **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σy:** 4 **σz:** 2.53
Total length (m): 68.2 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,073.03	5,483,631.94
2	417,037.52	5,483,601.15
3	417,036.17	5,483,599.98

Source: Segment C (SEGMENTC) **Configuration:** Adjacent **Max vehicle height (m):** 3.2
Plume height (m): 5.44 **Emission height (m):** 2.72 **Lane type:** Single
Maximum vehicle width (m): 2.6 **Plume width (m):** 8.6 **σy:** 4 **σz:** 2.53
Total length (m): 133.5 **Emission rate (g/s):** See Appendix G **Reference:** F

Volume source nodes	X (m)	Y (m)
1	417,064.82	5,483,495.33
2	417,095.43	5,483,508.90
3	417,088.77	5,483,562.09

References: **C:** sampling campaign
N: nominal value provided by the manufacturer
F: emission factor (mention the reference)
E: estimate taken from the documentation (mention the reference)
A: other (specify)

2.3 AIR QUALITY STANDARDS AND CRITERIA

According to the CAR, air quality standards are associated with certain contaminants modelled in this study. Moreover, for other contaminants, the MELCC has set air quality criteria or preliminary risk assessment thresholds (PRAT). The following table presents them.

Table 2.3.1 Air Quality Standards and Criteria

Contaminant	CAS	Standard, criterion or RRAT	Limit value (µg/m_3)	Initial concentration (µg/m_3)	Period
Antimony (Sb)	7440-36-0	Standard	0.17	0.001	1 year
Arsenic (As)	7440-38-2	Standard	0.003	0.002	1 year
Barium (Ba)	7440-39-3	Standard	0.05	0.025	1 year
Beryllium (Be)	7440-41-7	Standard	0.0004	0	1 year
Cadmium (Cd)	7440-43-9	Standard	0.0036	0.0005	1 year
Chromium (Cr)	7440-47-3	Standard	0.1	0.01	1 year
Copper (Cu)	7440-50-8	Standard	2.5	0.2	24 hours
Mercury (Hg)	7439-97-6	Standard	0.005	0.002	1 year
Nickel (Ni) (in 10)	7440-02-0	Standard	0.07	0.005	24 hours
			0.02	0.002	1 year
Lead (Pb)	7439-92-1	Standard	0.1	0.004	1 year
Vanadium (V)	7440-62-2	Standard	1	0.01	1 year
Zinc (Zn)	7440-66-6	Standard	2.5	0.1	24 hours
Silver (Ag)	7440-22-4	Criterion	0.23	0.005	1 year
Cobalt (Co)	7440-48-4	Criterion	0.1	0	1 year
Manganese (Mn) (in PM10)	7439-96-5	Criterion	0.025	0.005	1 year
Selenium (Se)	7782-49-2	Criterion	2	0.15	1 hour
Tin (Sn)	7440-31-5	Criterion	2	0	4 minutes
			0.1	0	1 year
Tellurium (Te)	13494-80-9	Criterion	1	0	1 hour
Titanium (Ti) (in PM10)	7440-32-6	Criterion	2.5	0	24 hours
Sodium tetraborate	1330-43-4	PRAT	2.22	0	1 hour
			0.004	0	1 year
Hydrogen cyanide (HCN)	74-90-8	Criterion	50	0	4 minutes
			0.16	0	1 year
CaO	1305-78-8	PRAT	2.22	0	1 hour
			0.004	0	1 year
Benzene	71-43-2	Standard	10	3	24 hours
Hexane	110-54-3	Standard	5,300	140	4 minutes
			140	3	1 year
Toluene	108-88-3	Standard	600	260	4 minutes
Ethylbenzene	100-41-4	Standard	740	140	4 minutes
			200	3	1 year
Xylenes	1330-20-7	Standard	350	150	4 minutes
			20	8	1 year
Fine particulate matter (PM$_{2.5}$)	-	Standard	30	15	24 hours
Total particulate matter	-	Standard	120	40	24 hours
Crystalline silica	14808-60-7	Criterion	23	6	1 hour
			0.07	0.04	1 year

Contaminant	CAS	Standard, criterion or RRAT	Limit value (µg/m3)	Initial concentration (µg/m3)	Period
Nitrogen dioxide (NO_2)	10102-44-0	Standard	414	50	1 hour
			207	30	24 hours
			103	10	1 year
Sulphur dioxide (SO_2)	7446-09-05	Standard	1,050*	40	4 minutes
			288	10	24 hours
			52	2	1 year
Carbon monoxide (CO)	630-08-0	Standard	34,000	600	1 hour
			12,700	400	8 hours

* This limit value may be exceeded up to 0.5% of the time on an annual basis, without exceeding 1,310 µg/m3.

The initial concentrations entered for each contaminant come from two references:

- The file “Normes et critères québécois de qualité de l’atmosphère, version 6” (Québec air quality standards and criteria, version 6), available at the following address (reference 1) : https://environnement.gouv.qc.ca/air/criteres/Normes-criteres-qc-qualite- atmosphere.xlsx
- Table 1 on page 29 of the document “Guide d’instructions, Préparation et réalisation d’une modélisation de la dispersion des émissions atmosphériques, Projets miniers” (Instruction guide, Preparation and completion of modelling of the dispersion of atmospheric emissions, Mining projects), available at this address (reference 2: https://environnement.gouv.qc.ca/air/criteres/secteur_minier.pdf

Table 1 of the second reference mentions recommended initial concentrations or northern projects (north of the 51st parallel) when these projects are remote from other sources. In the case of this project, the site is located on the 49th parallel. However, according to the NPRI website, there are no other sources within a 50 km radius around the study site. Thus, for all the contaminants issued by the site that have initial concentrations applicable in the northern environment, the proponent wishes to apply them for the modelling study. For all others, the initial considerations mentioned in the first reference will be used.

All the limit values (standards, criteria or preliminary risk assessment thresholds (PRAT)) are taken from reference 1. The standards are also presented in Schedule K of the Clean Air Regulation (CAR).

2.4 OTHER INDUSTRIAL SOURCES AROUND THE STUDY SITE

After doing research on the NPRI website, we did not find any industrial source possibly emitting contaminants common with the study site within a 5 km radius around this site.

2.5 WEATHER DATA AND STATISTICS

The surface weather data used for modelling was provided by Environment Canada. On the MELCC's recommendation, we chose hourly data from the Chibougamau-Chapais Airport weather station. For the period, according to:

the quality analysis performed by AERMET, the surface data is complete at over 98.66% for all the parameters required. The period present an average wind speed of 3.18 m/s and a calm wind frequency of 4.81%.

Concerning the aerological data, again on the MELCC's recommendation, we chose the Maniwaki aerological station. All the aerological and surface data covers five full years, from 2006 to 2010. For the period, according to the quality analysis performed by AERMET, the aerological data is complete at over 99.22% for all the parameters required. The weather data was converted and processed with the *AERMET processor to generate an hourly weather data file* (.sfc and .pfl).

2.6 AERMET SURFACE CHARACTERISTICS

The land use parameters (albedo, Bowen ratio, roughness) were estimated by analyzing the Natural Resources Canada maps *Earth Observation for Sustainable Development of Forests* (EOSD), through the AERMET View tool (via the "land use creator" function).

These parameters are calculated for the weather station, as expected by the MELCC. However, the land use for the commercial/industrial/transport use zones was awarded code 21 (low-density residential) in the original file and was corrected for the right type, i.e. code 23 (specified here as an airport site it AERSURFACE).

The values of the parameters are calculated per season for 2 sectors (of more than 30°) by using the AERSURFACE tool in AERMET View, which calculates and applies the values recommended according to the use of the surfaces for each sector based on the procedure approved by the MELCC (the US-EPA procedure with adjustments specific to Québec's reality):

- Calculation of the albedo by season for the 10 km by 10 km region;
- Calculation of the Bowen ratio by season for the 10 km by 10 km region;
- Calculation of surface roughness by season for the 1 km region for 2 sectors (of a maximum of 30 degrees):
- Sector 1 - 0 to 190 degrees (primarily the airport)
- Sector 2 - 190 to 0 degrees (mix of forest types)
- Assume snow cover for winter;

The "Randomize wind directions" option is activated.[1]

The surface characteristics must be calculated on a seasonal or monthly basis and the definition of the seasons, according to the MELCC, is as follows:

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[1] The wind directions are reported every 10 degrees by Environment Canada.

➢ Spring:	May and June;
➢ Summer:	July and August;
➢ Fall:	September and October;
➢ Winter:	November to April.

The following figures present the 10 km by 10 km region and the sectors within a 1 km radius around the study site.

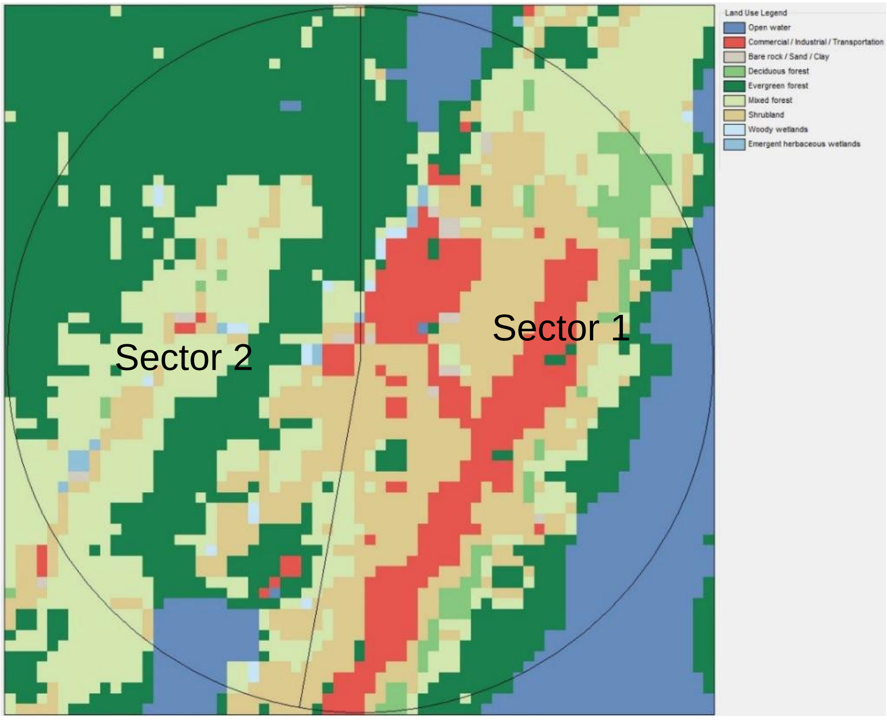


Figure 2.6.1: Surface Types in 1 km Zone and Sectors Viewing Through AERMET View (Wood and EGS Ecosupport, 2019)

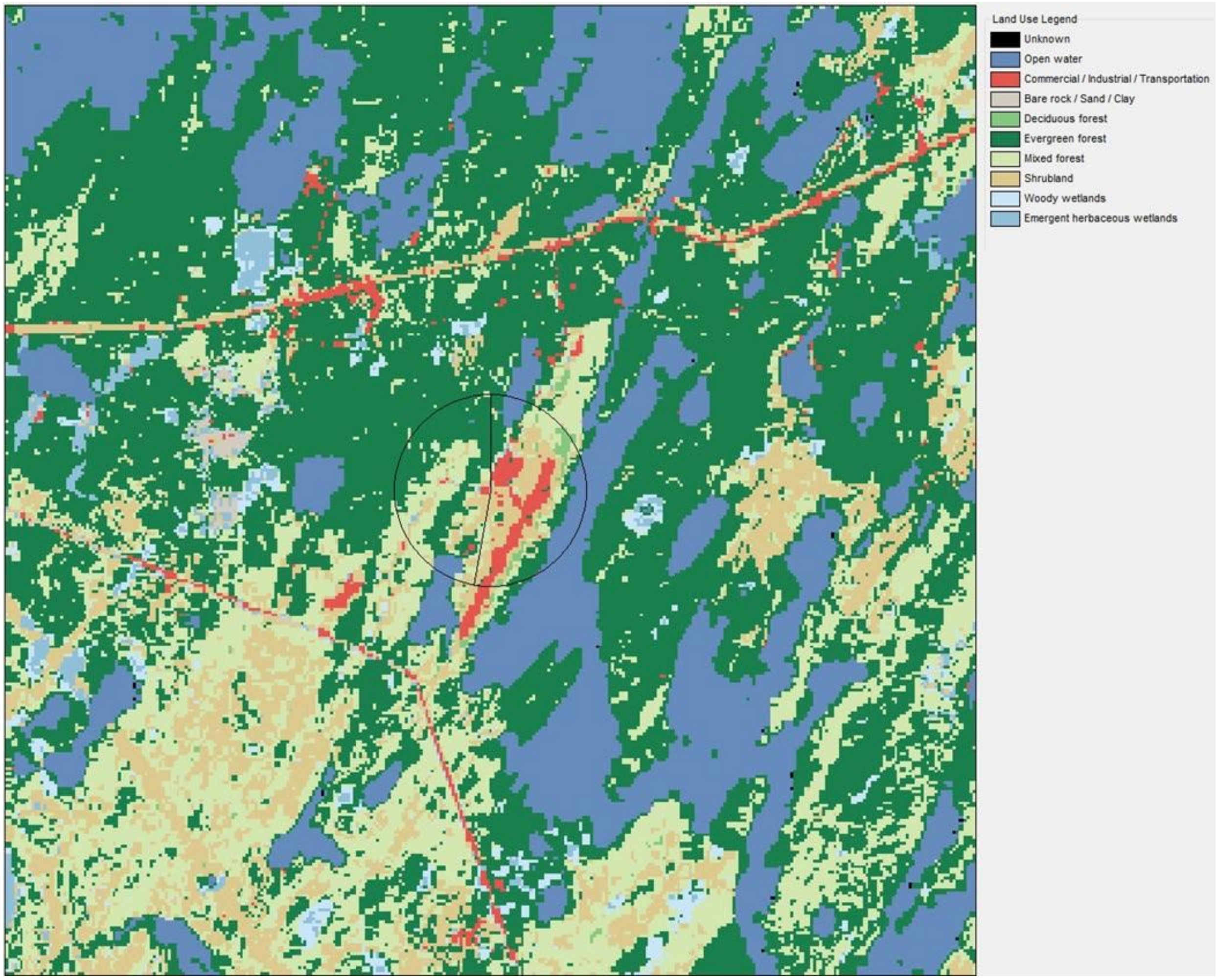


Figure 2.6.2: Surface Types in 10 km Zone Viewing Through AERMET View (Wood and EGS Ecosupport, 2019)

Table 4.6.1 presents the surface parameters, as entered in AERMET. The "Adjust Surface Friction Velocity (ADJ_U*)" option was applied in AERMET for data processing, so the "Adjusted Friction Velocity" option is applied in AERMOD. As requested by the MELCC, the Bowen ratio was corrected to 0.5 in winter to account for the expanses of frozen water during this season.

Table 2.6.1 Values of *AERMET Surface Characteristics*

Parameter		Season			
		Sp	Su	F	W
Albedo		0.130	0.130	0.130	0.33
Bowen ratio		0.47	0.27	0.55	0.500
Roughness by sector	Sectors				
	0-190°	0.185	0.19	0.179	0.133
	190-0°	0.661	0.696	0.62	0.529

Sp: Spring – to be defined (months): May and June
Su: Summer – to be defined (months): July and August
F: Fall – to be defined (months): September and October
W: Winter – to be defined (months): November to April

2.7 WIND ROSE

A wind rose was generated with the *WRPlot View* software from *Lakes Environmental* (see Appendix B.) This wind rose was produced for 16 wind directions. It can be seen that the prevailing winds are from the west.

2.8 PHYSICAL AND DISPERSION PARAMETERS

2.8.1 MIXING HEIGHT

Based on the weather data used for modelling, the *AERMOD* model automatically calculates the mixing heights.

2.8.2 RURAL/URBAN AREA

Because less than 50% of the land use is urban within a 3 km radius around the source, we determined that the area is rural, as mentioned in section 4.11 of the *Guide de la modélisation de la dispersion atmosphérique* (Atmospheric dispersion modelling guide).

2.8.3 TOPOGRAPHY OF THE TERRAIN

Because the difference in altitude between certain receptors is more than 10 metres, the land elevations were integrated during modelling. The *AERMAP* program included with the software was used to import the land elevations of the modelling area. The files from which the land elevations were extracted are files in DEM format - 15 minutes. They have a precision of approximately 23 m. These files were downloaded directly from the *AERMAP* program.

2.8.4 BUILDING EFFECT

The building effect was considered for modelling, because the BPIP program included in the software was used. The true dimensions of the buildings on the study site were used. The plan in Appendix C shows the main buildings of the study site. A map of the area of influence of the buildings is in Appendix D. No change has been made since the April 2019 Wood and Ecosupport report was issued.

2.9 RECEPTOR GRIDS

According to the *Guide de la modélisation de la dispersion atmosphérique* (Atmospheric dispersion modelling guide), the receptor grid for a Level 2 model must cover a minimum of 10 km by 10 km. We modelled a receptor grid with irregular rectangular mesh to have more receptors near the study site. The following table shows the grid mesh dimensions according to the distance of the barycentre from the emission points.

Table 2.9.1 Receptor Grid Mesh Dimensions (Near the Mine Site)

Grid dimensions around the study site	Mesh dimensions
2 km by 2 km	**100 m by 100 m**
4 km by 4 km	**200 m by 200 m**
10 km by 10 km	**500 m by 500 m**

Moreover, another receptor grid 1 km by 1 km was used for the modelling scenario around the Indigenous camp near the Barry-Bachelor road.

Table 2.9.2 Receptor Grid Mesh Dimensions (Near the Indigenous Ca\mp)

Grid dimensions around the study site	Mesh dimensions
1 km by 1 km	**100 m by 100 m**

We used satellite photos imported from Google Earth© to help locate the study site and the receptors. The maps with modelling domain are in Appendix E.

6 sensitive pinpoint receptors were located around the study site, described in the table below. Moreover, there are 209 discrete receptors at the limits of the area 300 metres or less from the limits of the mining lease, to obtain a receptor each 100 metres. It should be noted that the receptors included in the zone located 300 metres or less from the limits of the mining lease were removed from the grid, as required by the *Guide d'instructions, Préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques, Projets miniers* (Instruction guide, Preparation and completion of modelling of the dispersion of atmospheric emissions, Mining projects). None of the sensitive receptors is less than 300 metres from the limits of the mining lease.

Table 2.9.3 Sensitive Pinpoint Receptors

No	X (m)	Y (m)	Z (m)	Description
1	415,448.20	5,482,799.04	346.22	Mining camp
2	415,700.48	5,481,909.44	327	Permanent Cree camp
3	413,995.26	5,484,403.16	312	Village of Desmaraisville
4	415,551.42	5,485,701.49	317.12	Landfill site
5	419,269.30	5,487,511.25	294.49	Vacation properties/Cottages, campgrounds
6	419,133.97	5,485,973.33	296.02	Camp
7	408,727.41	5,453,414.15	321	Indigenous camp near the Barry-Bachelor road

Moreover, at the MELCC's request, we added an Indigenous camp to the sensitive pinpoint receptors, south of the study site, located near the road used by the ore transport trucks from the Barry site to the Bachelor site mill. An alternative modelling scenario was produced to determine the impact on this camp of the passage of ore transport trucks.

The maps of the sensitive pinpoint receptors are in Appendix E.

2.10 INFORMATION ON THE METHODOLOGY USED FOR MODELLING

Several assumptions were used to calculate the emission rates. They are described in the tabs specific to each source of the emission rate calculation file in Appendix G.

The "Summation" tab compiles the emission rates for each contaminant by emission point.

2.10.1 MODELLING OVER PERIODS OF LESS THAN ONE HOUR

Because the model used does not allow simulation of dispersion of periods shorter than one hour, verification of compliance with standards of less than one hour requires special processing. According to the *Guide de la modélisation de la dispersion atmosphérique* (Atmospheric dispersion modelling guide), we can calculate the concentration over four-minute periods based on the one-hour concentration as follows:

$$C_{4\text{ minutes}} = 1.91\ C_{1\text{ hour}}$$

In addition, certain contaminants have initial concentrations in the ambient air. We took them into account for the modelling. Thus, for example, for modelling of sulphur dioxide over four minutes, because this was done over 1 hour, the concentration not to be exceeded at the limit of the area 300 metres or less from the limits of the mining lease is:

$$\frac{1{,}050\ \mu g/m^3 - 40\ \mu g/m^3}{1.91} = 528.796\ \mu g/m^3$$

2.10.2 VARIABLE EMISSIONS

For certain emission sources, emission factors were used in the model, via the "Variable Emissions" option, to account for the variability of the emissions according to certain factors, i.e. the wind speed, the time of day and the month of the year. All the details of this aspect are in the emission rate calculation file in Appendix G.

2.11 MODELLING RESULTS

2.11.1 PRINCIPAL MODELLING DOMAIN – DESIRED FUTURE SITUATION

As mentioned in section 4.3 of the *Guide d'instructions, Préparation et réalisation d'une modélisation de la dispersion des émissions atmosphériques, Projets miniers* (Instruction guide, Preparation and completion of modelling of the dispersion of atmospheric emissions, Mining projects) were examined at the limit of the area 300 metres or less from the limits of the mining lease and the sensitive pinpoint receptors of the modelling domain, to ensure compliance with the air quality standards and criteria. The modelling results presented in graphs generated by the software and the output files of all the scenarios on the software are in Appendix G.

The first table shows the results in maximum values, at the limit of the area 300 metres or less from the limits of the mining lease and for each of the 6 sensitive pinpoint receptors near the site, obtained for several contaminants, accounting for the entire receptor grid. These modelling scenarios were produced by using the "Multi-Chemical Run" option that allows modelling of several contaminants simultaneously.

Table 2.11.1.1 Maximum Concentrations Obtained Around the Mine Site

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m$_3$)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m^3)	Limit value (µg/m^3)
Antimony (Sb)	1 year	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.17
Arsenic (As)	1 year	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.003
Barium (Ba)	1 year	0.028	0.02	0.02	0.02	0.02	0.02	0.02	0.05
Beryllium (Be)	1 year	0	0	0	0	0	0	0	0.0004
Cadmium (Cd)	1 year	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0036
Chromium (Cr)	1 year	0.011	0.01	0.01	0.01	0.01	0.01	0.01	0.1
Copper (Cu)	24 hours	0.25	0.2	0.2	0.2	0.2	0.2	0.2	2.5
Mercury (Hg)	1 year	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.005
Nickel (Ni) (in PM$_{10}$)	24 hours	0.016	0.006	0.005	0.005	0.005	0.005	0.005	0.014
	1 year	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.02
Lead (Pb)	1 year	0.005	0.004	0.004	0.004	0.004	0.004	0.004	0.1
Vanadium (V)	1 year	0.015	0.01	0.01	0.01	0.01	0.01	0.01	1
Zinc (Zn)	24 hours	0.15	0.1	0.1	0.1	0.1	0.1	0.1	2.5
Silver (Ag)	1 year	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.23
Cobalt (Co)	1 year	0	0	0	0	0	0	0	0.1
Manganese (Mn) (In PM$_{10}$)	1 year	**0.035**	0.006	0.005	0.005	0.006	0.005	0.005	0.025
Selenium (Se)	1 hour	0.15	0.15	0.15	0.15	0.15	0.15	0.15	2
Tin (Sn)	4 minutes	0	0	0	0	0	0	0	2
	1 year	0	0	0	0	0	0	0	0.1
Tellurium (Te)	1 hour	0	0	0	0	0	0	0	1

Table 2.11.1.1 Maximum Concentrations Obtained Around the Mine Site (continued)

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m$_3$)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m^3)	Limit value (µg/m^3)
Titanium (Ti) (in PM$_{10}$)	24 hours	0.18	0.01	0.01	0.01	0.01	0	0	2.5
Crystalline silica	1 hour	**71.35**	17.19	12.68	10.11	11.46	6.81	7.29	23
	1 year	**0.95**	0.06	0.05	0.05	0.06	0.04	0.05	0.07
Calcium oxide (CaO)	1 hour	1.16	0.22	0.16	0.11	0.12	0.03	0.05	2.22
	1 year	**0.0043**	0.0002	0.0001	0.0001	0.0002	0.0001	0.0001	0.004
Sodium tetraborate	1 hour	0.17	0.06	0.06	0.05	0.05	0.03	0.04	2.22
	1 year	**0.0058**	0.0006	0.0005	0.0004	0.0007	0.0003	0.0005	0.004
Benzene	24 hours	8.89	3.25	3.15	3.1	3.12	3.02	3.01	10
Hexane	4 minutes	309.47	150.29	145.71	143.32	144.31	140.58	140.88	5,300
	1 year	3.81	3.02	3.01	3.01	3.02	3	3	140
Toluene	4 minutes	453.12	271.61	266.44	263.74	264.86	260.65	261	600
Ethylbenzene	4 minutes	152.35	140.74	140.41	140.24	140.31	140.04	140.06	740
	1 year	3.06	3	3	3	3	3	3	200
Xylenes	4 minutes	199.28	152.95	151.64	150.95	151.24	150.17	150.28	350
	1 year	8.23	8.01	8	8	8	8	8	20
Sulphur dioxide (SO2)	4 minutes	103.26	48.03	44.59	42.74	43.83	40.52	40.89	1,050
	24 hours	18.48	10.43	10.29	10.16	10.21	10.02	10.03	288
	1 year	2.68	2.01	2.01	2.01	2.01	2	2	52
Carbon monoxide (CO)	1 hour	1232.82	679.95	645.06	626.94	637.57	604.98	608.61	34,000
	8 hours	732.39	421.64	415.26	407.53	411.13	400.97	401.73	12,700

The results obtained for all the modelled contaminants in this scenario show compliance with the applicable standards and criteria, except the manganese criterion, the crystalline silica criteria and the annual PRAT for sodium tetraborate and calcium oxide. In the case of manganese, sodium tetraborate and calcium oxide, their annual limit values are exceeded in a small area that extends beyond the 300-metre area around the limit of the mining lease, without reaching a sensitive pinpoint receptor. The sodium tetraborate emission rate, included in the melting agents used in the ore refining furnace, was calculated by assuming that the particle emission rate is equal to the maximum rate permitted according to the process feed rate according to Schedule C of the CAR. This emission rate is probably overestimated in relation to reality and the exceedance of the limit value of a PRAT does not necessitate the presentation of a corrective measure to the MELCC. For crystalline silica, the exceedances of the 1-hour and 1-year limit values occurred over larger areas, but without reaching a sensitive receptor. According to the Teams discussion held last March 9 with the MELCC representative, exceedances of standards or criteria outside the area of 300 metres around the limit of the mining lease should not be problematic if the exceedances do not reach any sensitive receptor.

The other contaminants were modelled in separate scenarios to be able to analyze the results in more detail, because the “Multi-Chemical Run” option does not allow analysis of exceedances, for example. The following tables show the results of these contaminants.

Table 2.11.1.2 Maximum Concentrations Obtained Around the Mine Site for Hydrogen Cyanide

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m^3)	Limit value (µg/m^3)
Hydrogen cyanide (HCN)	4 minutes	31.32	11.43	8.35	5.76	6.81	1.78	1.93	50
	1 year	**0.45**	0.04	0.03	0.02	0.03	0.01	0.02	0.16

The annual criterion is exceeded in an area to the northwest that exceeds the 300 metre area around the limit of the mining lease, without reaching the sensitive pinpoint receptor. The impact due to this exceedance is therefore minimal.

Table 2.11.1.3 Maximum Concentrations Obtained Around the Mine Site for Fine Particulate Matter

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m³)	Limit value (µg/m³)
Particulate matter	24 hours	29.89	15.82	15.68	15.37	15.46	15.09	15.1	30

The standard for this contaminant is respected at all times for all receptors.

Table 2.11.1.4 Maximum Concentrations Obtained Around the Mine Site for Total Particulate Matter

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m³)	Limit value (µg/m³)
Total particulate matter	24 hours	108.06	51.74	49.74	43.28	43.4	41.01	40.64	120

The standard for this contaminant is respected at all times for all receptors.

Table 2.11.1.5 Maximum Concentrations Obtained Around the Mine Site for Nitrogen Dioxide (NO_2)

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m_3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m^3)	Limit value (µg/m^3)
Nitrogen dioxide (NO_2)	1 hour	**520.32**	110.24	84.44	70.71	78.96	53.91	56.73	414
	Number of hourly exceedances	**129 (0.29%)**	0	0	0	0	0	0	---
	24 hours	151.15	36.17	34.24	32.34	32.99	30.35	30.45	207
	1 year	19.82	10.19	10.17	10.1	10.18	10.03	10.06	103

Nitrogen dioxide exceedances occurred in an area to the northwest that exceeds the 300 metre area around the limit of the mining lease, without reaching the sensitive pinpoint receptor. The impact due to these exceedances is therefore minimal.

2.11.2 PRINCIPAL MODELLING DOMAIN – CURRENT SITUATION

The following tables show the results in maximum values, at the limit of the area 300 metres or less from the limits of the mining lease and for each of the 6 sensitive pinpoint receptors near the site, obtained for hydrogen cyanide and total particulate matter, accounting for the entire receptor grid. These modelling scenarios were produced at the request of the MELCC to determine if there is an increase in the concentration of these contaminants for which exceedances were observed in the currently authorized situation.

Table 2.11.2.1 Maximum Concentrations Obtained Around the Mine Site for Hydrogen Cyanide

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m^3)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m^3)	Limit value (µg/m^3)
Hydrogen cyanide (HCN)	4 minutes	43.05	9.04	4.19	2.54	3.27	0.46	0.54	50
	1 year	**0.41**	0.02	0.02	0.01	0.02	0	0.01	0.16

The maximum concentrations of this contaminant, according to the current situation, are higher than those forecast according to the future situation over the 4-minute period. This is due to the fact that, currently, hydrogen cyanide emissions from the mill's tanks are discharged passively into the atmosphere via 7 roof vents, which disperses the emissions less efficiently.

Table 2.11.2.2 Maximum Concentrations Obtained Around the Mine Site for Total Particulate Matter

Contaminant	Period	Maximum concentration at the limit of the area 300 metres around the limit of the mining lease, including the initial concentration (µg/m3)	Maximum concentration at sensitive pinpoint receptor #1, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #2, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #3, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #4, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #5, including the initial concentration (µg/m³)	Maximum concentration at sensitive pinpoint receptor #6, including the initial concentration (µg/m³)	Limit value (µg/m³)
Total particulate matter	24 hours	91.39	44.48	43.32	41.52	43.92	40.33	40.73	120
	Maximum number of exceedances	0	0	0	0	0	0	0	---

The current situation does not cause exceedances of the standards at the limit of the 300-metre area around the limit of the mining lease.

2.11.3 SECONDARY MODELLING DOMAIN

Because the repeated passage of trucks transporting ore from the Barry site to the Bachelor site risks causing an impact on the atmospheric emissions generated near the road, the MELCC wishes to know the consequences of compliance with the standards and criteria applicable to the Indigenous camp located closest to the public road used by the trucks. The following table presents the maximum results obtained for the receptor grid of 1 km by 1 km, centred on the Indigenous camp.

Table 2.11.3.1 Maximum Concentrations Obtained Around the Indigenous Camp Located Near the Barry-Bachelor Road

Contaminant	Period	Maximum concentration in the modelling domain 1 km by 1 km, including the initial concentration (µg/m³)	Maximum concentration at the Indigenous camp, including the initial concentration (µg/m³)	Limit value (µg/m³)
Total particulate matter (TSP)	24 hours	**270.41**	59.19	120
	Number of	**187 (10.24%)**	0	---
Fine particulate matter ($PM_{2.5}$)	24 hours	21.06	15.5	30
Nitrogen dioxide (NO_2)	1 hour	67.9	52.31	414
	24 hours	38.57	30.76	207
	1 year	11.46	10.04	103
Sulphur dioxide (SO_2)	4 minutes	42.25	40.29	1,050
	24 hours	10.56	10.05	288
	1 year	2.09	2	52
Carbon monoxide (CO)	1 hour	609.19	601.19	34,000
	8 hours	406.58	400.68	12,700

An area located near the road presents exceedances of the particulate matter standard. However, the emission rates may have been overestimated, because the trucks must reduce their speed because of the intersection, which was not taken into account for the calculation of the emission rates. No exceedance of the applicable standards is present in the Indigenous camp.

3 CONCLUSION

This revised study was conducted in the context of the impact assessment for processing of gold ore from the Barry project and the increase in the milling rate at the Bachelor site in Desmaraisville of Bonterra Resources Inc., about 165 km southwest of Chibougamau, in the Nord-du-Québec region, in territory governed by the James Bay and Northern Québec Agreement (JBNQA). This study is required because of the impact on ambient air quality that the increase in the gold ore milling rate at the Bachelor site may have, particularly for the sensitive receptors located near the mine site. It also seeks to answer the Ministère's questions relating to the modelling study dated January 20, 2021 in the context of the impact assessment. Moreover, it should be noted that changes and optimizations have been made to the project since the impact assessment was submitted by Wood (2019). The main change is the withdrawal of the Moroy project, which will increase ore processing from 800 to 1,800 tonnes per day instead of 2,400 tonnes per day, as was initially foreseen. Moreover, optimizations were also carried out to improve the environmental and technical control of operations and result from the progress of the concept engineering stages. They were integrated into the revision of the modelling study.

33 contaminants generated by the mine site's activities were modelled. Air quality standards present in the CAR are associated with 22 contaminants. Air quality standards set by the MELCC are associated with 9 other contaminants. Finally, PRAT are associated with the last 2 contaminants.

Following the revision of the modelling of atmospheric dispersion of these contaminants with a model approved by the MELCC (AERMOD model), we compared the results obtained with the standards and criteria corresponding to each modelled period (4 minutes, 1 hour, 8 hour, 24 hours or 1 year, all depending on the contaminants). It is proved that, at maximum production, the limit values applicable for certain contaminants are exceeded at the limit of the zone 300 metres or less from the limits of the mining lease:

- The annual hydrogen cyanide criterion;
- The annual manganese criterion;
- The hourly and annual crystalline silica criteria;
- The annual PRAT for sodium tetraborate;
- The annual PRAT for calcium oxide;
- The hourly nitrogen dioxide standard.

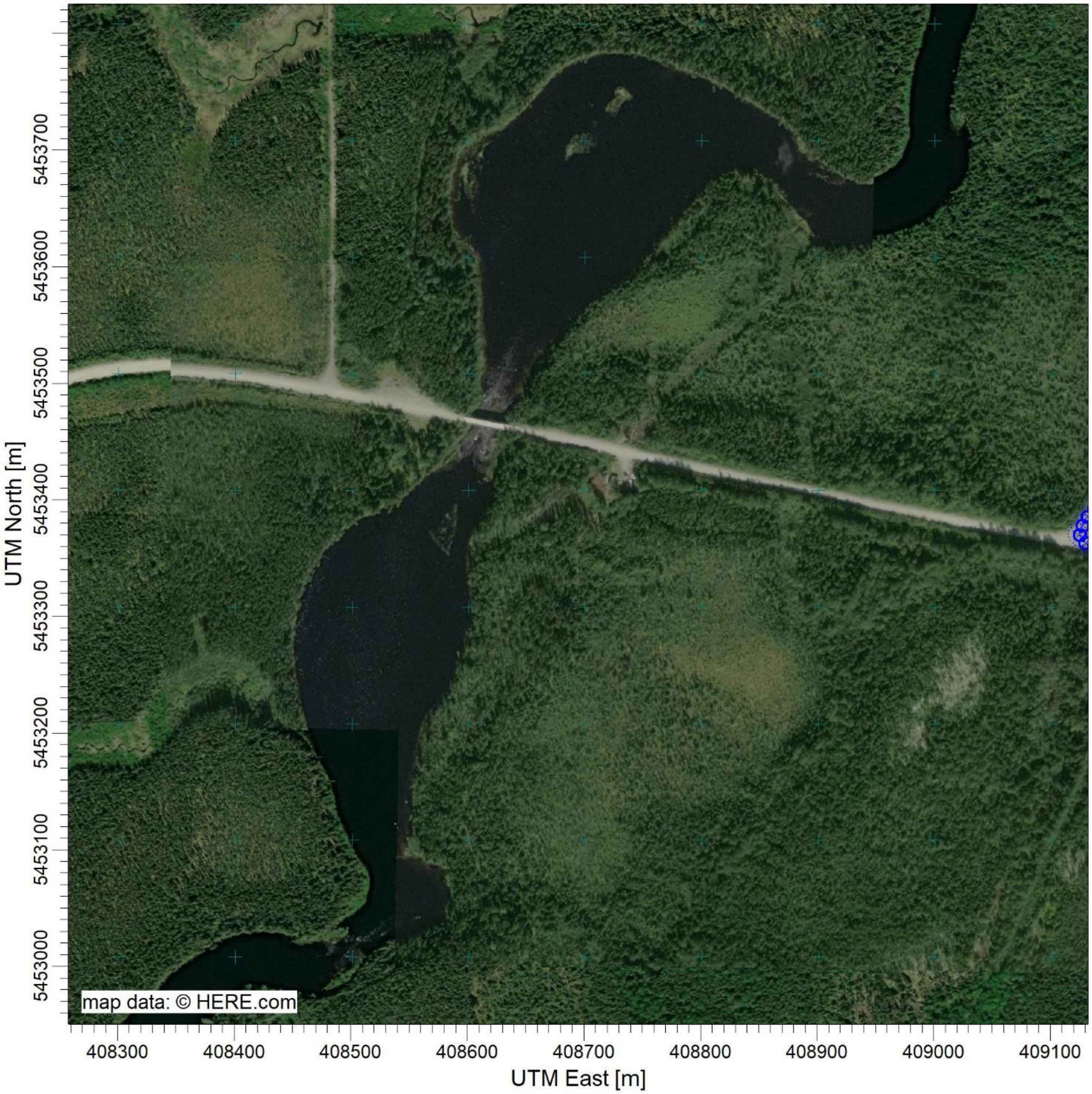
However, the areas where the exceedances occur are mostly located near the 300-metre limit around the mine site and no exceedance occurred on a sensitive pinpoint receptor. The impact of these exceedances is therefore considered minor.

Finally, the passage of ore transport trucks does not cause exceedances of the standards applicable to the Indigenous camp closest to the public road. Bonterra Resources also plans to suspend ore transport for two weeks in spring during the snow goose hunting period, and reduce ore transport by at least 25% in the fall during the moose hunt, in order to limit the nuisances for the users of the territory.

APPENDIX A GEOGRAPHIC AND TOPOGRAPHIC MAPS

PROJECT TITLE:

Geographic Map Around the Indigenous Camp



COMMENTS:

SOURCES:

1

COMPANY NAME:

Imausar Inc.

RECEPTORS:

122

MODELLER:

Éric Lauzé, Eng.

SCALE: 1:5,500

0 0.2 km

DATE:

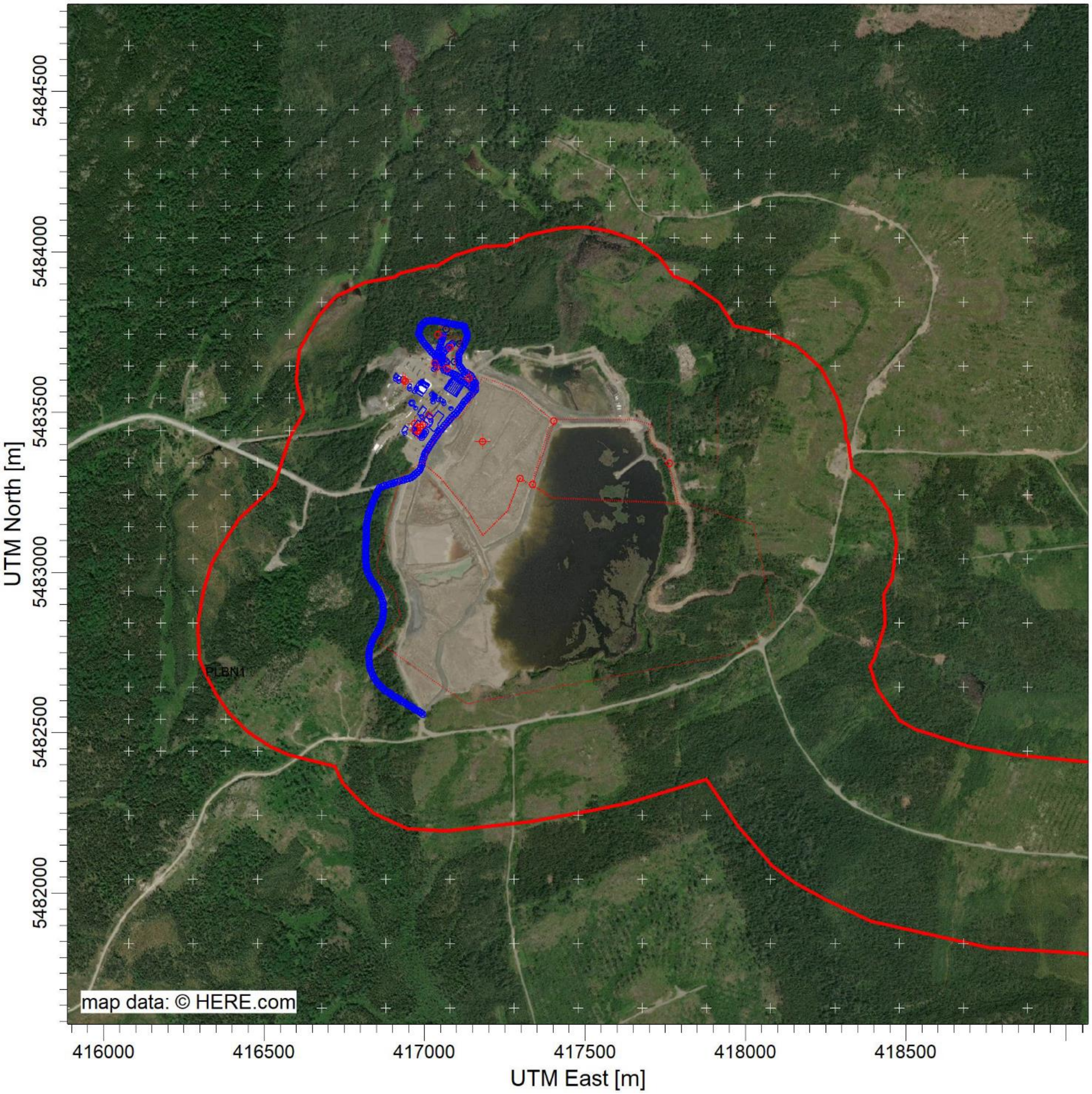
2021-01-11

PROJECT NO.:

IBTER-01

PROJECT TITLE:

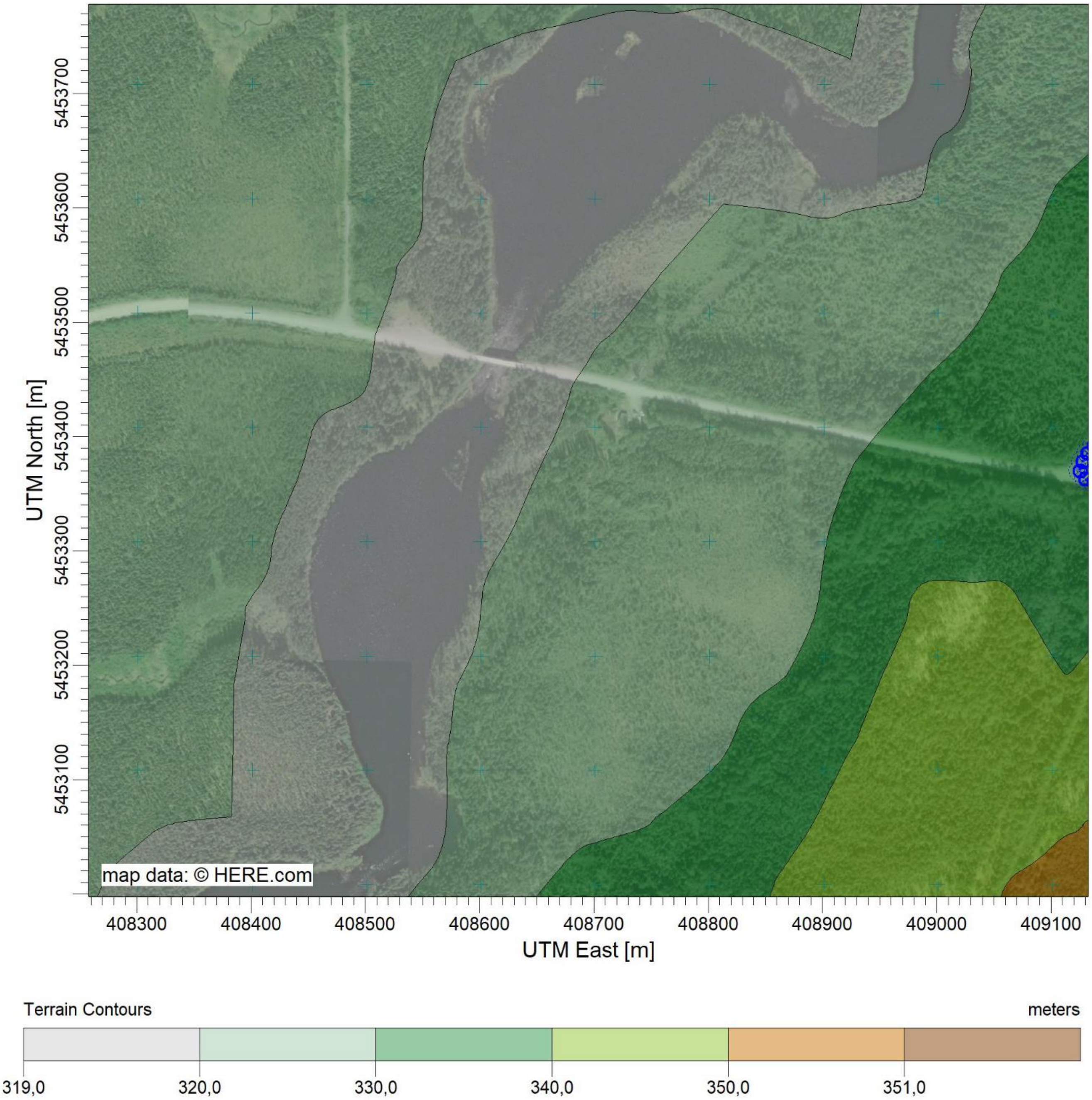
Geographic Map of the Mine Site



COMMENTS:	SOURCES: **32**	COMPANY NAME:	
	RECEPTORS: **1050**	MODELLER:	
		SCALE: 1:20,000 0 0.5 km	
		DATE: **2022-07-07**	PROJECT NO.: **IBTER-01**

PROJECT TITLE:

Topographic Map Around the Indigenous Camp



COMMENTS:

SOURCES:

1

COMPANY NAME:

Imausar Inc.

RECEPTORS:

122

MODELLER:

Éric Lauzé, Eng.

SCALE: 1:5,500

0 0.2 km

DATE:

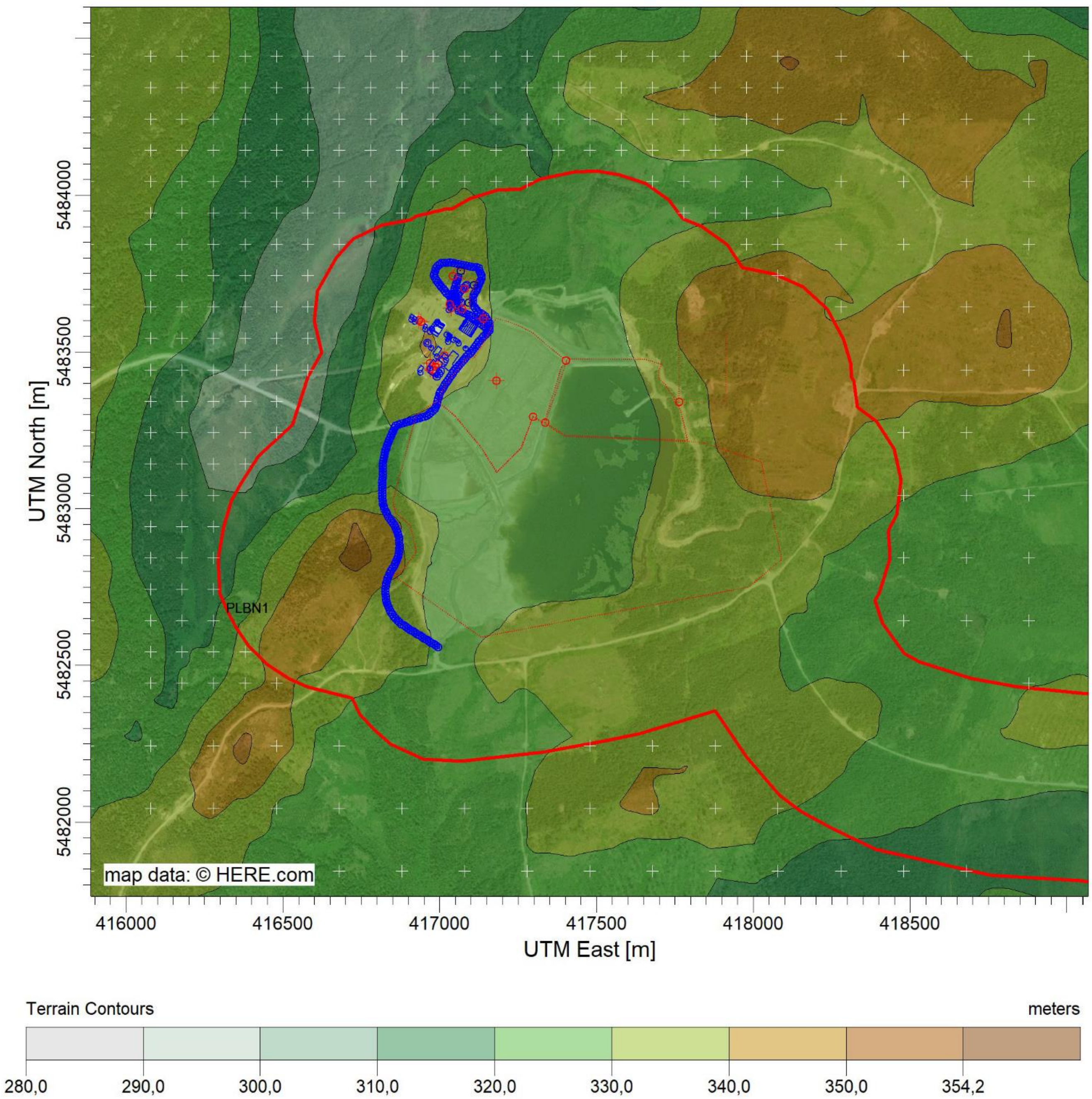
2021-01-11

PROJECT NO.:

IBTER-01

PROJECT TITLE:

Topographic Map of the Mine Site



COMMENTS:

SOURCES:
32

COMPANY NAME:

RECEPTORS:
1050

MODELLER:

SCALE: 1:20,000

0 0.5 km

DATE:
2022-07-07

PROJECT NO.:
IBTER-01

AERMOD View - Lakes Environmental Software

C:\Lakes\AERMOD View\IBTER-01\Rev 2\IBTER-01_rev2\IBTER-01_rev2.isc

APPENDIX B WIND ROSE

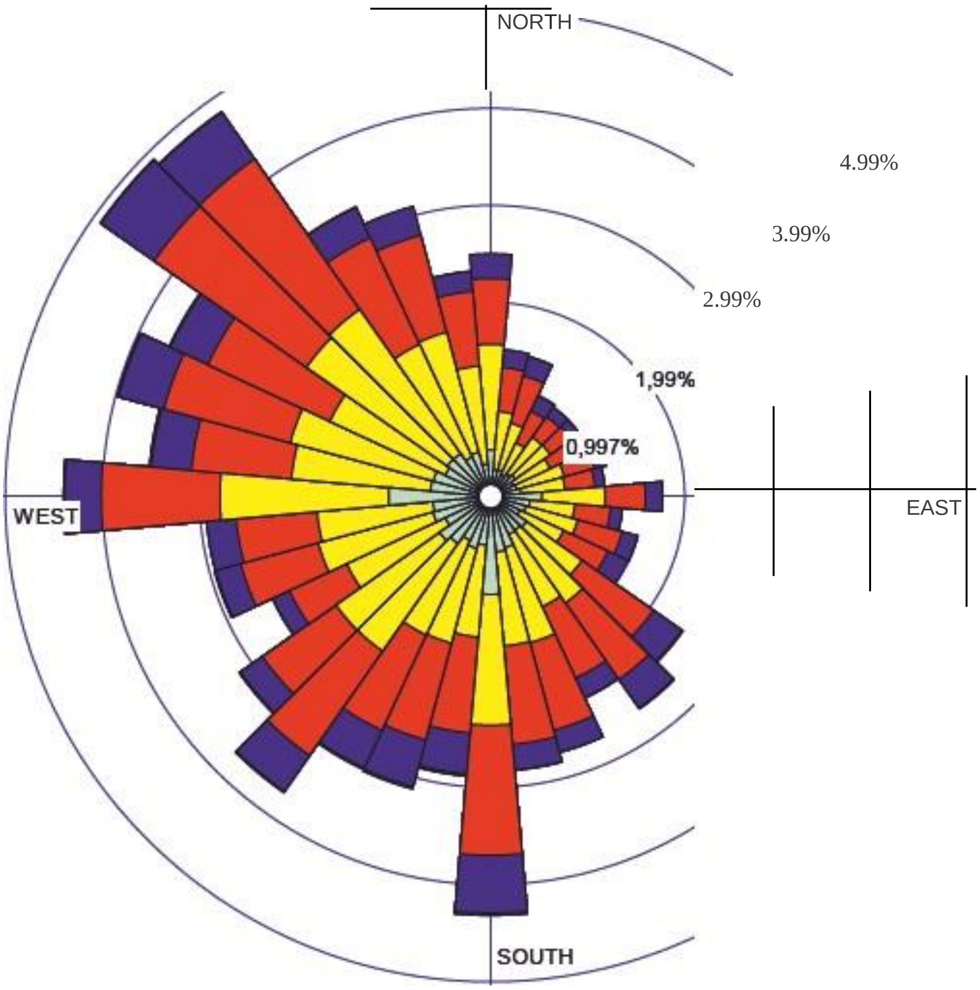
WNJ ROSEFt.err.

Wind Rose of the Ch M:Weather Station -Chibougamau w;n• SPffd

'-,--..-

01$PLAV:

Direction (blowing from}



WIND SPEED
(m's)

D ,.11,10
- 8,80-11,10
- 5,70 · **8.11)**
- 3,60-5.70
D 2.10-:i.ro
D o,so-2.10

Calm: 4.81%

COMMENTS:

Wind rose generated from weather stations for the years 2000-2010 inclusive

DATA PERIOD:

Start Date: 2006-01-01 - 00:00
End Date: 201 12-31- 23:59

COMPANY NAME:

MODELER:

CALM WINDS:

4.81%

TOTM.*ClOI.Hr.*

43234 hrs.

AVG. WIND SPEED:

3.18 m/s

o,,re

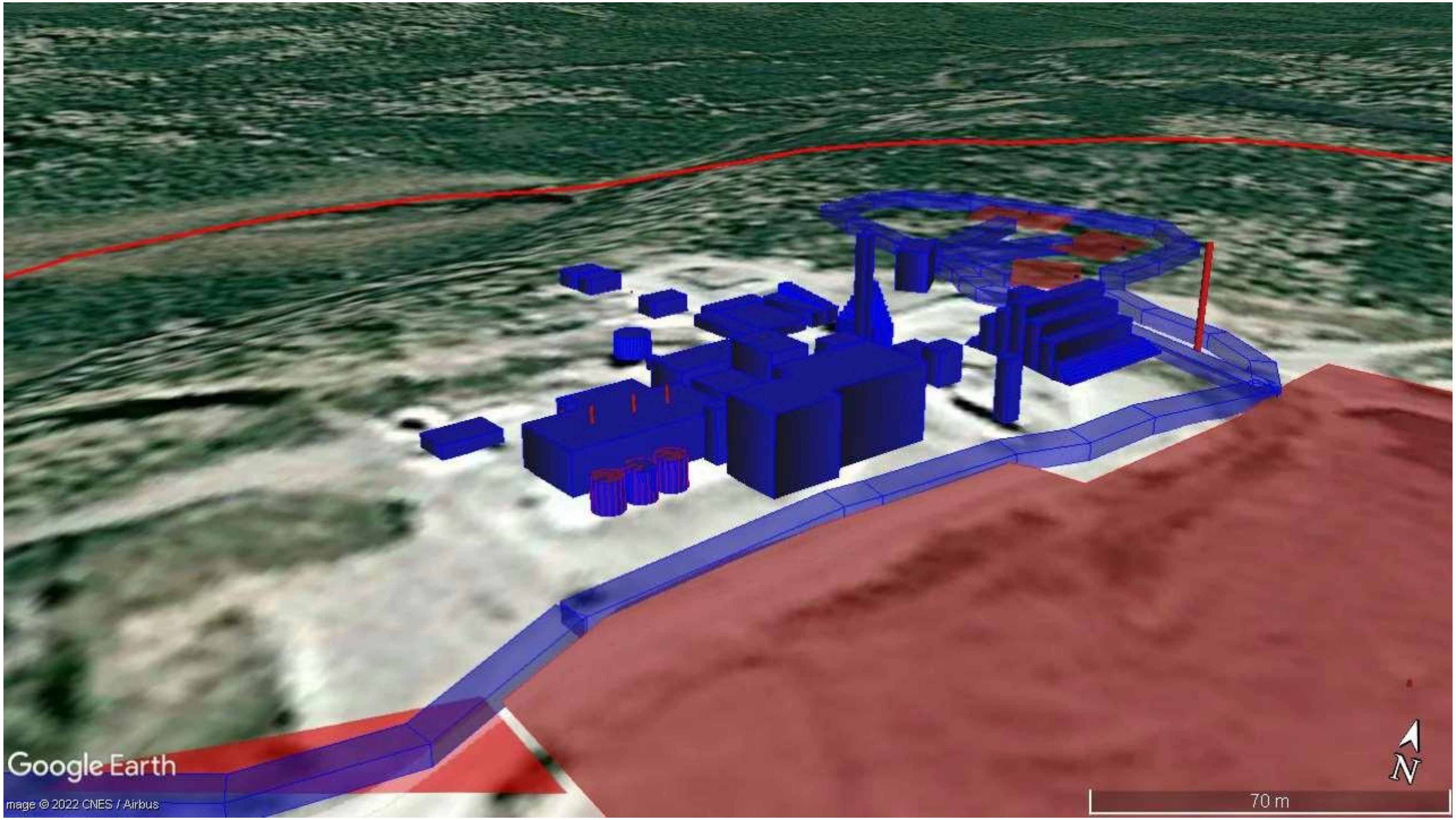
2021-01-11

PROJECT NO.:

IBTER-01

WAPLOT\lew •i..c. 6a.O11.at.o1$:lltwon:

APPENDIX
C BUILDING AND SOURCE LOCATION PLANS OF THE STUDY SITE



IMAUSAR

Project: **Bonterra Resources Inc.**
200 Chemin de la Mine, Desmaraisville

IBTER **01** **CA01** **01**

Title: 3D PLAN OF THE MINING FACILITIES
Modelling of Atmospheric Dispersion of Contaminants
Study 200 Chemin de la Mine, Desmaraisville (QC)

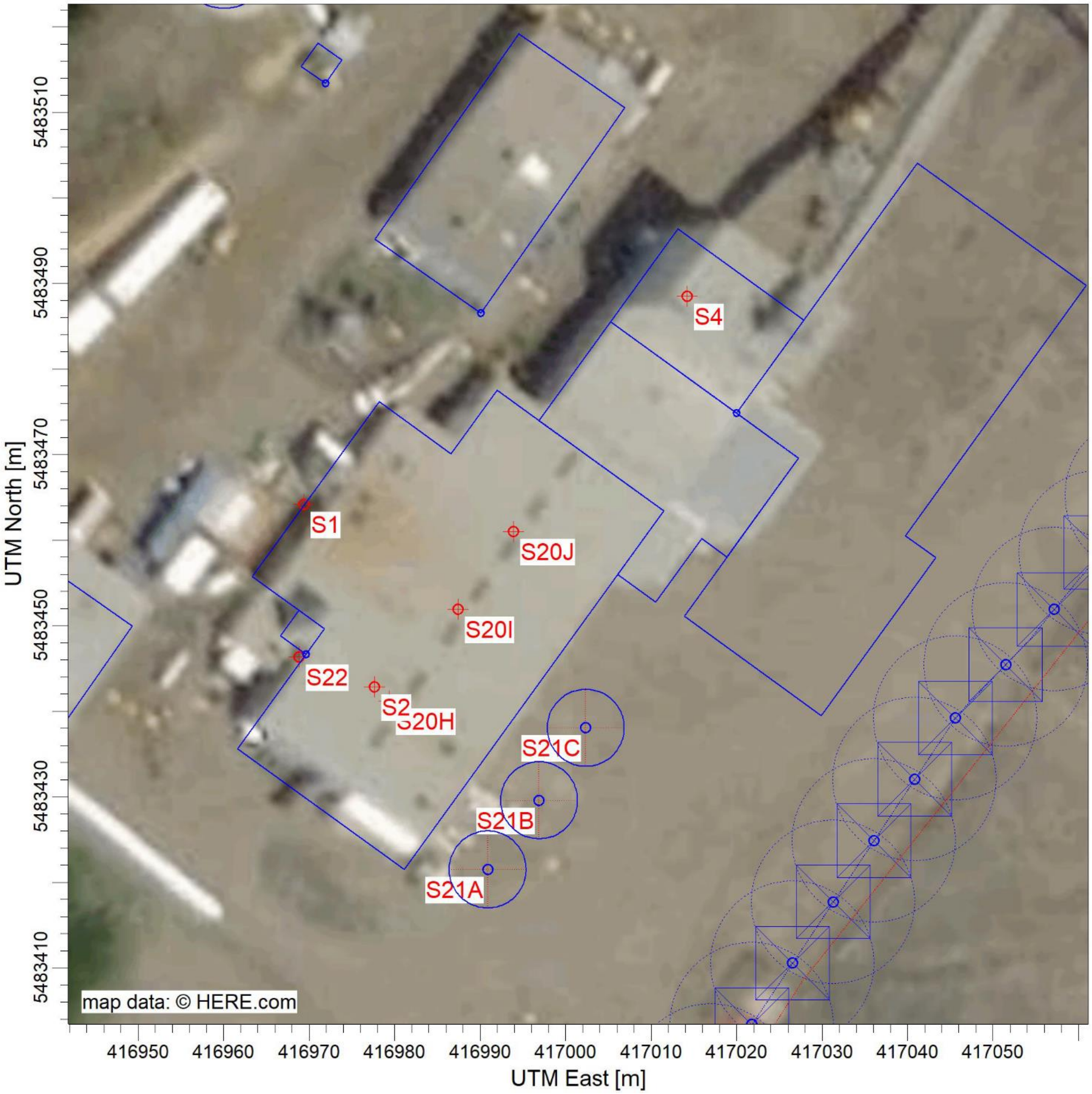
Date: July 7, 2022

Docket: IBTER-2009-01

Plan generated with Google Earth© and AermodView©

PROJECT TITLE:

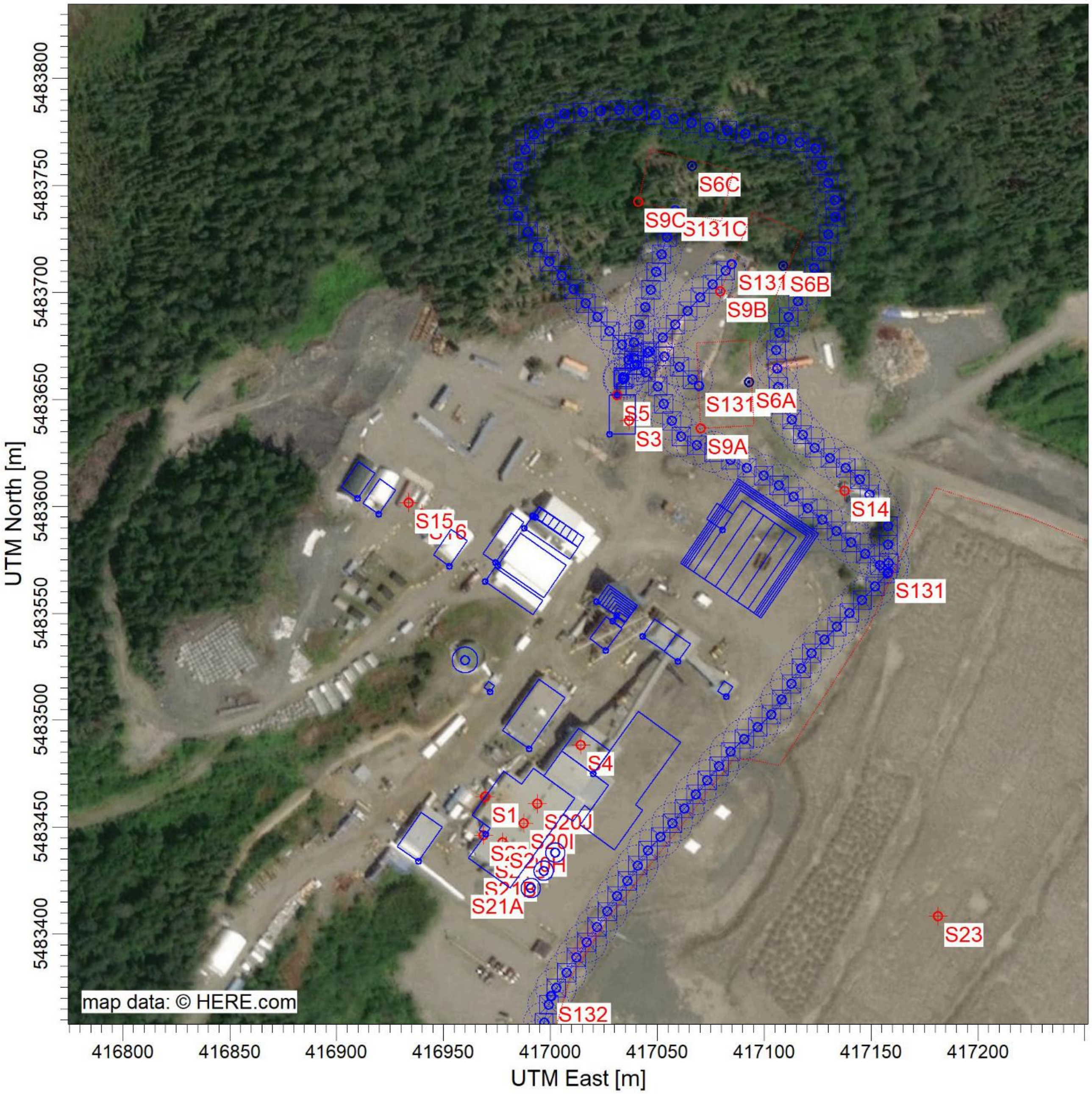
Building and Source Location Plan of the Ore Processing Mill Study Site Close-up View of the Ore Processing Mill



COMMENTS:	SOURCES: **32**	COMPANY NAME:	
	RECEPTORS: **1050**	MODELLER:	
		SCALE: 1:750 0 0.02 km	
		DATE: **2022-07-07**	PROJECT NO.: **IBTER-01**

PROJECT TITLE:

Building and Source Location Plan of the Study Site View of the Different Buildings and Stockpiles



COMMENTS:

SOURCES:

32

RECEPTORS:

1050

COMPANY NAME:

MODELLER:

SCALE: 1:3,000

0 0.1 km

DATE:

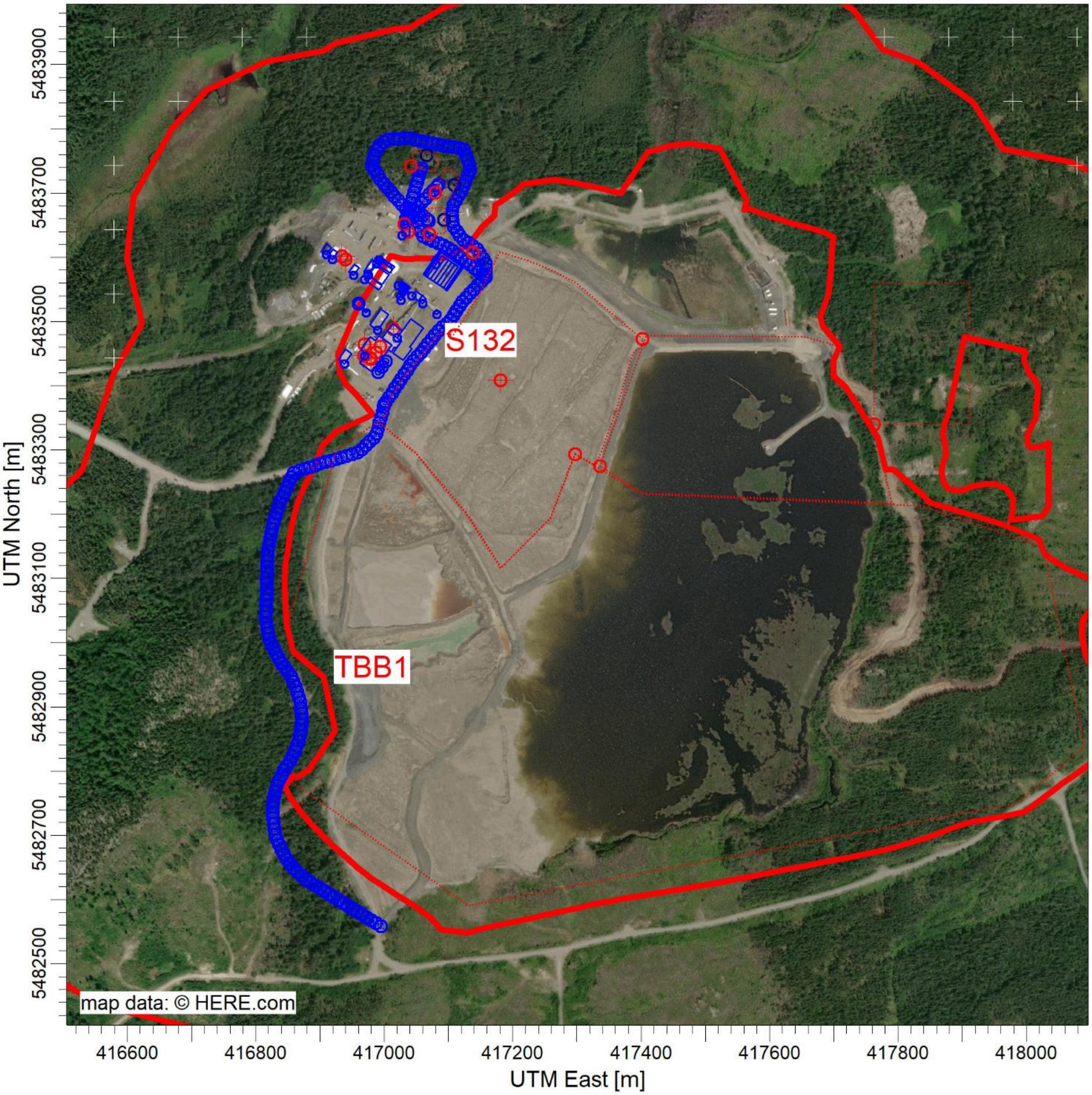
2022-07-07

PROJECT NO.:

IBTER-01

PROJECT TITLE:

Building and Source Location Plan of the Study Site View of the Facilities at the Limits of the Mining Lease



COMMENTS:	SOURCES: **32**	COMPANY NAME:	
	RECEPTORS: **1050**	MODELLER:	
		SCALE: 1:10 AM,000 0 0.3 km	
		DATE: **2022-07-07**	PROJECT NO.: **IBTER-01**

GENERAL SITE LAYOUT
SCALE: 1/2"=1'-0"

FOR PERMIT

DO NOT USE FOR CONSTRUCTION

SEAL & SIGNATURE

REV.	DATE	DESCRIPTION	BY	VER.	APP.
P1	2022-09-30	FOR PERMIT	ABA	ABA	ML
P0	2022-06-28	FOR PERMIT	W.S	APHG	APHG
ZC	2022-06-23	FOR COMMENTS	W.S	APHG	-
ZB	2022-04-26	IN PROGRESS	W.S	APHG	-
ZA	2022-03-10	IN PROGRESS	APHG	APHG	-

CLIENT

INFO CLIENT 10636 - BONTERRA RESSOURCES

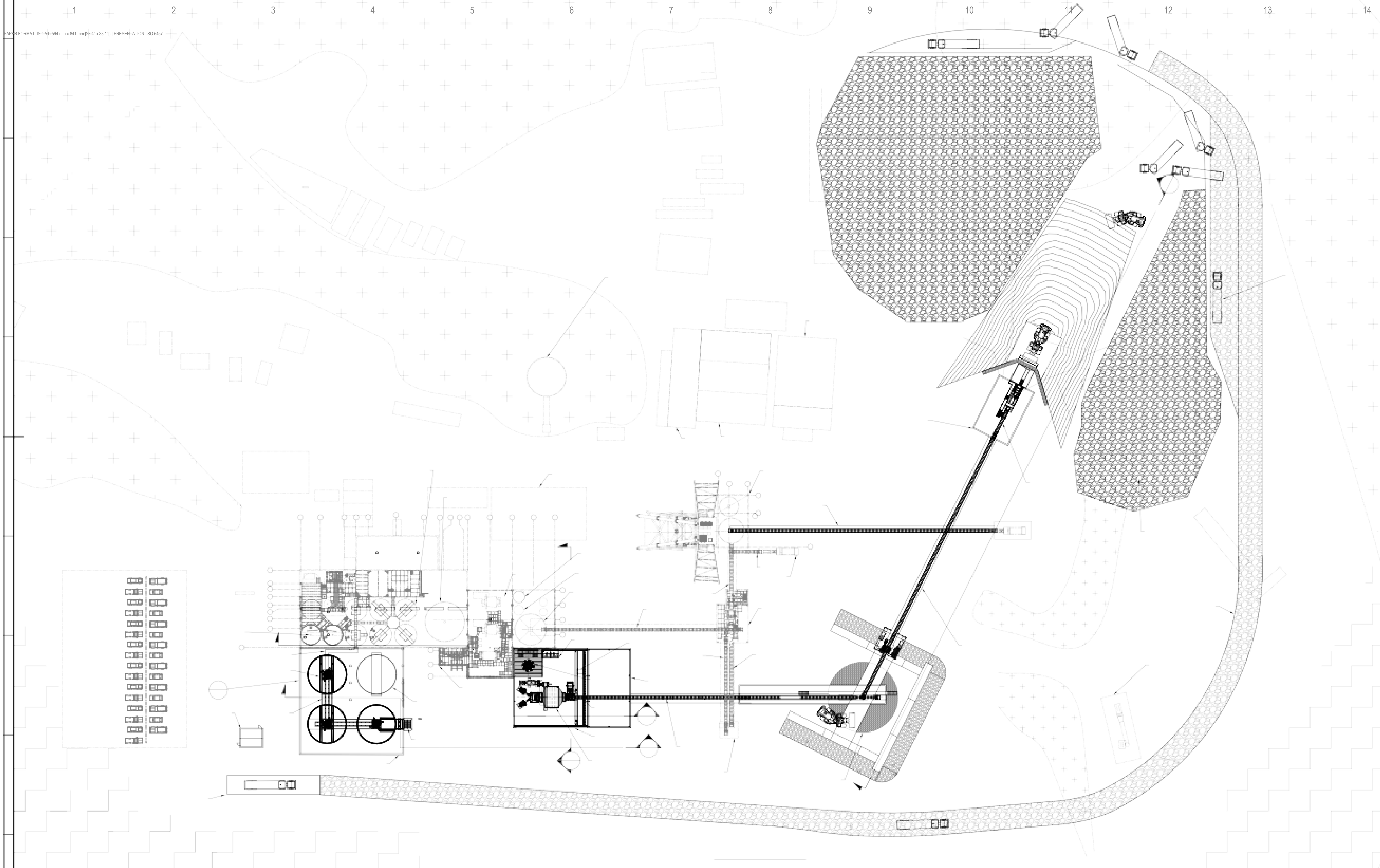
DRAWN BY WILLIAM ST-AMAND
VERIFIED BY ADAM-PIERRE H. GAGNON,
APPROVED BY Eng. ADAM-PIERRE H.
CREATION DATE GAGNON, Eng.
SCALE
PROJECTION
2022-03-10
INDICATED

DRAWING TITLE

SURFACE AREA
GENERAL
GENERAL LAYOUT - 1,800 TPD
URBAN-BARRY PLANT

PROJECT #	DRAWING #	REV.	SHEET
10636	5000-000-G-2002 SECTOR–LEVEL – DISCIPLINE – SEQUENTIAL #	P1	1/1

PAPER FORMAT: ISO A1 (594 mm x 841 mm [23.4" x 33.1"]) | PRESENTATION: ISO 5457



6098005-000000-41-D50-0001

STORAGE CAPACITY	IN THE TAILINGS MANAGEMENT AREA		TIME
OF STOCKPILING (Mm³)	SOUTH DIKE HEIGHT*	WEST DIKE HEIGHT*	CUMULATIVE DEPOSITION (YEARS)
6.5	341.5 - 342.5 m	341.5 - 342.5 m	10
4.44	340 - 342.1 m	340 - 341.4 m	7.4
2.96	337.5 - 339.6 m	337.5 - 338.9 m	4.9
1.58	335 - 337.1 m	335 - 336.4 m	2.6

*Crest level, including "revenge" (15 m for south and west, 10 m internal)

ACCESS
ROAD

GH-18-04R @ 0.00

DESCRIPTION OF DEPOSITION

CONVENTIONAL
DEPOSITION
TONNAGE CONCERNED: 1,200 t/d
(340,000 m³/yr)
VOLUME (1.3 t/m³): ± 660 000 m³

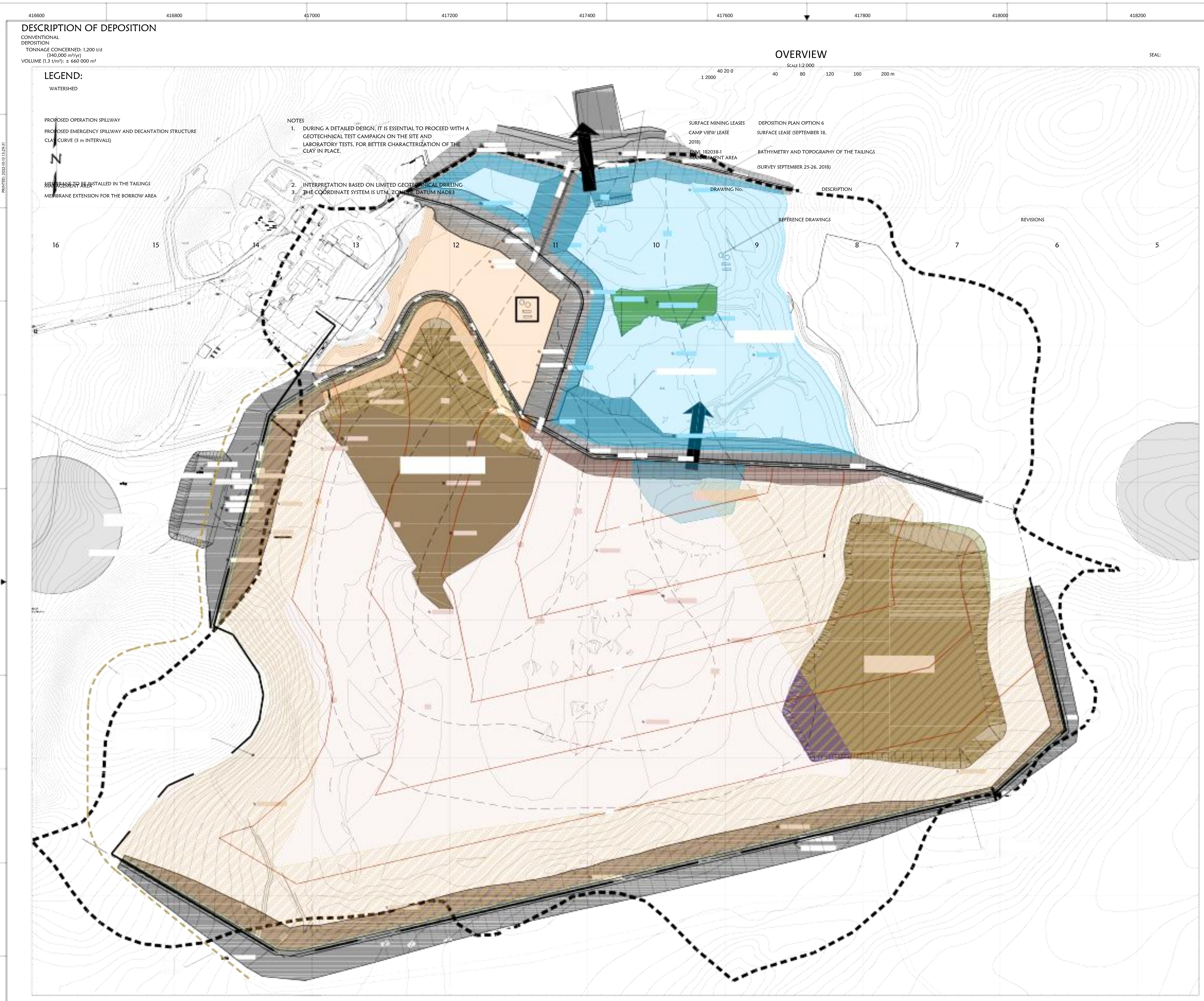
LEGEND:

WATERSHED
PROPOSED OPERATION SPILLWAY
PROPOSED EMERGENCY SPILLWAY AND DECANTATION STRUCTURE
CLAY CURVE (3 m INTERVALS)
MEMBRANE TO BE INSTALLED IN THE TAILINGS MANAGEMENT AREA
MEMBRANE EXTENSION FOR THE BORROW AREA

NOTES
1. DURING A DETAILED DESIGN, IT IS ESSENTIAL TO PROCEED WITH A GEOTECHNICAL TEST CAMPAIGN ON THE SITE AND LABORATORY TESTS, FOR BETTER CHARACTERIZATION OF THE CLAY IN PLACE.
2. INTERPRETATION BASED ON LIMITED GEOTECHNICAL DRILLING
3. THE COORDINATE SYSTEM IS UTM, ZONE 18, DATUM NAD83

OVERVIEW

SCALE 1:2 000



BY: MARC-ANDRÉ DOUCET
PRINTED: 2022-10-13 13:29:31

DRAWING No.	DESCRIPTION
SURFACE MINING LEASES	DEPOSITION PLAN OPTION 6
CAMP VIEW LEASE	SURFACE LEASE (SEPTEMBER 18, 2018)
ENVI_182038-1 MANAGEMENT AREA	BATHYMETRY AND TOPOGRAPHY OF THE TAILINGS (SURVEY SEPTEMBER 25-26, 2018)

REFERENCE DRAWINGS

REVISIONS

SEAL:

INDEX DES PLANS

6753003-41-D50-0001	PARC À RESIDUS AN 10		-		VUE EN PLAN
6753003-41-D01-0001	DIGUE SUD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0002	DIGUE OUEST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0003	DIGUE INTERNE	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0004	DIGUE INTERNE	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0005	DIGUE NORD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0006	DIGUE NORD	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0007	DIGUE DRYSTACK - RESIDUS	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0008	DIGUE DRYSTACK - BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0009	DIGUE DRYSTACK - BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0010	DIGUE DE SÉPARATION - BASSIN	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D50-0002	PARC À RESIDUS AN 2				VUE EN PLAN
6753003-41-D01-0011	DIGUE CELLULE OUEST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0012	DIGUE SUD AN 2	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D02-0001	TABLEAU DES MATÉRIAUX				
6753003-41-D50-0003	PARC À RESIDUS AN 3				
6753003-41-D01-0013	DIGUE BANC D'EMPRUNT EST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0014	DIGUE SUD AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0015	DIGUE OUEST AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0016	DRYSTACK AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0017	DIGUE INTERNE AN 3	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL
6753003-41-D01-0018	BANC D'EMPRUNT EST	-	DÉTAIL TYPIQUE ET PROFIL	-	VUE EN PROFIL

PROJECT: BONTERRA TAILINGS MANAGEMENT AREA STUDY

TITLE: TAILINGS MANAGEMENT AREA 10-YEAR PLAN VIEW

CLIENT:
BY:
DESIGNED
DRAWN BY:
APPROVED BY:
VERIFIED BY:
DATE: 2022-09-16
SCALE: 1:5000
DRAWING No.: 6098005-000000-41-D50-0001
SHEET: FORMAT: A0 REV.: AA

0 1 2 3 4 5 6 7 8 9 10 cm

C:\USERS\MADOU\DROPBOX (COMPTE PERSONNEL)\FAMILY ROOM\PROJET\22\010-10 BONTERRA\6.CAD\3.EN COURS\6753003-000000-41-D50-0001.DWG

POUR COMMENTAIRES
NE PAS UTILISER POUR CONSTRUCTION
DATE : 2022-09-16
BBA

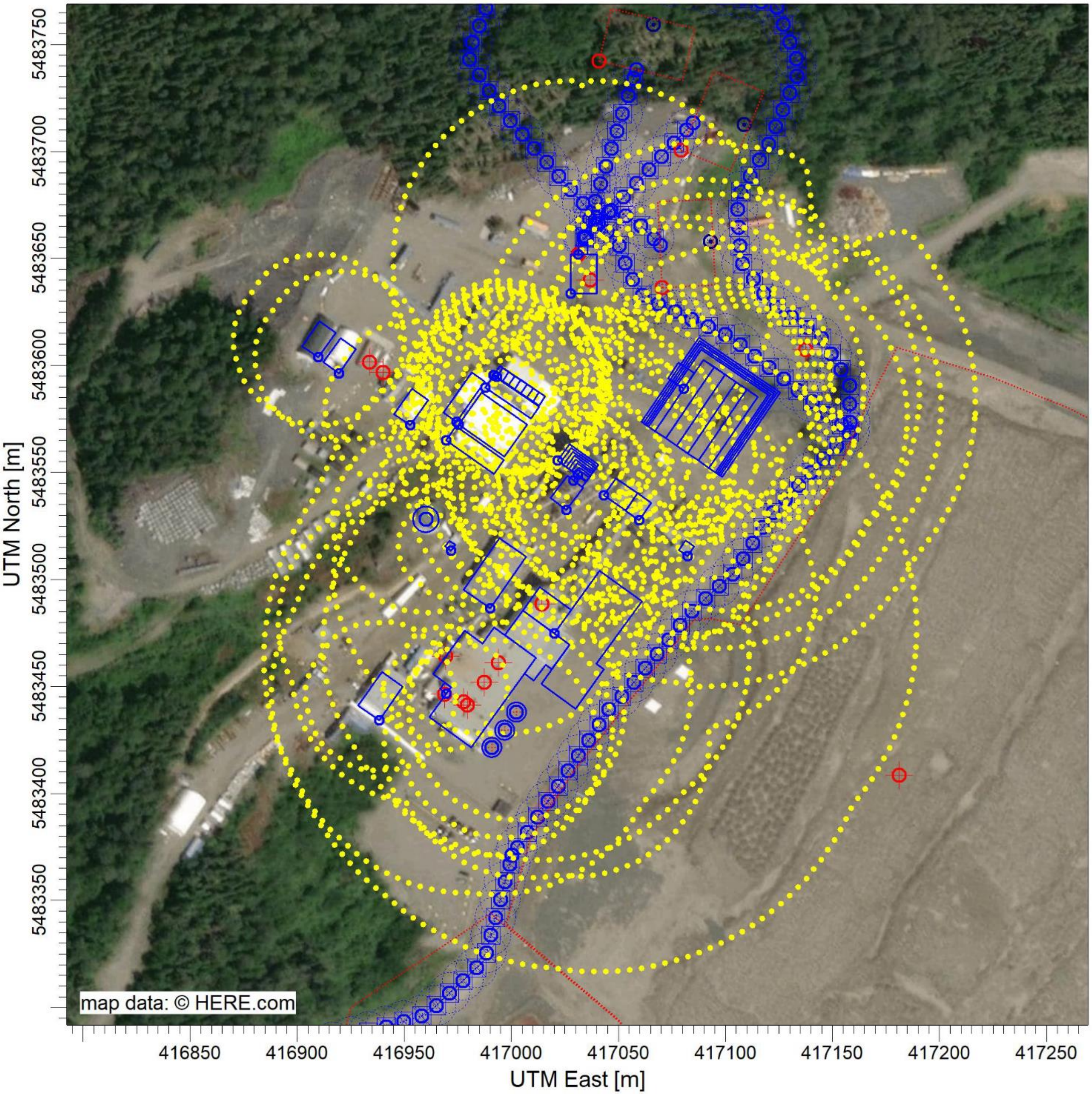
AA	CONCEPTUEL	V. MARIER	L. ROKOCHA	[illegible]
REV.	DESCRIPTION	VÉRIFIÉ PAR	APPROUVÉ PAR	DATE

BBA
BONTERRA

APPENDIX D MAP OF THE AREA OF INFLUENCE OF BUILDINGS

PROJECT TITLE:

Map of the Area of Influence of Buildings

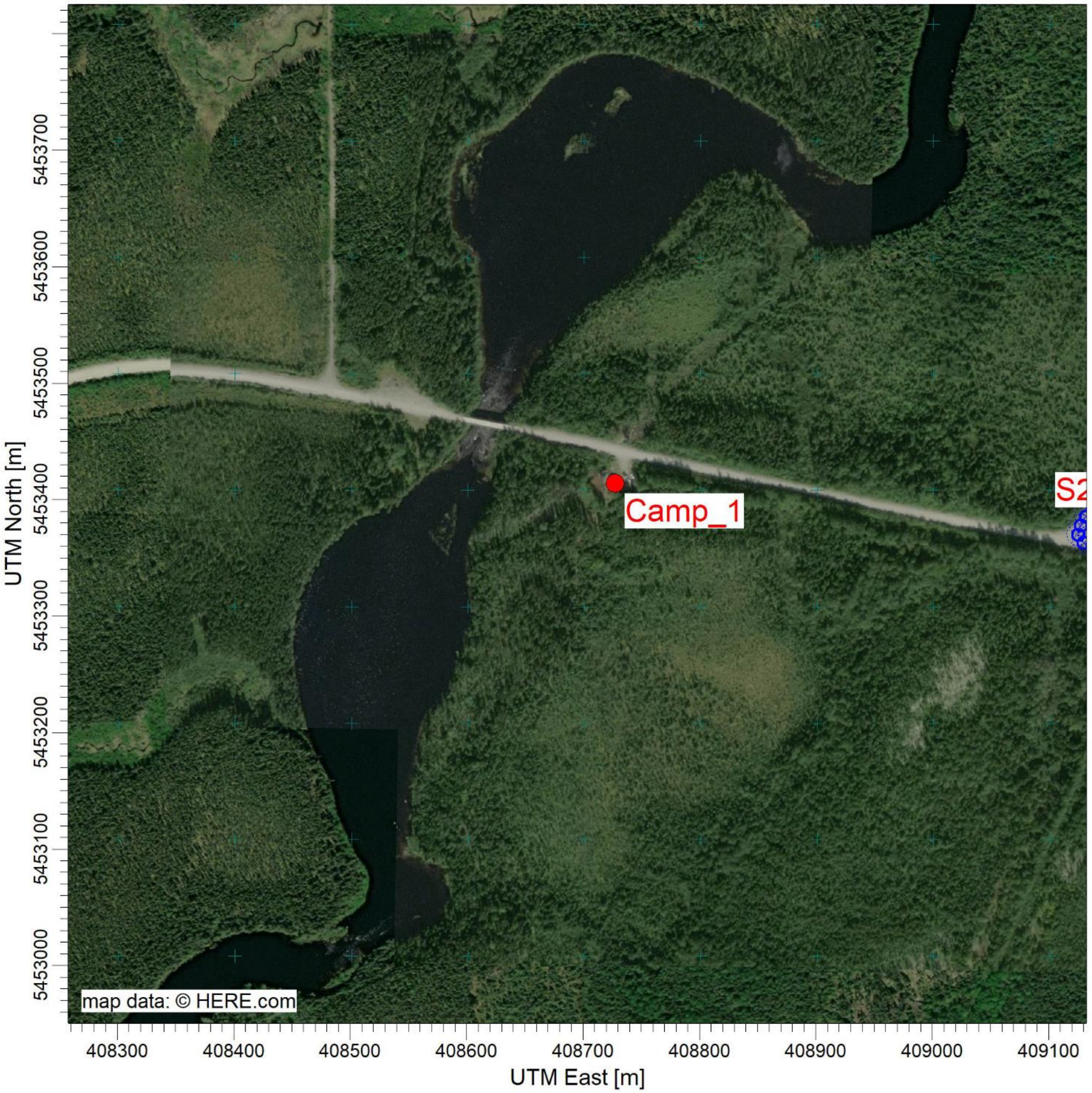


COMMENTS:	SOURCES:	COMPANY NAME:	
The area of influence of the buildings on the sources is represented by yellow dotted lines.	**32**		
	RECEPTORS: **1050**	MODELLER:	
		SCALE: 1:3,000 0 0.1 km	
		DATE: **2022-07-07**	PROJECT NO.: **IBTER-01**

APPENDIX E MAPS WITH MODELLING DOMAIN AND SENSITIVE PINPOINT RECEPTORS

PROJECT TITLE:

Map of the Modelling Domain Around the Indigenous Camp



COMMENTS:

The Indigenous camp is represented by a red dot.

SOURCES:

1

RECEPTORS:

122

COMPANY NAME:

Imausar Inc.

MODELLER:

Éric Lauzé, Eng.

SCALE: 1:5,500

0 0.2 km

DATE:

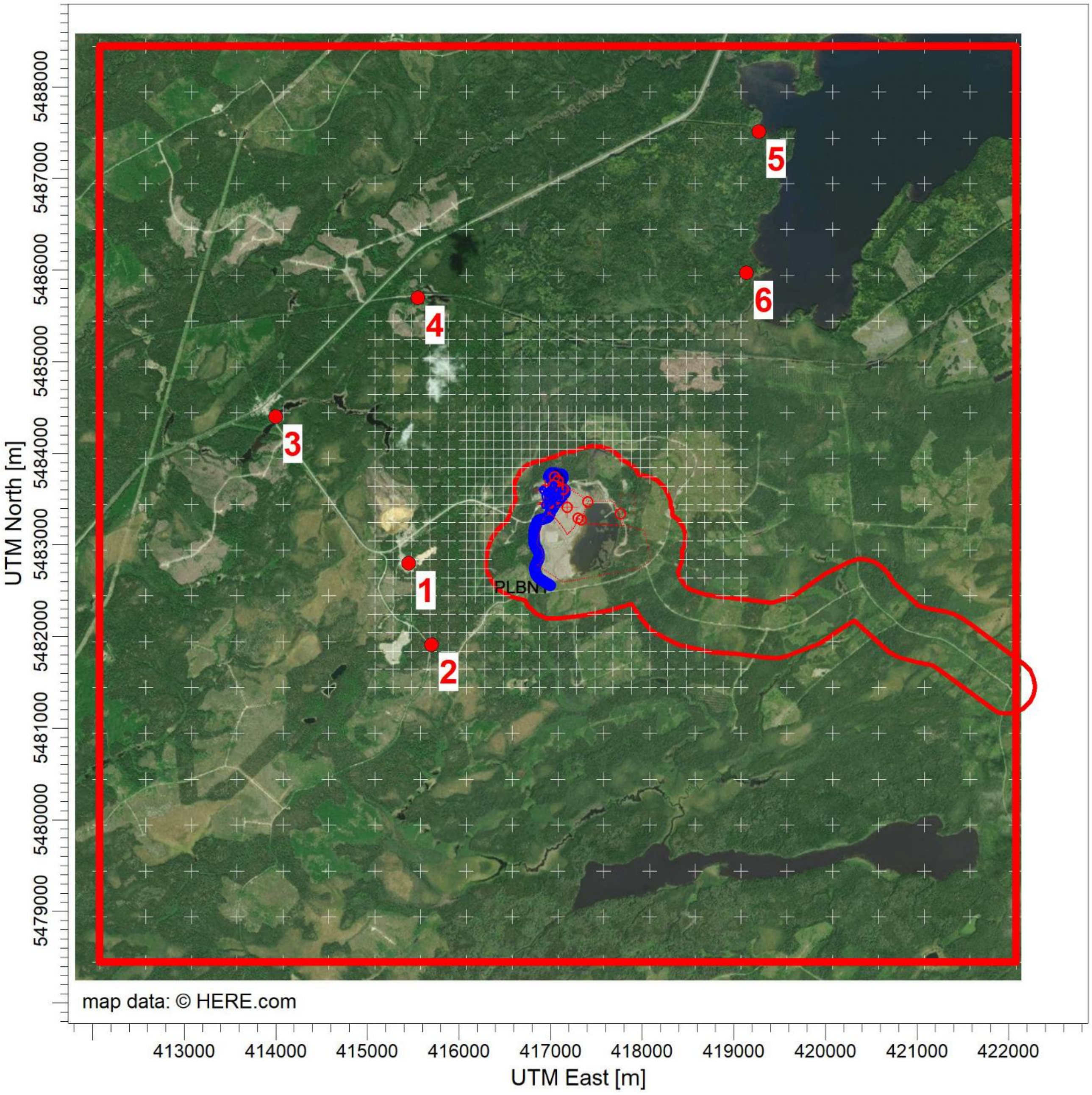
2021-01-11

PROJECT NO.:

IBTER-01

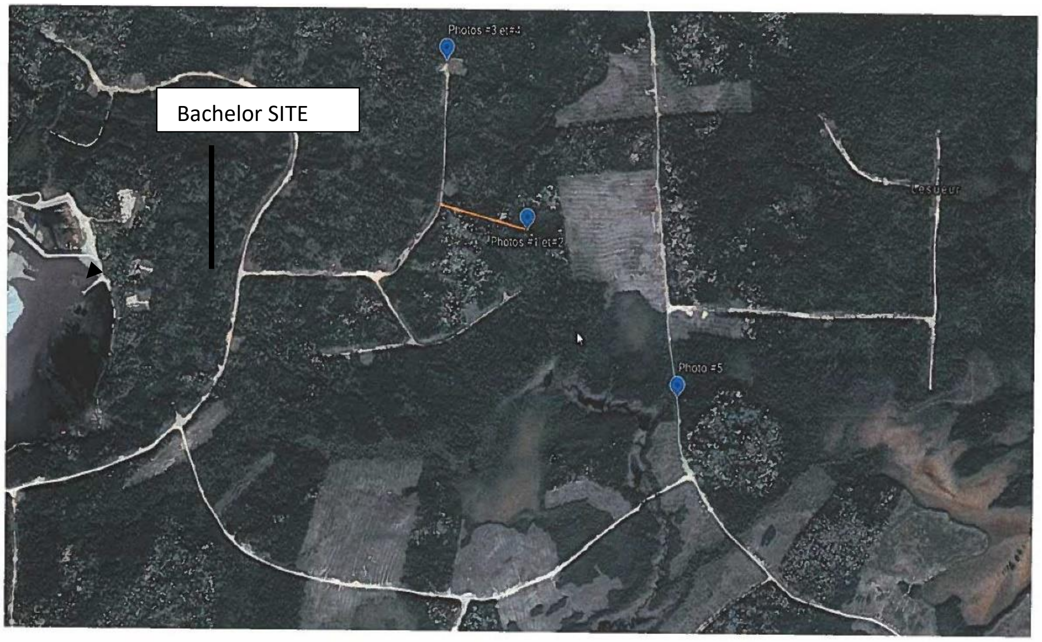
PROJECT TITLE:

Map of the Modelling Domain and the Sensitive Pinpoint Receptors



COMMENTS:	SOURCES:	COMPANY NAME:
The sensitive pinpoint receptors are represented by red dots with numbers.	**32**	
	RECEPTORS: **1050**	MODELLER:
		SCALE: 1:70,000 0 2 km
		DATE: **2022-07-07**
		PROJECT NO.: **IBTER-01**

APPENDIX F PHOTOGRAPHIC REPORTING



Locations where the photos were taken

Photo #1

Photo #2

Photo #3

Photo #4

Photo #5

APPENDIX G (ON DVD)

1. EMISSION RATES CALCULATION FILE
2. MATERIAL SAFETY DATA SHEETS
3. FUEL STATION ATMOSPHERIC EMISSIONS CALCULATOR
4. GRAPHS OF MODELLING RESULTS
5. AERMOD MODEL OUTPUT FILES

QC2-6: MINUTES OF THE MEETING WITH THE TALLYMEN ON JULY 12, 2020

Meeting date: July 12th, 2022

Meeting start time: 10:00AM

Meeting End time: 12:00PM

Meeting attendance (on TEAMS):
Waswasnipi First Nation: Joshua Blacksmith, Allan Saganash, Matthew Blacksmith
Bonterra: Steve Gaudreault, Marc-André Pelletier, Karine Gauthier-Hétu (GCM consultant), Martin Boucher (Envirofor)

Purpose of the meeting: W24A land consultation. The intent of the meeting is to make Bonterra aware of all the activities and land use on W24A land. That exercise was completed 2 years ago for the Impact study, and it needs to be checked again for accuracy.

Minutes:
We all introduced ourselves first. Matthew (W24A Tallyman) and Allan (main user) were appointed to represent the W24A land. Allan's wife is member of the Blacksmith family. Have hunted since mid-sixties. Has worked with Frank and Frank's father at identifying protected areas in the W24A trapline.

We had discussions on how CTA (Cree Tallyman Association) appoints officially the Tallyman. Matthew is waiting for the final resolution from CTA.

Steve shared his screen on google map. We were able to see the W24A land (approximate contour) and the Bachelor mine site.

Allan mentioned there is a wildlife protected area (see figure 1), an aquatic reserve around Waswanipi lake (see figure 2), there is a 1% of protected area (mostly around camp areas but not all, some are registered, and some are not, ongoing as per Josh), and a 25% of wildlife interested area defined by the Tallyman and land users (mostly moose habitats). Allan mentioned the pinpoint does not represent the protected or hunting areas. It should be an area not a dot but an area!

There are 6 Cree seasons. The number of land users depends on the season (like goose break). Hunting can happen anywhere in the trapline. Bonterra is aware of that.

Family maps document areas of interest such as spawning areas. Some maps are available, but some are not (like the Family maps based on traditional knowledge, those information on the maps are owned by Waswanipi, cannot share it as per CNG, with a confidentiality agreement- to be confirmed).

Karine showed more maps showing the Waswanipi lake protection area and some other protected area.

Discussion on the map showing the Bachelor-Moroy site and a 5km circle radius which represent the study area (refer to figure 3). We can see camps (orange and pink) identified 2 years ago. Another map showing all activities is presented from the impact study document (figure 4)

Allan, Josh, and Matthew showed us on google map where the camps, protected areas and biological refuge are. Located a camp near Lac Cerré (figure 5). Camps on Bachelor Lake and Bachelor River, closer to mine site (see figure 6 and 7) and located three permanent camps. On Rivière Auger, Henry Saganash's camp was approximately located (owned by his son now-figure 8). Lac Auger old camp is showed on figure 9. There is 1% protected area there. The red circle is a beaver protected area (5 lakes). They reproduce there. No trapping activity there. Figure 10 shows not used camp close to mine site. Discussed about camps that are outside the study area. Review the dots that were mentioned as camping site in the Impact study (figure 11)

Discussed about road access improvement. A by-pass was built to avoid mine site (4500). It appears that is a public road. Discussion about a big hill that is avoided during springtime (figure 12).

Lac Malouin is outside the study area but is located near the bachelor-Barry access road. Discussion about the distance away from the road that could be impacted. Josh mentioned there are impact like noise and dust and wildlife is important to consider as well (figure 13).

There is a hunting trail between Lac Auger and Lac Malouin (figure 14)

At the end of the meeting, it was mentioned the exercise would it be much easier if that was face to face because it is a bit difficult to do that remotely. If we could share maps (like the forestry company) the process would be much easier. The meeting ended, Steve mentioned that we are going to have a harmonization committee meeting on Monday July 18.

Figures:

Figure 1: Approximate location of the Wildlife protected area (no harvest work there, for moose only)

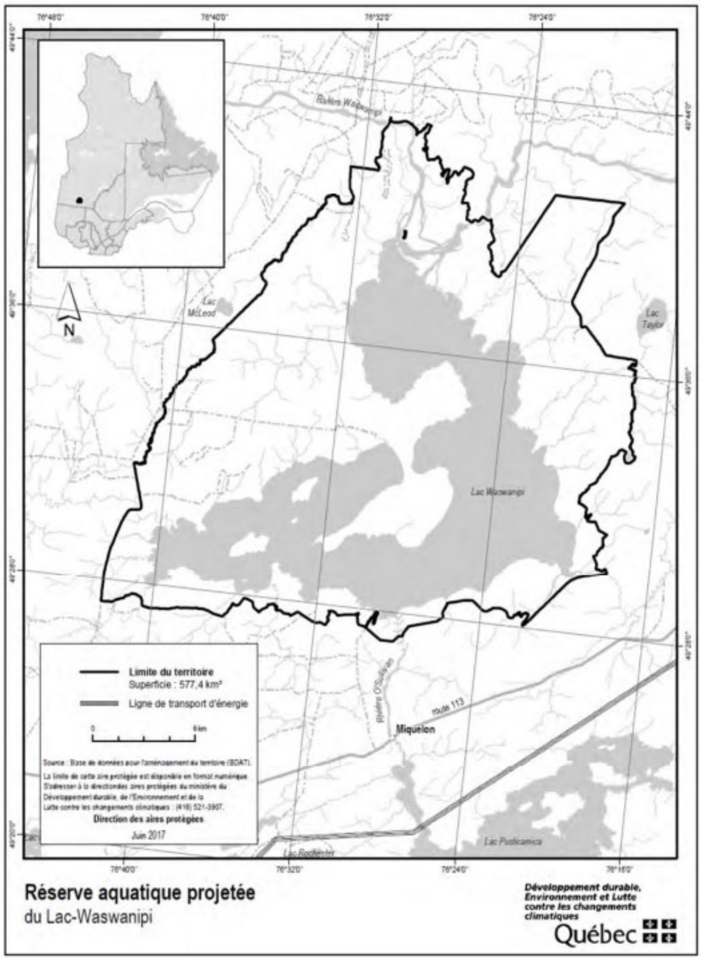


Figure 2: Waswanipi protected area

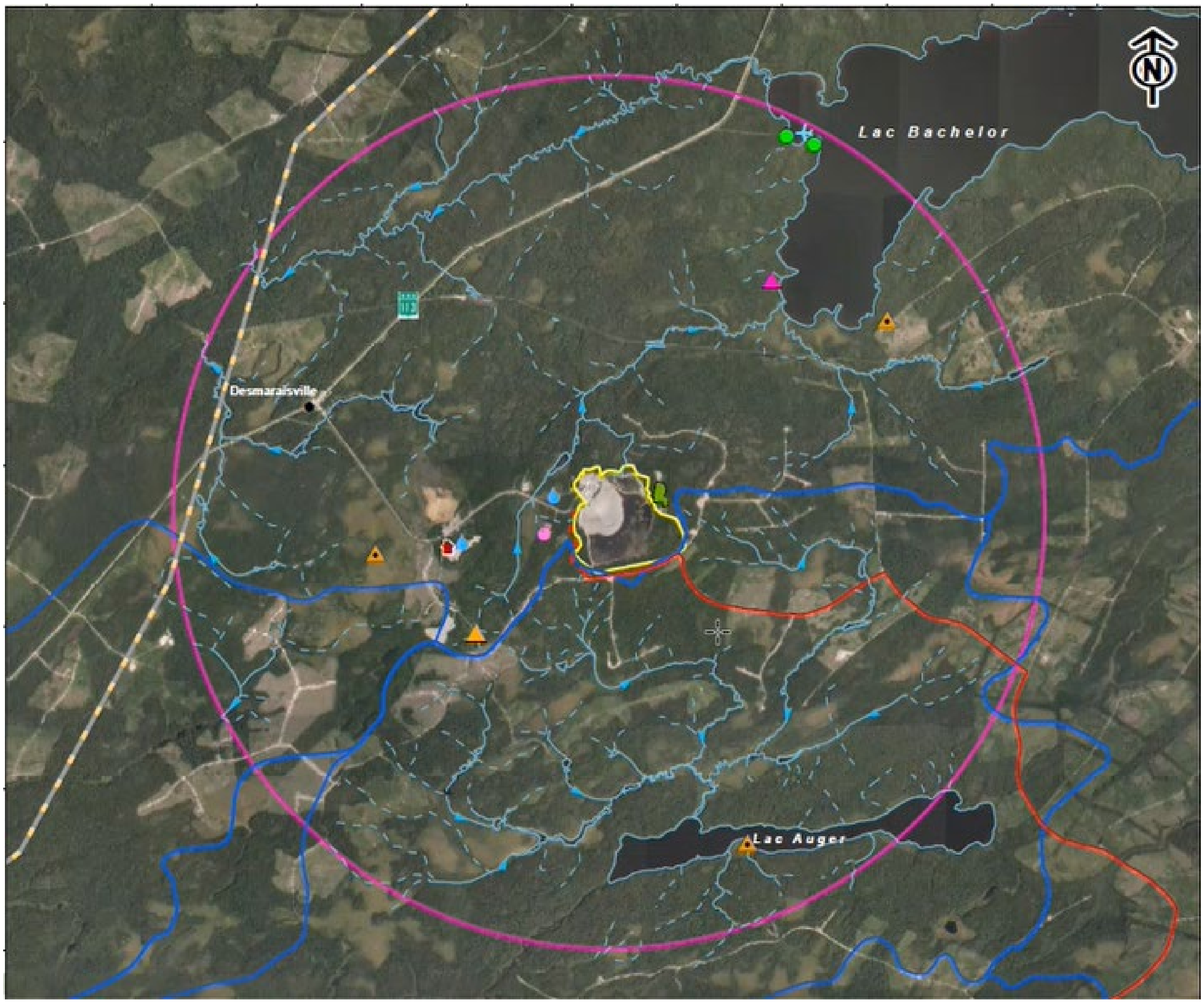


Figure 3: A 5km circle radius surrounding the Bachelor sire (area of study in the Impact Study)

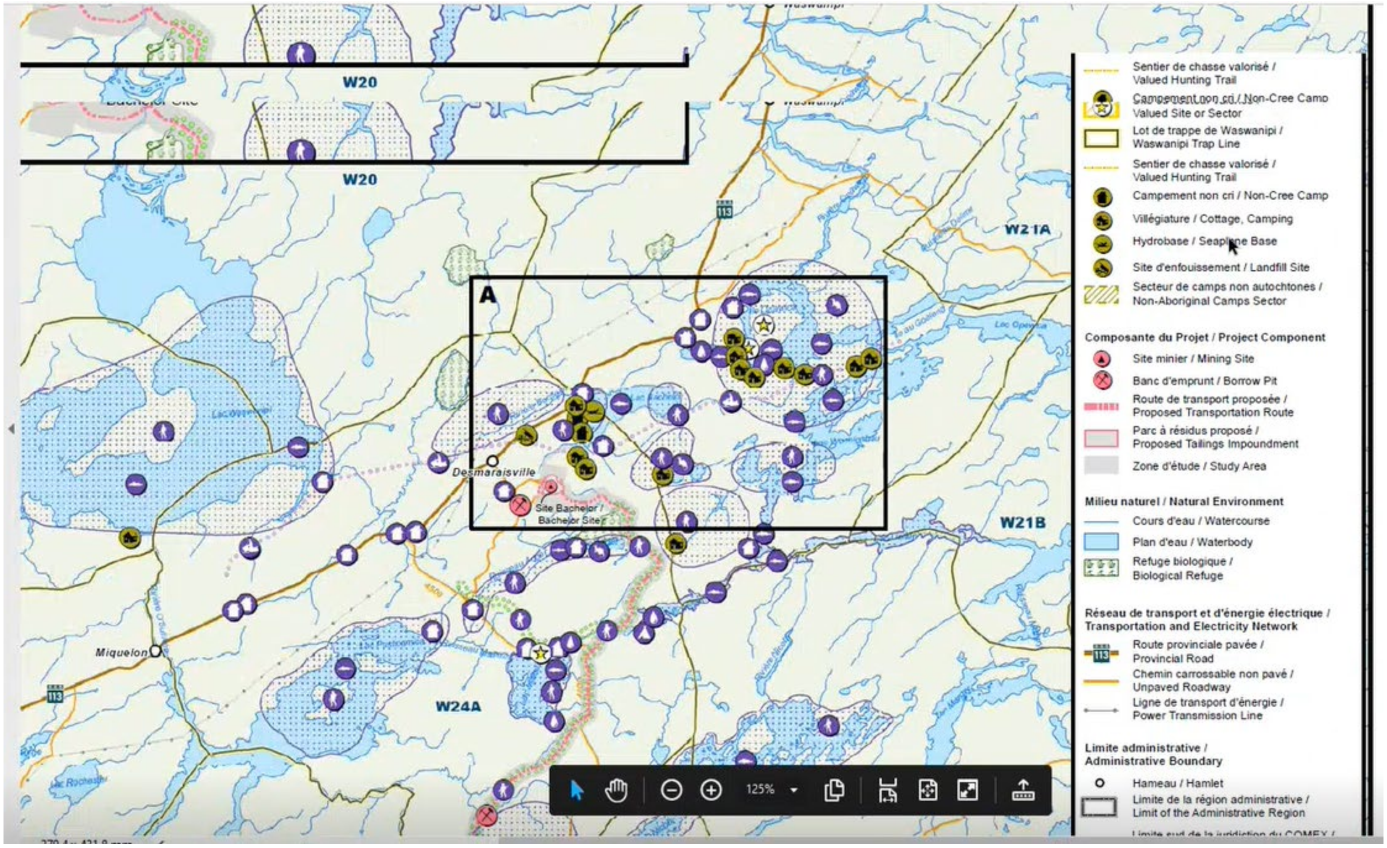


Figure 4: Map showing all the land activities from the impact study document

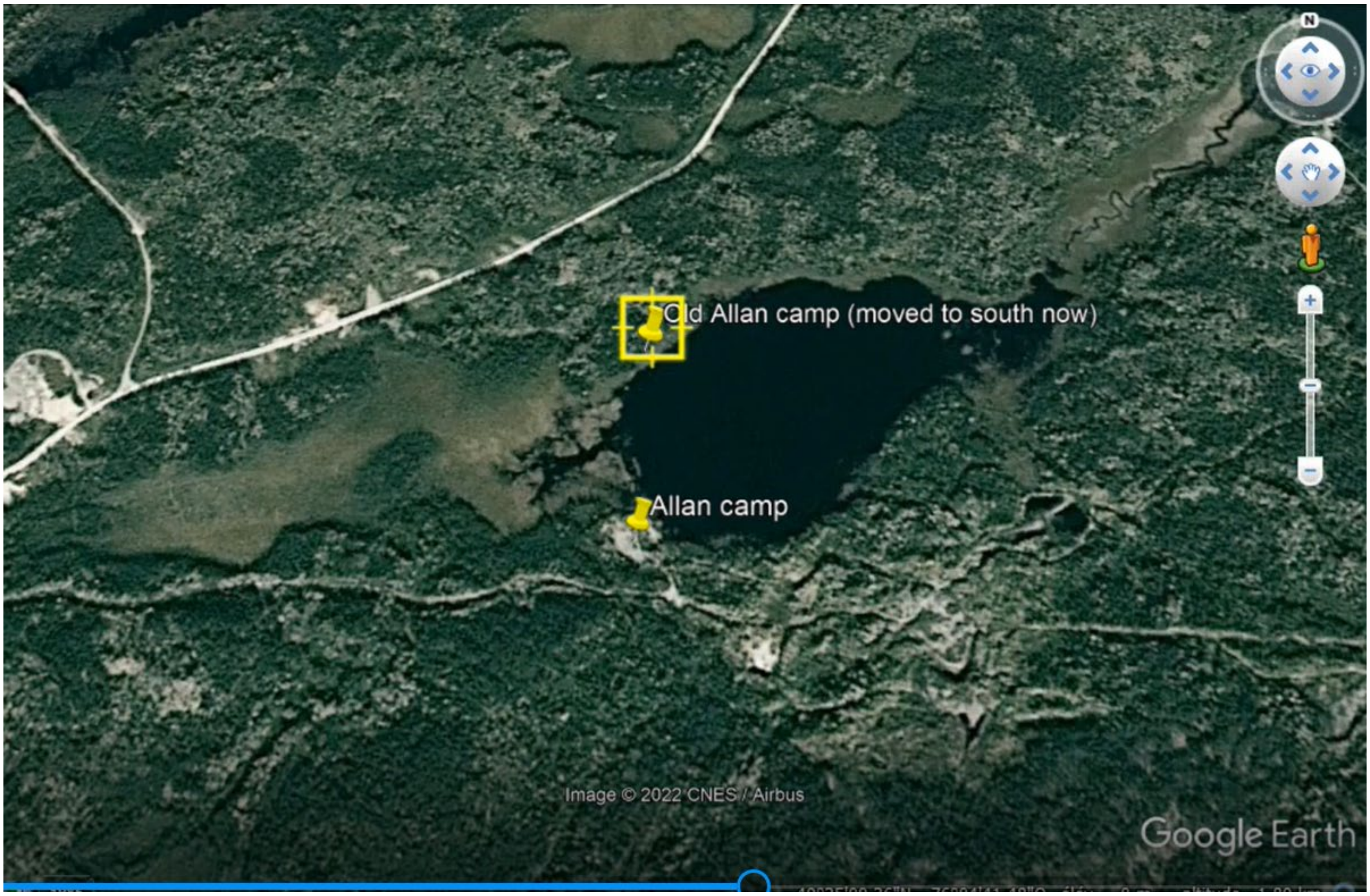


Figure 5: Lac Cerré map

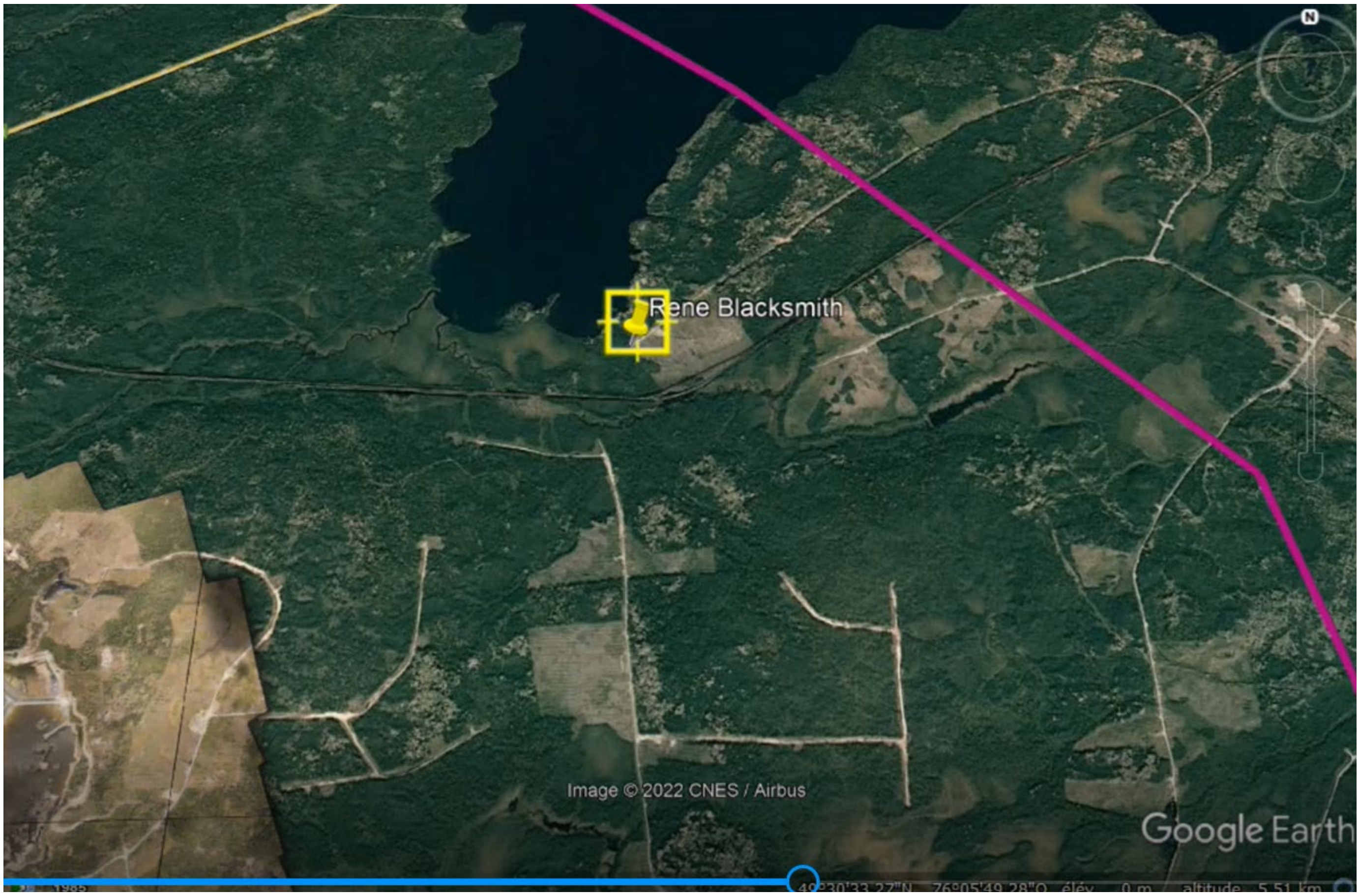


Figure 6: Map showing the Lac Bachelor, near the mine site

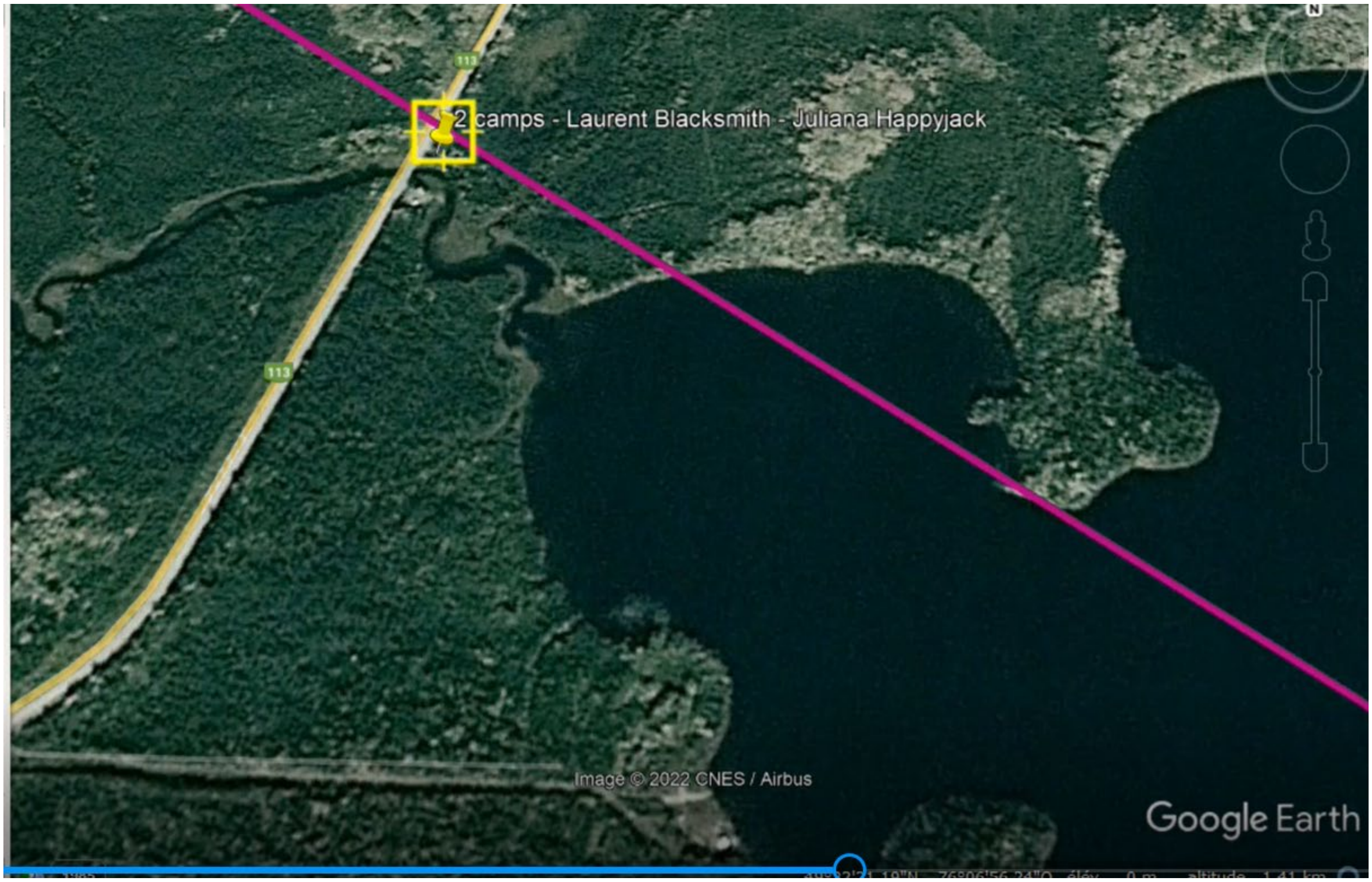


Figure 7: Permanent camps near the highway 113 and Bachelor River

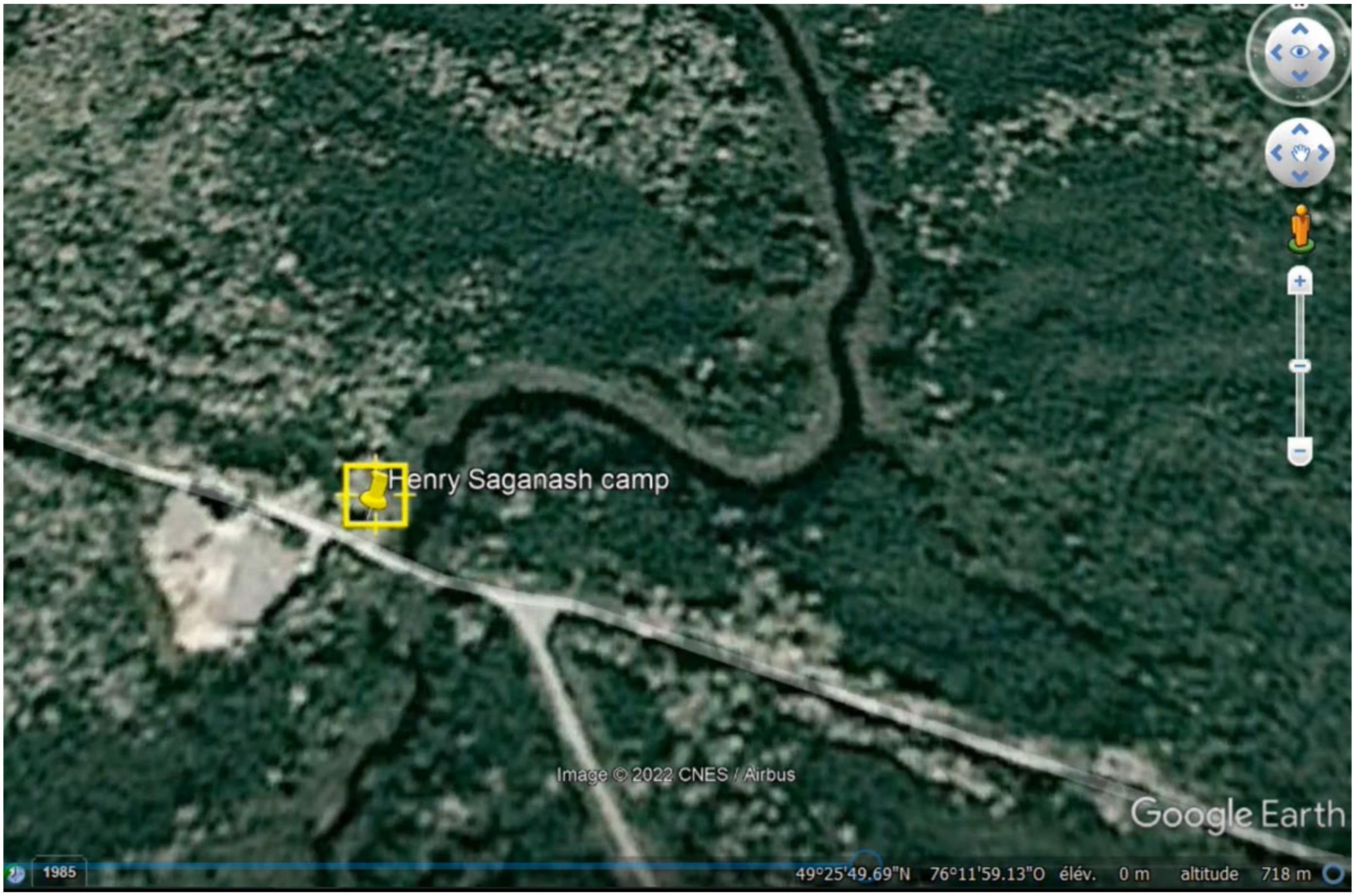


Figure 8: Lac Auger River where Henry's camp is approximately located

Figure 9: Lac Auger and a beaver protected area

Figure 10: shows not used camp close to mine site

NOM_EN	Cottage, Camping
NOM_FR	Villégiature
DESCRIPTIO	Validation des données de Genivar de 2011 par Catherine Lussier, nov. 2018
NOM_FR_EN	Villégiature / Cottage, Camping
ENTREVUE	Georgette et Ron Blacksmith
SOURCE	Genivar
an_source	2011
PRODUCTION	Silva, Angela
VERSION	2018/12/21
CHECK	OK

Figure 11: Hunting site and camping site that was identified in the Impact study (black dots).

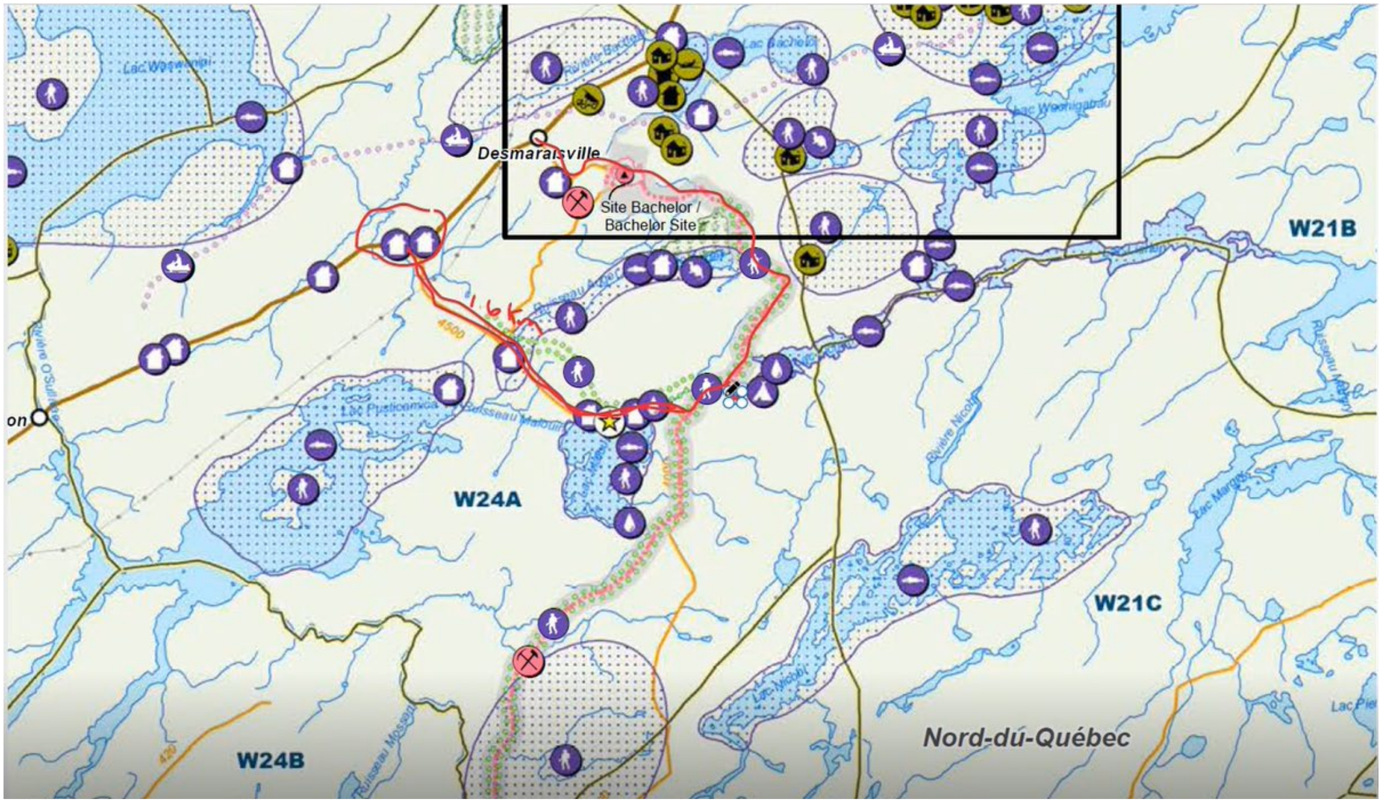


Figure 12: Access Road with the steep hill and the by-pass

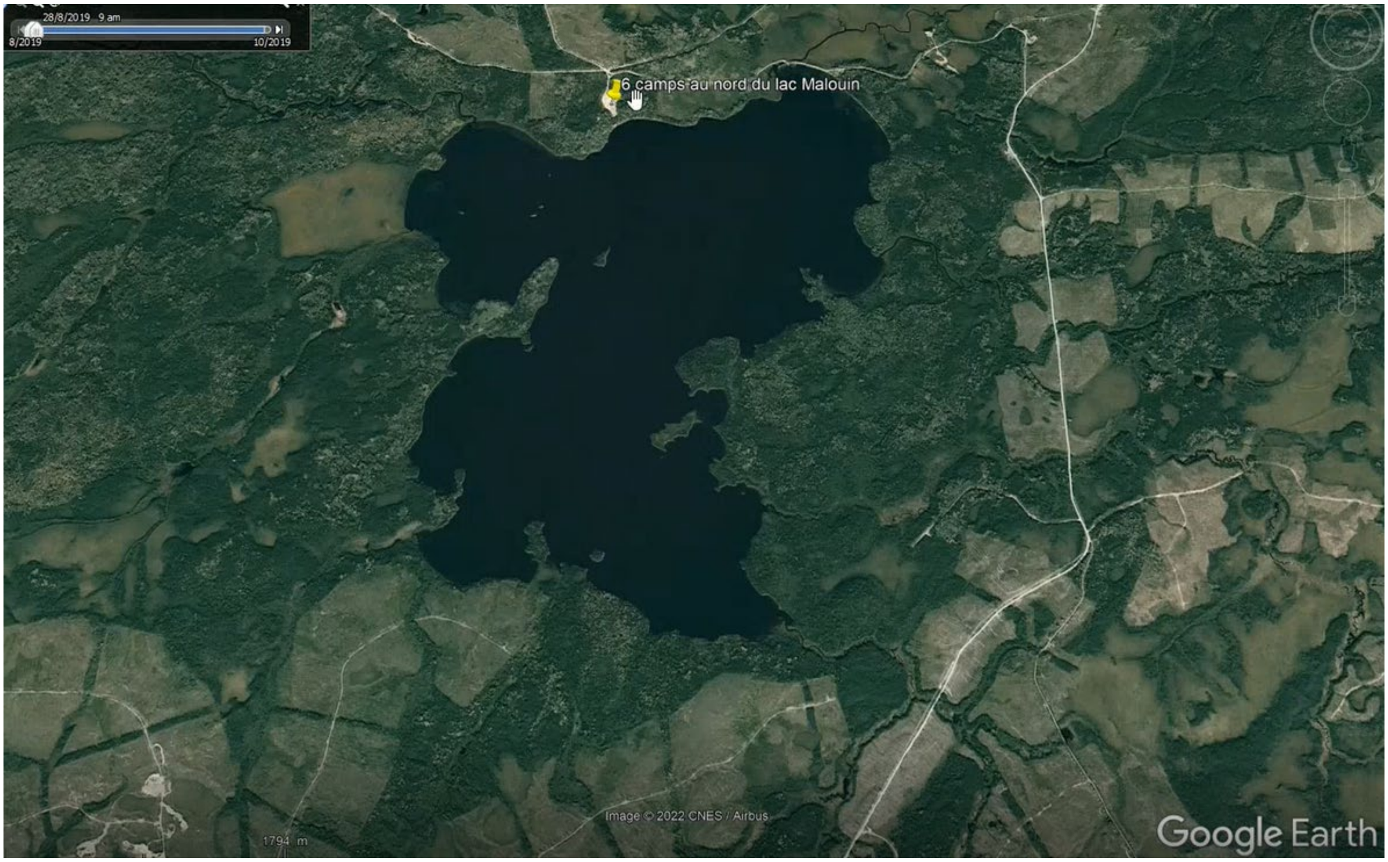


Figure 13: Lac Malouin camps

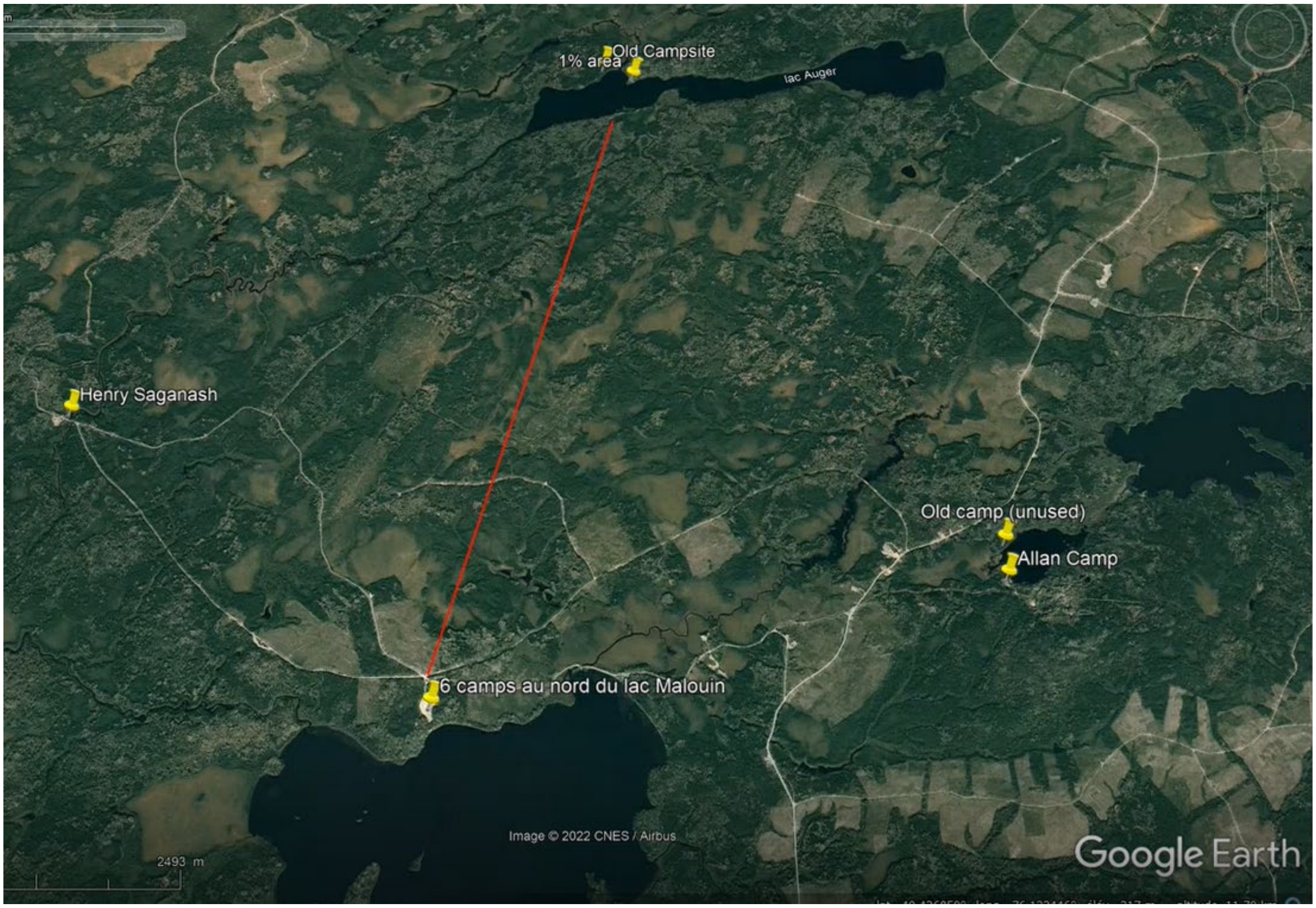
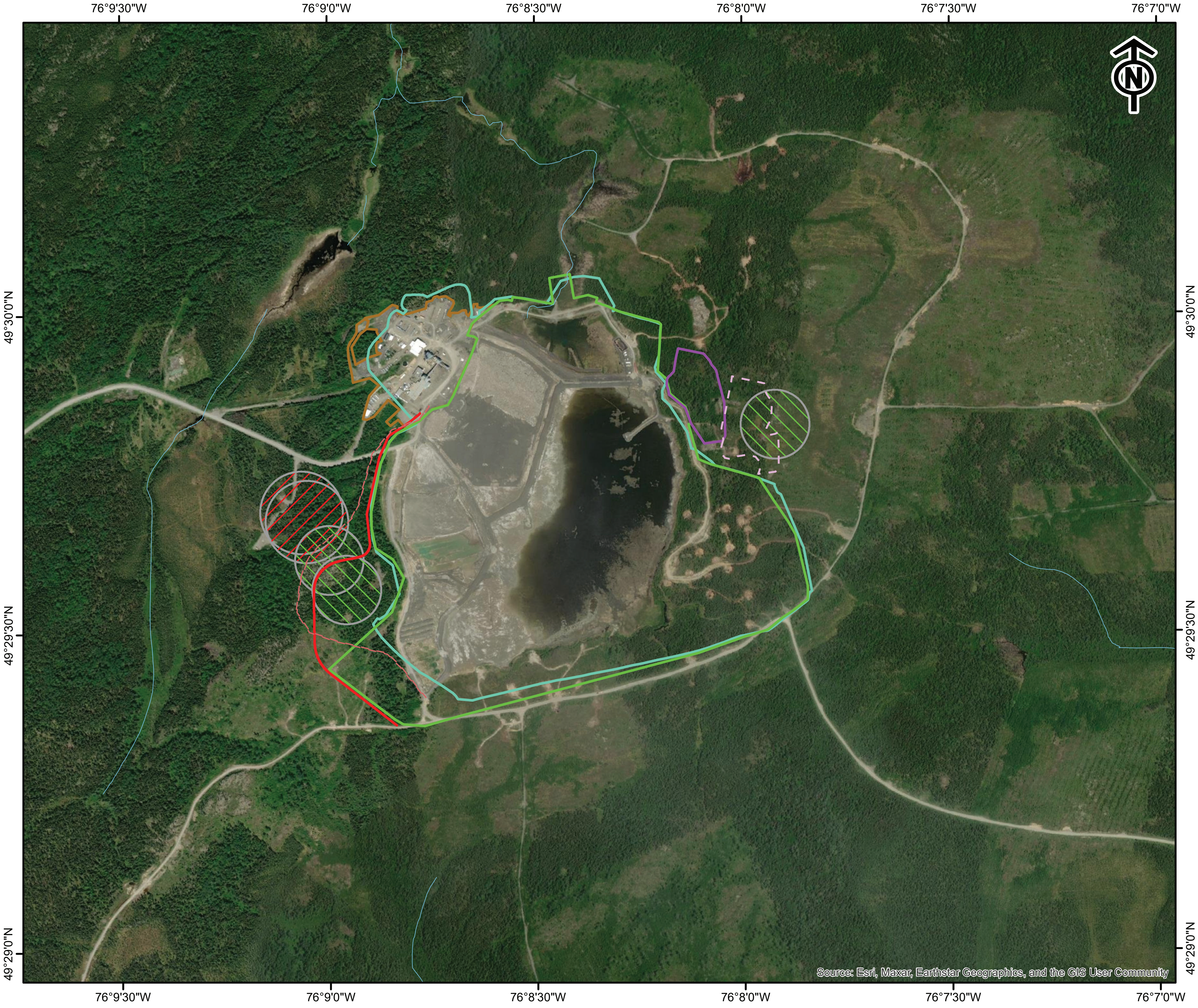


Figure 14: Hunting trail between Lac Auger and Lac Malouin. The trail is used especially during moose hunting

QC2-7: TECHNICAL NOTE – BACHELOR MILL PERIPHERAL ROAD PROJECT AND MICROMAMMAL MAP



BONTERRA

Site Bachelor : Traitement aurifère du projet Barry

Emprise du projet sur les espèces à statut

1 : 11 000

Système de coordonnées : MTM Zone 9 NAD83

0 125 250 500 Mètres

Légende

Cours d'eau permanent

Habitats d'espèces à statut

- Campagnol des rochers
- Campagnol-lemming de Cooper

Infrastructures -- Original

- Accès sud - Original
- Emprise du projet -- Original
- Halde à mort-terrain -- Original

Infrastructures -- Révisée

- Accès Sud -- Original-révisé
- Parc à résidus et digues
- Halde à mort-terrain
- Usine, bâtiments et entreposage

Réalisé par : Robert LeBrun
21 octobre 2022

21-0696-0784

GCM CONSULTANTS

QC2-8: REPORT – CHIROPTERA INVENTORY – BREEDING PERIOD (GCM, 2022)

Desmaraisville, Québec

BACHELOR SITE

CHIROPTERA INVENTORY- BREEDING PERIOD

ENV0161-1501-00_EN

GCM Reference No.: 22-0696-0161

Prepared by: Fabienne Côté, Biologist
Enviro Science et Faune

Verified by: Amélie Trottier-Picard, Biologist
GCM Consultants

Revision	Issuance	Date
00	**FINAL**	**2022.10.24**

CLIENT – BONTERRA RESOURCES INC.

Marc-André Pelletier, Eng.	President and Chief Executive Officer
Mélissa Bruneau	Environment Superintendent

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Michel La Haye, Biol., M. Env.	Revision

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2. Detailed Results by Recording Date of Identified Bat Calls, Bonterra, 2022

1.0 BACKGROUND

Enviro Science et Faune inc. conducted a chiroptera inventory in the breeding and nesting period at the Bachelor site of Bonterra Resources (hereinafter Bonterra), located in Desmaraisville, Québec. This study was conducted in the context of the environmental and social impact assessment (hereinafter impact assessment) (Bonterra) in May 2020 formulated in the context of the project to process gold ore from the Barry and Moroy projects and increase the milling rate of the mill to 2,400 tonnes per day at the Bachelor mine site. (Y/Ref.: 3214-14-027).

After receiving the first series of questions from the Environmental and Social Impact Review Committee (hereinafter COMEX) in May 2020, a chiroptera inventory was produced in the migration period. The results of this inventory were presented in the context of an addendum to the answers to the COMEX questions and comments submitted in March 2021. The report recommended, in particular, that inventories of chiroptera in the breeding period and the buildings be produced to detect the presence of diurnal roosts and complete the picture. For this reason, in the context of a second series of questions, COMEX requested that a new inventory be conducted to cover the breeding period and verify the presence of roosts and maternity colonies in the mine site's buildings.

The objective of this inventory in the breeding period was to identify the chiroptera species present, with special attention to species at risk, validate the presence of maternity sites and feeding habitats used in this period of the year, and identify the environments used by each species or each species group.

2.0 EQUIPMENT AND METHODS

The study area, covering about 374 ha, is located around Bonterra’s Bachelor mining project, southeast of Desmaraisville. The natural environments of the study area are composed primarily of softwood (spruce) forests, with several smaller hardwood stands. Several forest cuts were done over the past ten years and a large part of the forests is therefore regenerating. A network of small watercourses and a few ponds can also be found.

An inventory covering the migration period was produced in 2020. This inventory concerns the breeding period. The methodology used for this inventory is derived from the Recueil des protocoles standardisés d’inventaires acoustiques de chauves-souris au Québec (Ministère des Forêts, de la Faune et des Parcs (hereinafter MFFP), 2021). The location of the recording stations was chosen prior to the field work. The stations were placed according to ecoforestry maps and orthophotos to cover the entire study area, ensuring that the potential chiroptera habitats are covered and that the stands are representative of the stands encountered in the study area. During installation of the detectors, the location was changed slightly to ensure maximum recording potential. The detectors were placed in the same locations as in 2020, or very close to them (less than 30 metres).

A total of four (4) recording stations were deployed for this inventory. A recording station is composed of a bat detector (Anabat SD1, Titley Electronics) coupled to a battery, all in a watertight case with an opening for the microphone. The stations were installed in trees, at a height of two metres above the ground. The microphone was oriented to openings in the environment favourable to the presence of chiroptera. If branches could hinder recording, they were cut. Table 1 summarizes the habitats chosen for each station.

Table 1. Description of the Habitats Chosen for Each Bat Recording Station, Bonterra, 2022

Station	Habitat
CH01	Edge of a pond, along a softwood forest
CH02	Softwood cutover, open environments in regeneration
CH03	Opening in a softwood forest, on a barren rocky summit
CH04	Rocky summit with little shrub cover, overhanging a road

All the recording stations were installed on June 22, 2022. The bat detectors were programmed to operate from 20:30 to 04:30. This corresponds to 8 hours of recording per evening. The recording stations remained in place until mid-August, when another team recovered the material. It should be noted that one recorder was not found. This is the one located at station CH02. Searches were conducted again to try to find it. In addition to the recording stations, a weather station (Vantage Pro 2, Davis) was installed in the centre of the study area to collect data on temperature, wind strength and direction, and precipitation. The location of the recording stations for the inventory is in Appendix 1.

During the June 22 field visit, the accessible buildings and anthropogenic structures were inspected to detect the presence of chiroptera. The visual inspection sought to detect visible traces of bat activities (feces, entry points used or individuals). The personnel met on site were also questioned to find out if chiroptera observations had occurred. All of the buildings and structures were inspected, i.e. the entire complex around the offices, the dormitories and the structures near the tailings management area. Two bat roosting boxes already present on the dormitories were also inspected.

All the data collected on the bat detector memory cards was transferred to a computer for analysis with software (Analook). During the analyses, the calls showing enough distinctive characteristics were identified with the species. However, in some cases, the call structure does not allow sure identification. The call then is classified in a subgroup. Thus, the calls of the Big Brown Bat (*Eptesicus fuscus*), Hoary Bat (*Lasiurus cinereus*) and Silver-haired bat (*Lasionycteris noctivagans*) may have very similar characteristics that make them difficult to distinguish at certain times. In this case, the call was classified as part of the low-frequency group.

Similarly, the weather data recorded on the weather station recorder was also transferred to the computer with WeatherLink software and then exported to an Excel file. The analysis of the weather data showed the recording periods most favourable to bat activity. These normally correspond to nights with little wind (<6 m/s), little precipitation and a temperature above 10ºC.

3.0 RESULTS

During the data transfer, it was recognized that all the detectors were in operation at least between June 22 and July 18. Although some detectors were in operation longer, this date range was selected for the analysis. During this 21-day period, a total of 124 hours of recording under good weather conditions was completed. A total of 199 bat calls was counted for this period. Three species were identified, Big Brown Bat (*Eptesicus fuscus*), Hoary Bat (*Lasiurus cinereus*) and Silver-haired bat (*Lasionycteris noctivagans*).

Of the 199 calls, 98 (49%) belong to the Silver-haired Bat, 75 (38%) are Hoary Bat calls and 4 calls (2%) were identified with the Big Brown Bat. Finally, 22 calls (11%) were classified in the low-frequency group and could belong to any of the species. Table 2 summarizes the results obtained for the selected dates. A detailed table for each recording date is available in Appendix 2. The total index of activity is 0.53 (199 calls/station/h).

Table 2. Identification of Bats (Number, Percentage and Index of Activity), Bonterra, 2022

	Low-frequency group			Big Brown Bat			Hoary Bat			Silver-haired Bat			Grand total
	NB	%	IA	NB	%	IA	NB	%	IA	NB	%	IA	NB
Total	22	11.1	0.06	4	2.0	0.01	75	37.7	0.10	98	49.2	0.26	199

NB: Number of calls
IA: Index of activity (number of calls/station/hour)

Table 2 summarizes the results obtained for each station. The locations of the inventory stations are presented on the map in Appendix 1. Bat activity was more intense at two stations, i.e. stations CH03 (93 calls) and CH04 (88 calls). These two stations recorded more than 90% of the calls. The two stations have similar characteristics, open environments located at a slightly higher altitude and near rocky outcrops. It should be noted that the station CH02 recorder could not be recovered. Investigations are under way to determine whether the device could have been moved or stolen.

Table 3. Number of Individuals Per Bat Species Identified for Each Station, Bonterra, 2022

Station	Low-frequency group	Big Brown Bat	Hoary Bat	Silver-haired Bat	Grand total
CH01	2	0	6	10	18
CH02	N/A	N/A	N/A	N/A	N/A
CH03	6	0	40	47	93
CH04	14	4	29	41	88
Grand total	**22**	**4**	**75**	**98**	**199**

NA: Not available

During the inspection of the buildings, no sign of the presence of bats was observed.

4.0 DISCUSSION

The diversity of chiroptera in the study area is low. Only three species were identified during this inventory, Big Brown Bat, Hoary Bat and Silver-Haired Bat. The Hoary Bat and the Silver-haired Bat are species likely to be designated threatened or vulnerable in Québec (MFFP, 2022). The Big Brown Bat does not have any special status. The index of activity of the bats is also relatively low. It is similar to the index obtained during the migration inventory in 2020 (0.48 calls/station/h in 2020 and 0.53 calls/station/h in 2022) (GCM, 2021). These results may largely be due to the absence of the *Myotis* group, species that previously were present at these latitudes. Indeed, although the habitats of the study area were suitable for the presence of *Myotis*, no species of this genus were detected. This is probably related to the decline of this species caused by white-nose syndrome (hereinafter WNS). This is a fungal infection caused by *Geomyces destructans,* which forms on the nose, ears or wing membrane of bats affected by this ailment (Blehert et al., 2009). It is decimating the cave-dwelling bat populations in eastern North America, including those of Québec. The presence of WNS has been confirmed in Québec for several years and is now reported in almost every region of the province. Bats of the genus *Myotis* are now considered endangered following an emergency order of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2013 (COSEWIC, 2013).

This inventory covered the breeding period. The Hoary Bat and the Silver-haired Bat, two migratory and tree-dwelling species, were much more present than the Big Brown Bat. The Big Brown Bat had been most detected in 2020 (GCM, 2021). This indicates that the two species (Hoary Bat and Silver-haired Bat) use the territory in the breeding period (birthing, feeding and rearing of young) and leave in early fall for the migration.

During this inventory, the habitats in which the majority of the bats were reordered were openings in forest environments. However, station CH01 was also located in an open environment, but few calls were recorded there. The proximity of the rest habitats could play a role in the distribution of chiroptera on the site. The Hoary Bat and the Silver-haired Bat are tree-dwelling species (Tremblay and Jutras, 2010). They use the foliage of large hardwood or softwood trees as diurnal roosts (Willis and Brigham, 2005). The presence of clusters of large hardwoods near stations CH03 and CH04 could be beneficial for these species. It is therefore recommended to conserve the mature forest patches to ensure maintenance of a quality habitat. Moreover, bats often travel along linear forest structures, such as tree lines or forest edges (Grindal, 1996; Grindal, Scott and Brigham, 1998). By maintaining these types of structures and ensuring they are connected to the rest sites, their habitat is improved.

The Big Brown Bat and the Hoary Bat have the habit of hunting in open environments. The Hoary Bat often feeds in open habitats, such as forest cuts (Krusic et al., 1996). The Big Brown Bat often feeds along roads (Krusic et al., 1996). The Silver-haired Bat also hunts in large forest openings where large living trees are found (Jung et al., 1999).

5.0 CONCLUSION AND RECOMMENDATIONS

The chiroptera inventories showed the presence of at least three bat species. This inventory implies that certain habitats are more important than others, such as open environments located near forests with mature trees or near rocky structures. The conservation of connected mature wooded patches near forest openings could be favourable to the species present. It should also be noted that during the inspection of the buildings, no sign of the presence of bats was observed.

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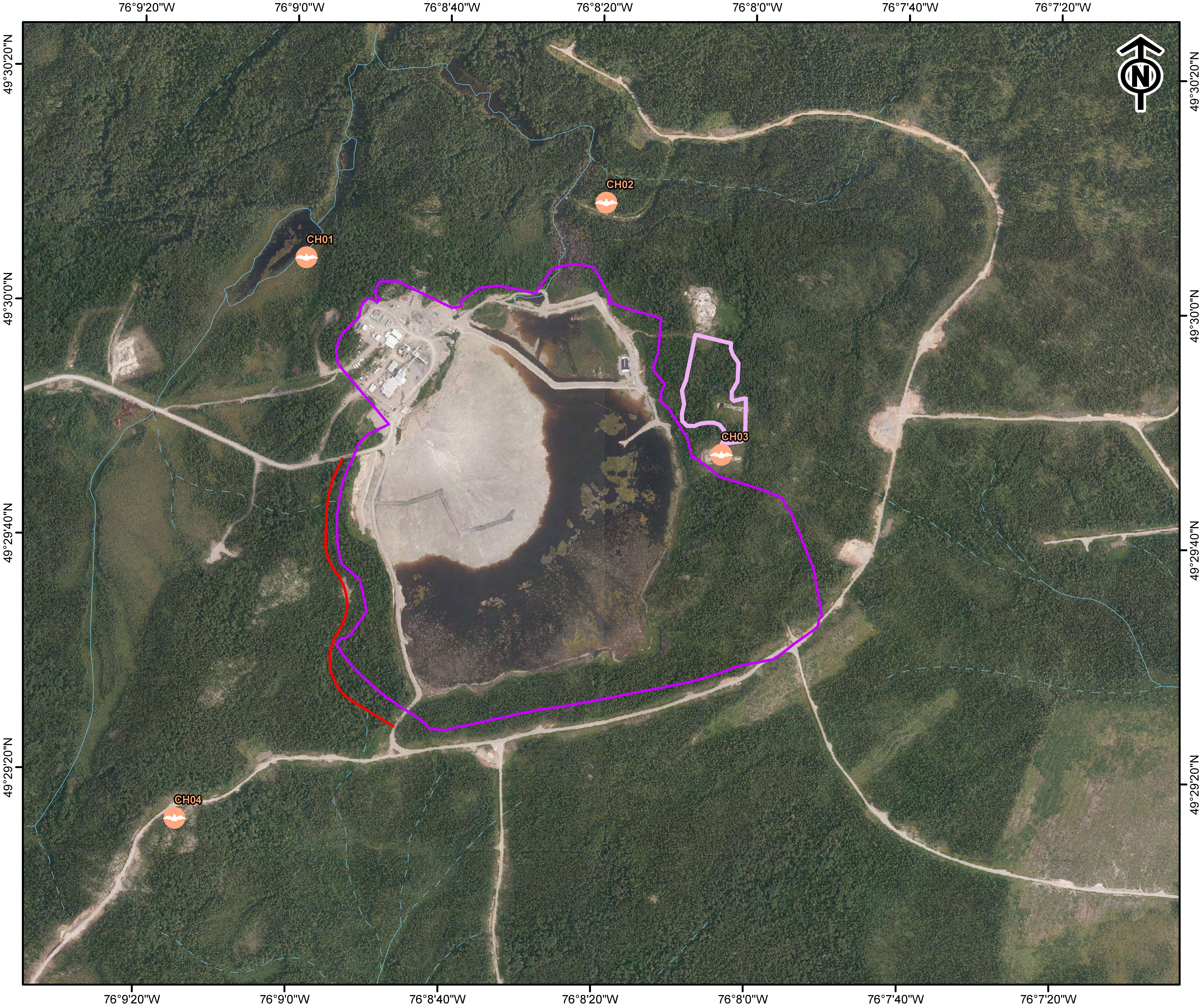
APPENDIX 1

LOCATION MAP OF INVENTORY STATIONS



BONTERRA

Inventaire des chiroptères - Site Bachelor

Stations d'inventaire

1 : 10 000
Système de coordonnées : NAD 83 UTM zone 18N

0 250 500
Mètres

Légende :

- ● Enregistreur de chauves-souris
- 〰 Cours d'eau permanent
- ⁓ Cours d'eau intermittent

Infrastructures projetées

- 〰 Accès sud à l'étude
- ☐ Halde à mort-terrain nouvel emplacement
- ☐ Zone d'agrandissement projetée

Par Robert LeBrun
28 septembre 2022

22-0696-0161

GCM CONSULTANTS

APPENDIX 2

DETAILED RESULTS BY RECORDING DATE OF IDENTIFIED BAT CALLS, BONTERRA, 2022

APPENDIX 2- DETAILED RESULTS BY RECORDING DATE OF IDENTIFIED BAT CALLS, BONTERRA, 2022

Date	Low-frequency group			Big brown bat			Hoary bat			Silver-haired bat			Grand total
	NB	%	IA	NB	%	IA	NB	%	IA	NB	%	IA	NB
22-June	0	0.00	0.00	0	0.00	0.00	3	50.00	0.13	3	50.00	0.01	6
23-June	1	9.09	0.00	0	0.00	0.00	3	27.27	0.07	7	63.64	0.02	11
24-June	1	25.00	0.00	0	0.00	0.00	1	25.00	0.07	2	50.00	0.01	4
25-June	0	0.00	0.00	0	0.00	0.00	1	12.50	0.03	7	87.50	0.02	8
26-June	4	36.36	0.01	0	0.00	0.00	3	27.27	0.07	4	36.36	0.01	11
27-June	2	18.18	0.01	0	0.00	0.00	4	36.36	0.10	5	45.45	0.01	11
01-July	3	50.00	0.01	0	0.00	0.00	1	16.67	0.04	2	33.33	0.01	6
04-July	0	0.00	0.00	2	28.57	0.01	1	14.29	0.04	4	57.14	0.01	7
05-July	0	0.00	0.00	0	0.00	0.00	0	0.00	0.00	1	100.00	0.00	1
07-July	0	0.00	0.00	0	0.00	0.00	6	85.71	0.23	1	14.29	0.00	7
10-July	3	42.86	0.01	0	0.00	0.00	1	14.29	0.04	3	42.86	0.01	7
11-July	1	25.00	0.00	0	0.00	0.00	3	75.00	0.20	0	0.00	0.00	4
12-July	2	8.70	0.01	0	0.00	0.00	14	60.87	0.16	7	30.43	0.02	23
13-July	2	6.90	0.01	1	3.45	0.00	14	48.28	0.13	12	41.38	0.03	29
14-July	1	2.63	0.00	1	2.63	0.00	10	26.32	0.07	26	68.42	0.07	38
15-July	0	0.00	0.00	0	0.00	0.00	2	40.00	0.11	3	60.00	0.01	5
16-July	0	0.00	0.00	0	0.00	0.00	1	12.50	0.03	7	87.50	0.02	8
17-July	1	16.67	0.00	0	0.00	0.00	2	33.33	0.09	3	50.00	0.01	6
18-July	1	14.29	0.00	0	0.00	0.00	5	71.43	0.19	1	14.29	0.00	7
Grand total	**22**	**11.06**	**0.06**	**4**	**2.01**	**0.01**	**75**	**37.69**	**0.10**	**98**	**49.25**	**0.26**	**199**

NB: Number of calls

IA: Index of activity (number of calls/station/hour)

QC2-11: WATER FLOW PLAN NO. INF0784-55001 (GCM, 2022)

VUE D'ENSEMBLE

ÉCHELLE 1:2 000

1 : 2000 — 40 20 0 40 80 120 160 200 m

DESCRIPTION DE DÉPOSITION

DÉPOSITION
CONVENTIONNELLE
TONNAGE VISÉ: 8.5M t
VOLUME (1.44t/m³): ± 5.9M m³

LÉGENDE:

▬ ▬ ▬	BASSIN VERSANT
➡	DÉVERSOIR D'OPÉRATION PROPOSÉ
➡	DÉVERSOIR D'URGENCE ET STRUCTURE DE DÉCANTATION PROPOSÉS
— —	COURBE ARGILE (INTERVALLES AUX 3 m)
🟦	ZONE À L'INTÉRIEUR DE LAQUELLE LE FLUX D'EAU CALCULÉ EST SUPÉRIEUR À 0,5 l/m²/jour
▨	EXTENSION DE MEMBRANE POUR LA ZONE D'EMPRUNT
▨	MEMBRANE À INSTALLER DANS LE PARC À RESIDUS
🟦	EAU

DESSIN No	DESSINS DE REFERENCE
-	-

PLAN FINAL

JFQ CV

REV	DATE	EMISSIONS	PAR	VER.	APP.
00	2022.07.11	PLAN FINAL	J.F.Q.	Y.L.	C.V.
PA	2022.04.27	POUR INFORMATION	S.B.	Y.L.	C.V.

SCEAU

CLIENT

DESSINE PAR: SYLVAIN BERUBE	NO. PROJET CLIENT:
VERIFIE PAR: YVES LEBLANC	NO. PROJET GCM: 21-0696-0784
APPROUVE PAR: CHARLES VEILLEUX	ECHELLE: 1:2000
DATE: 2022.04.25	

GCM CONSULTANTS www.gcmconsultants.com

TITRE ÉTUDE DES IMPACTS - PROJET DE TRAITEMENT DU MINERAI
AURIFÈRE DES PROJETS BARRY ET MOROY AU SITE BACHELOR ET
AUGMENTATION DU TAUX D'USINAGE
FLUX D'EAUX SOUTERRAINES

DESSIN No INF0784-55001 REV 00

FORMAT A0 métrique 1189x841

QC2-12: TECHNICAL NOTE – ASSISTANCE IN LOCATING THE PREFERRED LOCATIONS OF OBSERVATION WELLS TO DETERMINE THE FLUORIDE BACKGROUND LEVELS OF THE BACHELOR PROJECT IN DESMARAISVILLE (RICHELIEU HYDROGÉOLOGIE, 2021)

Richelieu, 14 September 2021

GCM Consultants inc. By e-mail

For the attention of Mrs. Mélissa Tremblay, Eng. Project Manager

Subject: **Assistance in locating preferred locations**
Observation wells to determine the background of fluorides Bachelor project in Desmaraisville

Dear Madam,

I am pleased to provide you with a technical opinion intended to establish the locations of additional observation wells at the Bonterra site in Desmaraisville.

To fulfill the mandate, we downloaded the SIGEOM geological map in electronic format and superimposed it on satellite imagery, as well as on the modelled piezometric map when the tailings management area is completed. The criteria for selecting locations were the following:

- Be upstream hydraulically of the tailings management area;
- Be representative of each lithological unit encountered on the site;
- Be accessible for drilling equipment with minimum development work for access roads;

A total of six locations were selected. The use of at least four of these locations would be recommended. These are located in figures 1 and 2 in the appendix, while their UTM coordinates, as well as their justification, are shown in table 1.

In addition, these observation wells should be installed in such a way as to sample only the water from the bedrock. Thus, the strainer must be isolated from the overlying horizons by a sealed bentonite plug. The installation of such a plug requires the presence of an annular space between the casing and the wall of the drillhole. The recommended drillhole size is HQ (9.6 cm diameter), while the diameter of PVC strainers and casings should be 5 cm in diameter, resulting in an annular space of 2.3 cm. This diameter allows the use of most of the usual sampling techniques. A calibre 1 gravel pack must first be placed in this space at the strainer to promote the flow of water towards it and prevent it from clogging. The top of the gravel pack must be at a level higher than that of the strainer in order to prevent the introduction of bentonite into the latter. The base of the filter sand must be lower than the base of the strainer. A sealing plug made of bentonite (granular, powder, pellet or grout) is then placed over the filter materials to isolate the strainer from the water from the overlying layers. In order to maximize the length of rock intersected to intercept the network of cracks, the length of the strainer must be 6 m.

The annular space remaining between the top of the bentonite plug and the ground surface must be filled with a mixture of cement-bentonite or bentonite. The upper part of the well must be protected by a protective casing filled with a bentonite cement grout plug placed from the surface and ideally up to the frost line (at least 2 m). This plug is used to prevent the infiltration of runoff water and to physically support the protective casing. Surface development should be completed by placing a conical mound 15 cm high over a distance of one metre, composed of a compacted material with low permeability, in order to keep surface water away from the well.

Each of the steps involved in completing a drillhole, constructing an observation well, or installing sampling equipment is likely to affect the representativeness and integrity of the samples. The person responsible for drilling the wells and installing sampling instruments must monitor the work and ensure that his instructions are followed.

In order to control the factors that may influence the quality of the samples, the use of drilling residues or any other "general" material to construct the observation well should be prohibited. Any deviation from this rule should be well documented. This practice could, among other things, move contaminants from the surface or soil to the horizon to be characterized and thus influence the results of analyses, in addition to spreading the contamination. In addition, the use of "general materials" in the upper part of a drillhole could in some cases promote the creation of preferential flow paths.

After construction, the wells will have to be developed by pistoning or overpumping. The development of an observation well is first used to remove the finest particles that can be found that the level of the strainer and the gravel pack or the rock. It is also used to remove the fluid introduced during drilling (if any), which should prevent the fluid from interfering with the results of the water quality analyses. Particular attention must therefore be paid when a large quantity of drilling fluid has been injected during the production of the well. It is recommended to wait at least 24 hours after installation of the well seal before proceeding with its development, to ensure that the integrity of the bentonite and grout is not compromised. Development should continue until water is obtained that is visually free of suspended particles or at least has a stable turbidity. The duration of development will vary depending on many factors, including the chosen development method.

The typical construction of an installation is shown below.

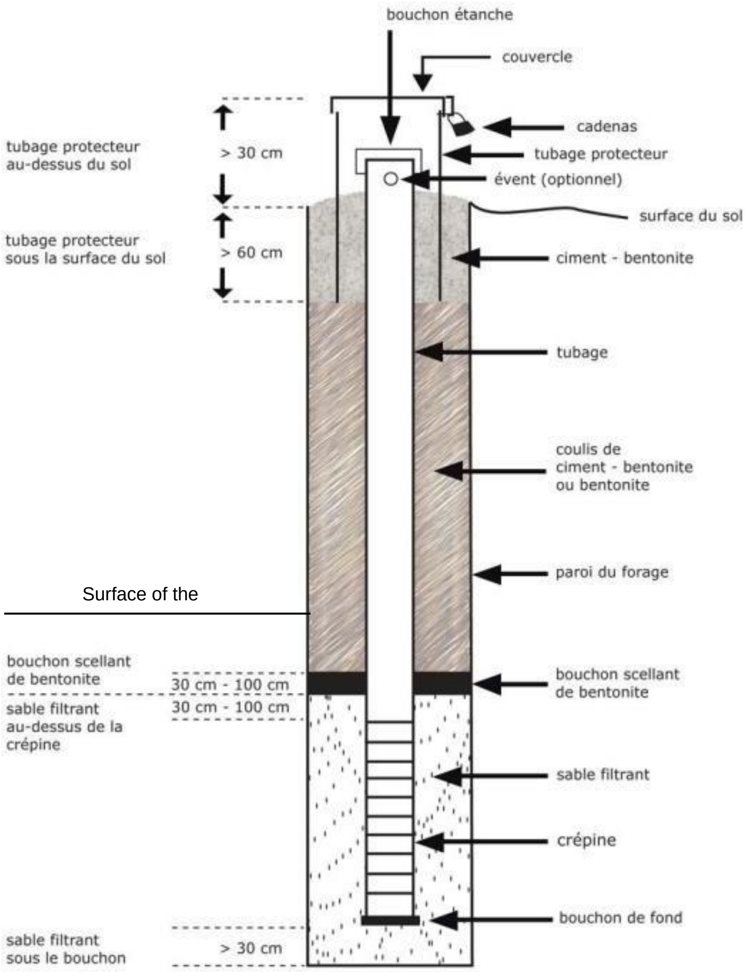


Figure 1: Installation diagram of the observation wells

With regard to sampling, it is recommended that sampling be carried out using dedicated equipment so as to avoid cross-contamination. The minimum sampling frequency is twice a year and should ideally take into account seasonal variations of hydrogeological conditions: recharge and low water table. The detailed procedure for sampling and sample retention is described in workbook 3 of the Sampling guide for environmental analyses (https://www.ceaeq.gouv.qc.ca/documents/publications/echantillonnage/eaux_soutC3.pdf). The main sampling steps are summarized below:

1. **Inspection of the well**: inspection of the structural integrity of the well (good condition of the inner casing: no breakage, degradation or cracks) and its protective equipment (no sign of vandalism) and the good condition of its surface sealing system and the absence of water around the well.
2. **Water level measurement:** When arriving on-site, it is recommended that the water levels of each of the wells be recorded in the shortest possible time in order to reduce the effects of possible fluctuations caused by barometric variations. The measurements must always be made from the same reference, which must be fixed (the best reference is the top of the PVC because the protector can be moved by the frost, while the ground can be uneven around the well).
3. **Purge:** The recommended purge method is that of low flow and low drawdown. This method involves subjecting the observation well to pumping at a rate of 0.1 to 0.5 l/min and taking measurements of the drawdown, the temperature, the pH and the electrical conductivity of the water. Purging should continue until measurements of each parameter are stable, before sampling can proceed. In the event that a well provides very little Water, the minimum purge method would then be recommended.
4. **Sample collection:** When taking samples, avoid any overflowing of the bottles, any rinsing, any soiling on the neck of the bottle or in the stopper, follow the laboratory guidelines for certain analyses, including, amongst others, volatile compounds. For quality assurance and control purposes, it is also required to duplicate at least one in ten samples, using field blanks and laboratory blanks as required.
5. **Sample filtration:** Since one of the objectives is to measure the dissolved form of certain metals (since the aim is to characterize the contaminant likely

to move with the groundwater), filtering the samples in the field is recommended. Filtration should be done in-line with 0.45 µm dedicated filters.

6. **Field notes:** It is important to document all field observations: inspection results, water level measurements, purge details, visual and olfactory description of the samples.
7. **Storage and transport of samples:** Samples should be kept cold for the duration of their transport to the laboratory in order to avoid any deterioration of the water quality.
8. **Water analyses and preparation of a report:** Samples must be analysed in a MELCC-accredited laboratory for the relevant parameters. The analysis certificates provided by the laboratory will be included in the follow-up report, along with the sampling methodology, interpretation of the results obtained, a discussion, as well as the conclusions and recommendations.

The list of substances recommended for analysis is presented in table 2. This is an exhaustive list of metals, nutrients and organic compounds. The wells to be constructed with a recommended location will be added to the observation wells already present on the site, according to the principle of at least two observation wells to be sampled hydraulically downstream from each potential source of groundwater contamination.

Yours sincerely,

Yves Leblanc, Geo
Eng., M.Sc.

QC2-17: BONTERRA – PROGRAM FOR THE GEOTECHNICAL INVESTIGATION OF THE BACHELOR TAILINGS MANAGEMENT AREA (BBA, NOVEMBER 10, 2020)

Bonterra

Geotechnical investigation program for the Bachelor tailings management area

Val-d'Or, QC

Technical report

Geotechnical report

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FINAL

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1. INTRODUCTION

As part of the expansion of the Bachelor tailings management area, Bonterra will conduct a geotechnical investigation program in line with each dike in the area of the Bachelor tailings management area so as to properly characterize the foundation soil. In this context, Bonterra mandated BBA to carry out a geotechnical study to support the engineering and design of the retention infrastructure of the expanded tailings management area.

This report covers the original terms of reference in the service offer dated 21 November 2018 and the additional work carried out in July 2020. The "in situ" observations and tests as well as the results of the laboratory tests are presented in this report.

The original mandate includes 31 drillholes at the Bachelor tailings management site conducted between 26 March and 10 April 2019 by BBA and Marathon Underground. The additional work includes 4 drillholes on the west dike, whose soft clay was discovered in the initial mandate.

For the original mandate, the samples collected were sent to the Englobe, École de Technologie Supérieure (ETS) and AGAT laboratories for analysis. For the additional work, the collected samples were sent to the ABS Group laboratory. BBA has analyzed the site and laboratory information received and prepared this document.

BBA executed the mandate according to the following activities:

- Preparation of plans for surveys;
- Supervision of the work and collection of soil samples;
- Selection of samples for laboratory analysis;
- Interpretation of the results obtained and geotechnical analysis;
- Preparation of the geotechnical report.

This report contains a general description of the site, a description of the reconnaissance methods used, a detailed description of the nature and properties of the soils in place and the results of the tests performed on the collected samples. The laboratory tests were conducted by Englobe, École de Technologie Supérieur (ETS), ABS Group and AGAT.

2. GEOTECHNICAL CONTEXT

2.1 Location

The Bachelor site is located in Desmaraisville, about 93 km northeast of Lebel-sur-Quévillon. It is accessed from Route 113 via a private road about 5 km long. Its geographical coordinates are the following:

- 76° 8'46.50" West
- 49°29'52.73" North

2.2 Topography and surface drainage context

The average elevation of the land is about 330 metres. Surface drainage of the site is via a tributary of the Bachelor River, which is part of the James Bay watershed.

2.3 Climate

According to data from the Lebel-sur-Quévillon weather station, by Environment Canada, rainfall reached 703.8 mm, while snowfall averaged 226.0 cm. The average annual temperature is 1.0°C with a monthly average ranging from 17.1°C in July to -17.7°C in January. Detailed climate data are presented in Appendix A.

2.4 Geology

The Bachelor site is located in the geological context of the Archean greenstone belt of Abitibi. More specifically, the property under study is located within a band of Archean-age volcanic and plutonic rocks and is part of the Obatogamau Formation, which is composed of mafic and intermediate volcanic rocks consisting of basalt, andesite and volcaniclastic rocks, as well as a granodiorite intrusion. Structurally, the study site is located near the axis of a synformal fold with a NE-SW orientation. Some local faults are sub-parallel to the axis of this fold.

The unconsolidated deposits overlying the bedrock in the area of the property under study are mainly composed of a sequence of glacial till and fluvioglacial sediments at the base, topped by glaciolacustrine sediments composed of clay and silt, then by alluvial sediments composed of sand and silty sand. The sequence is completed by organic peat deposits. The unit mapped at the study site is composed of glacial till, which is bordered on both sides by areas of rock outcrop.

2.5 Hydrogeology and geotechnics

Laboratoire Ville-Marie Inc. conducted a geotechnical study for the design of a tailings dam in 1981. During this study, five trenches and two exploratory drillholes were performed, as well as geotechnical testing (Nilcon vane tester and grading analyses, natural water content and limit tests) on disturbed and undisturbed samples.

The study identified two areas where the characteristics of the surface deposits were different, a zone of outcropping till and a zone of varved clay 7 to 8 metres thick overlying the till. Both zones were covered with a thin layer of organic sediment. The geotechnical and hydrogeological properties of the units are summarized in Table 1.

Table 1: Geotechnical properties and hydrogeology of the Bachelor site, according to the Laboratoire Ville-Marie, 1981

Parameters	Clay	Sand and/or gravel
Thickness (m)	7-8	undetermined
Shear strength (kPa)	26.2 to 64.3 on the surface 13.7 to 14.2 at depth	n/a
Water content (%)	32 to 65	n/a
Density	n/a	Loose to dense
Penetration index	n/a	14 to 22
Consolidation	Normally consolidated	n/a
$K_{in\text{-}situ}$ (cm/s)	$1\times10_{-6}$ to $1\times10_{-8}$	n/a

The Laboratoire Ville-Marie inc. concluded that the construction of the dike should be carried out in two stages separated by a few years, in order to allow for the dissipation of the pore pressures generated in the clay during the construction of the first stage. In addition, given the high risk of differential settlement due to the different nature of the surface soils, either granular or clayey, it was recommended to select materials accordingly for the construction of the dike and a sequential construction. Constant monitoring of the condition of the dike should be done and the addition of material on the crest of the dike may be necessary to compensate for deformations caused by differential settlements.

Secondly, Golder Associés (in 2007) performed a geotechnical and hydrogeological study for the design of the Bachelor Lake mine tailings management area. This study included 15 drillholes with soil sampling, in-situ and laboratory testing, installation of 6 observation wells, chemical analysis of tailings samples, evaluation of potential receptors, interpretation of results and preparation of a technical report. Geotechnical and hydrogeological tests in situ and in the laboratory were carried out on the collected soil samples.

The study conducted by Golder Associés (2007) identified superficial layers of backfill, composed of tailings, followed by topsoil or peat, then a soft clay deposit, a transitional layer composed mainly of silt, and then a horizon of sand, silt and gravel deposited on the bedrock. The hydrogeological and geotechnical properties of the units obtained by Golder Associés Ltée are summarized in Table 2.

Table 2: Geotechnical and hydrogeological properties, according to Golder Associés (2007)

Parameters	Tailings	Clay	Sand and/or gravel
Thickness (m)	0.6 to 3.9	0.6 to 8.5 m	undetermined
Shear strength (kPa)	n/a	30 to 80 on the surface 20 to 22 at depth 6 to 9 in places	n/a
Water content (%)	n/a	32 to 65	n/a
Density	Loose and very loose	n/a	Loose and very loose
Penetration index	0 to 8	n/a	2 to 57
Consolidation	n/a	76 kPa at 7.6 m 73 kPa at 10.1 m	n/a
Particle density	n/a	2.74 to 2.77	n/a
$K_{in\text{-}situ}$ (cm/s)	n/a	$1 \times 10_{-6}$	$2 \times 10_{-5}$ (silty sand)
K_{lab} (cm/s)	n/a	$7 \times 10_{-8}$ to $4 \times 10_{-7}$	n/a

Analyses of the tailings indicate that the tailings would are poorly leachable for copper in the absence of acid generating conditions. However, they are poisoned with cyanide. The study indicates that under Directive 19 on the mining industry, Level A sealing measures will be required for the tailings management area.

In 2016, GHD performed a geotechnical soil investigation as part of the Bachelor Mine tailings management area expansion with the goal of determining the nature and geotechnical characteristics of the soils at the site. This study assisted the designer in conducting bearing capacity studies of the supporting soils and stability of the slopes to be constructed at Cell #1 of the mine tailings management area.

During this study, five drillholes and eight piezocone surveys were drilled, and in situ and laboratory geotechnical and hydrogeological tests were performed on the collected soil samples.

The GHD (2016) study identified 4 soil layers:

- An organic horizon with a thickness of 60 mm to 250 mm;
- A natural layer of silt with traces of sand from 0.69 m to 1.20 m thick;
- A natural cohesive deposit varved to depths ranging from 8.00 m to 12.45 m;

- A deposit of glacial origin, commonly known as till, composed of a sandy matrix beneath the clay deposit.

The hydrogeologic and geotechnical properties of the units obtained by GHD (2016) are summarized in Table 3.

Table 3: Geotechnical and hydrogeological properties, according to GHD (2016)

Parameters	**Peat**	**Silt**	**Clay**	**Sand and/or gravel**
Thickness (m)	0.06 to 0.25	0.69 to 1.20	0.6 to 8.5 m	undetermined
Shear strength (kPa)	n/a	n/a	20 to 124	n/a
Water content (%)	n/a	n/a	31 to 64	n/a
WL (%)	n/a	n/a	28 to 64	n/a
WP (%)	n/a	n/a	18 to 26	n/a
IP (%)	n/a	n/a	10 to 43	n/a
IL	n/a	n/a	0.88 to 1.3	n/a
Density	n/a	Loose to compact	n/a	compact
Penetration index	n/a	5 to 14	n/a	11 to 29
Consolidation	n/a	n/a	109 kPa at 10.3 m 252 kPa at 9.60 m	n/a
Specific gravity (kN/m$_3$)	n/a	n/a	15.6 to 19.4	n/a
Sensitivity	n/a	n/a	8 to 35	n/a
$K_{in\text{-}situ}$ (cm/s)	n/a	n/a	$1\times10_{-6}$	$2\times10_{-5}$ (silty sand)
K_{lab} (cm/s)	n/a	n/a	$8\times10_{-8}$ to $1.3\times10_{-7}$	n/a
Indices of initial voids	n/a	n/a	0.96 to 1.38	n/a

Richelieu Hydrogéologie Inc. in (2018) conducted a hydrogeological and geotechnical study in order to determine the geotechnical properties of the materials present on the site, and also to calculate the water flow per unit area from a future tailings management area. This study included 9 drillholes with soil sampling, in-situ geotechnical and hydrogeological tests, the installation of 6 observation wells, the interpretation of the results and the preparation of a technical report.

The in-situ tests involved standard penetration tests with recovery of Shelby tube, as well as undrained shear strength profiles with the Nilcon vane tester. Permeability tests were performed in the piezometers. Laboratory testing of split-spoon and Shelby tube samples was conducted for the natural water content, particle sizes and sedimentation analyses, Atterberg limits, specific gravity, shear strength, sensitivity, consolidation and density tests.

The study identified 4 soil layers:

- On the surface and to a maximum depth of 8 metres, sand with variable amounts of silt sometimes covered with vegetation or tailings;
- Then, in some drillholes, a layer of silty clay with some silt between 1 and 10 metres deep depending on the drillholes;
- Finally, a till layer with varying amounts of gravel, sand, silt and clay with pebbles and boulders through to the bedrock;
- The bedrock is between 1.2 and 13.25 metres deep. The average bedrock depth at the nine (9) drillholes is 6.35 metres.

The hydrogeological and geotechnical properties of the units obtained by Richelieu Hydrogéologie Inc. in (2018) are summarized in Table 4.

Table 4: Geotechnical and hydrogeological properties, according to Richelieu Hydrogéologie Inc. (2018)

Parameters	**Backfill / Tailings**	**Sandy silt**	**Clay**	**Till**
Thickness (m)	0 to 5.94	0 to 2.29	0 to 5.94	1.53 to 4.9
Shear strength (kPa) in situ	n/a	n/a	In places 25.48 depth 6.86 m 45.35 depth 10.06 m	n/a
Shear strength (kPa) lab	n/a	n/a	137.8 depth 5.66 m 30.9 depth 3.28 m 13.9 depth 1.93 m	n/a
Sensitivity	n/a	n/a	0.7 to 72	n/a
Water content (%)	17-22	7-29	32 to 63	18-20
Density	n/a	Very loose to compact	n/a	Compact to very dense
Penetration index	n/a	4-20	n/a	12-100
Consolidation	n/a	n/a	71 to 106	n/a
WL (%)	n/a	n/a	36-54	n/a
WP (%)	n/a	n/a	19-25	n/a
IP (%)	n/a	n/a	17-29	n/a
IL	n/a	n/a	0.21-1.33	n/a
$K_{in-situ}$ (cm/s)	n/a	n/a	$1\times10_{-6}$	$1\times10_{-5}$
Particle density	n/a	n/a	2.70 to 2.74	n/a
Indices of initial voids	n/a	n/a	1.31 to 1.56	n/a

Richelieu Hydrogéologie Inc. in (2018) concluded that the clay sampled at a depth of 5.66 metres is subconsolidated, while for the other two samples taken at a depth of 3.28 and 1.93 metres, the clay is overconsolidated. According to Richelieu Hydrogéologie Inc. in (2018) the clays are qualified as low sensitivity to sensitive.

3. DESCRIPTION OF THE COMPLETED WORK AND METHODOLOGY

3.1 Preparation of drilling plans

BBA prepared a geotechnical investigation plan including a total of 29 drillholes for the Bachelor site. The investigation plan includes 3 areas:

- Zone 1: drillholes on natural soil
  - Zone 1a: south dike (7 drillholes)
  - Zone 1b: west dike (3 drillholes)
  - Zone 1b: west dike (4 drillholes, additional work 2020)
- Zone 2: drillholes on existing infrastructures or in the existing basin
  - Zone 2a: north dike (6 drillholes)
  - Zone 2 b: internal dike (3 drillholes)
  - Zone 2c: middle dike (3 drillholes)
- Zone 3: the dry stack tailings management area (7 drillholes).

In zone 1b, two (2) additional drillholes were added for a better identification of the clay in zone 1b (west dike). Another drillhole in zone 1a (south dike, BH-BBA-19-06) was rejected at 1.8 m depth and moved a little to make a new drillhole (BH-BBA-19-06B).

Due to the presence of soft clay discovered at the future footprint of the west dike (zone 1b) during the 2019 investigation, an additional investigation in 2020 consisting of 4 drillholes was intended to further investigate the clay at the west dike footprint. One drillhole located on the crest of the west dike and the others located west of the foot of the dike.

In zone 2a, due to access difficulties caused by a swamp, one drillhole could not be drilled during the geotechnical campaign (BH-BBA-19-19). However, the new geotechnical campaign plan, including 31 drillholes, is presented in Appendix C.

The 31 drillholes in the 2019 mandate are distributed across the site as follows:

- Zone 1: drillholes on natural soil
  - Zone 1a: south dike (8 drillholes)
  - Zone 1b: west dike (5 drillholes)
- Zone 2: drillholes on existing infrastructures or in the existing basin
  - Zone 2a: north dike (5 drillholes)
  - Zone 2 b: internal dike (3 drillholes)
  - Zone 2c: middle dike (3 drillholes)
- Zone 3: the dry stack tailings management area (7 drillholes).

All 4 drillholes in the additional term (2020) are distributed on zone 1b, west dike.

3.2 Drilling and geotechnical testing in place

Site work for the original mandate took place between 26 March and 10 April 2019 under the constant supervision of BBA representatives. The thirty-one (31) geotechnical drillholes were carried out by Marathon Underground. Twenty-nine (29) geotechnical drillholes were carried out with a CME 850 geotechnical drill mounted on a crawler. Two (2) drillholes in zone 2a (BH-BBA-19-08 and BH-BBA-19-09) were located on the ice (in the center of the water basin). For safety reasons, a smaller EMCI 220 MPR drill rig was used for these two drillholes. In the seven (7) drillholes drilled in zone 3 (solid tailings management area), Casagrande type piezometers were installed to monitor the groundwater in the tailings.

Site work for the additional mandate took place between 6 and 7 August 2020 under the constant supervision of BBA representatives. The four geotechnical drillholes were carried out by Marathon Underground with a CME 850 geotechnical drill rig mounted on a crawler.

During the site work, due to access problems, the location of some drillholes was slightly modified. A land survey and grading survey of the land was conducted by Bonterra personnel to determine the elevation of the land at the location of the completed drillholes. The exact locations of the post-campaign drillholes were surveyed by Bonterra and are presented in Appendix B. Table 5 provides a summary of the locations and depths of the drillholes.

Table 5: Summary of location and depth of drilling, work 2019

Identification	East (m)	North (m)	Elevation (m)	Date	Zone	Probable rock elevation (m)
BH-BBA-19-01	418119.970	5482916.830	332.889	2019-04-01	1a	327.71
BH-BBA-19-02	418090.570	5482859.610	337.665	2019-04-01	1a	335.35
BH-BBA-19-03	417998.070	5482749.340	339.001	2019-03-31	1a	336.10
BH-BBA-19-04	417676.360	5482700.440	334.605	2019-03-31	1a	332.55
BH-BBA-19-05	417403.300	5482627.550	336.448	2019-03-31	1a	333.58
BH-BBA-19-06	417108.84	5482583.41	333.403	2019-03-30	1a	n/a
BH-BBA-19-06B	417108.840	5482583.410	333.403	2019-03-30	1a	331.57
BH-BBA-19-07	416916.620	5482733.520	334.886	2019-03-30	1a	331.29
BH-BBA-19-08	417569.850	5483269.490	325.090	2019-04-06	2a	322.81
BH-BBA-19-09	417525.730	5483268.140	324.450	2019-04-05	2a	318.15
BH-BBA-19-10	417440.220	5483239.660	326.000	2019-04-05	2a	315.19
BH-BBA-19-11	416877.740	5483087.880	330.713	2019-04-03	1b	328.88
BH-BBA-19-12	416877.030	5483177.740	328.448	2019-04-04	1b	317.54
BH-BBA-19-13	416943.910	5483296.510	332.834	2019-03-27 at 31	1b	328.38
BH-BBA-19-14	417567.790	5483438.680	328.030	2019-04-07	2b	322.70
BH-BBA-19-15	417502.230	5483461.850	331.769	2019-04-07	2b	317.58
BH-BBA-19-16	417244.840	5483606.000	327.701	2019-04-07	2b	320.84
BH-BBA-19-17	417533.930	5483667.060	328.369	2019-04-05	1c	326.24
BH-BBA-19-18	417467.320	5483674.080	325.622	2019-04-08	1c	317.24
BH-BBA-19-19	417451.7	5483731.7	-	not accessible	1c	-
BH-BBA-19-20	417411.450	5483661.210	325.552	2019-04-05	1c	311.22
BH-BBA-19-21	417306.090	5483673.840	327.421	2019-04-06	1c	317.54
BH-BBA-19-22	417235.580	5483683.350	328.460	2019-04-06	1c	324.95
BH-BBA-19-23	417217.010	5483571.840	334.673	2019-04-04	3	n/a
BH-BBA-19-24	417301.780	5483529.610	334.318	2019-04-04	3	n/a
BH-BBA-19-25	417134.410	5483436.110	335.994	2019-04-02	3	n/a
BH-BBA-19-26	417211.820	5483354.550	335.733	2019-04-03	3	n/a
BH-BBA-19-27	417290.190	5483353.930	334.565	2019-04-02	3	n/a
BH-BBA-19-28	417117.160	5483364.180	336.449	2019-04-01	3	n/a
BH-BBA-19-29	417217.35	5483262.06	335.455	2019-04-02	3	n/a
BH-BBA-19-30	416875.900	5483160.190	329.574	2019-04-09	1b	322.61
BH-BBA-19-31	416882.730	5483194.030	320.775	2019-04-10	1b	310.66

Table 6: Drillhole location and depth summary, work 2020

Identification	East (m)	North (m)	Elevation (m)	Date	Zone	Probable rock elevation (m)
BH-BBA-20-01	416916	5483210		2020-08-06	1b	
BH-BBA-20-02	416861	5483216	326.2*	2020-08-07	1b	318.73
BH-BBA-20-03	416853	5483198	325.7*	2020-08-06	1b	320.52
BH-BBA-20-04	416869	5483163	327.6*	2020-08-07	1b	319.22
*Elevations taken from Lidar data						

3.2.1 Drilling and sampling method

The drillholes were made using an auger. Disturbed samples (CF) of granular soil were collected from the drillholes using a split spoon of gauge (51 mm diameter). Shelby tubes (75 mm diameter) were used to collect minimally disturbed clay samples.

All drillholes were sampled continuously, either with a split spoon or with Shelby tubes. In the case of tailings, soil samples were taken directly from the auger.

The recovered samples were visually described in terms of their soil by BBA representatives on site to determine the nature of the soils. Subsequently, in the case of the 2019 mandate, the collected sample were sent to the Englobe laboratory in Laval, ETS and AGAT in Montreal to perform laboratory tests. For the 2020 mandate, the collected samples were sent to ABS Group laboratories to perform laboratory testing.

3.2.2 Standard penetration test (SPT)

The split spoon also makes it possible to obtain information on the density of the soil layers crossed, by obtaining standard penetration index values "SPT" called “N” indices. This index corresponds to the number of blows required to make the corer penetrate by 300 mm when it is struck with a hammer weighing 63.5 kg and falling from a height of 760 mm. The measured "N" indices are presented on the drillhole reports in Appendix B. Table 7 shows the relationship between the soil compactness grades and the N index measured in the SPT test.

Table 7: Relationship between compactness and the result of the evaluated N-index

Compactness	Standard penetration index "N"
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	> 50

3.2.3 In situ shear strength tests

The measurement of the intact undrained and disturbed shear strength of the clay deposit for all drillholes traversing the clay was performed using a FISH SCALE-MAT740 model field vane tester. Table 8 shows the relationship between degrees of clay consistency with intact undrained shear strength.

Table 8 : Relationship between intact undrained shear strength (C_u) and clay consistency

Consistency	C_u (kPa)
Very soft	<12
Soft	12-25
Firm	25-50
Stiff	50-100
Very stiff	100-200
Hard	> 200

The sensitivity (S_t) of the clay was calculated as the ratio of the shear strength of the intact soil to the disturbed shear strength at constant water content. A scale of qualifiers to define the sensitivity of the clay is given in Table 9.

$$= \frac{}{}$$

Table 9: Sensitivity to clay disturbance

S_t	Sensitivity level
<2	Insensitive
2-4	Medium sensitivity
4-8	Sensitive
8-16	Very sensitive
> 16	Extremely sensitive

3.2.4 Hydrogeological tests

Casagrande piezometers were installed in drillholes BH-BBA-19-23 to BH-BBA-19-29 in zone 3 (solid tailings management area) in order to measure the piezometric level in the surroundings.

3.3 Geotechnical laboratory testing program

For the 2019 work, representative samples of the soils in place were selected to perform the following laboratory analyses:

1. Englobe Laboratory

- fifteen (15) grading analyses by sieving (LC 21-040);
- fourteen (14) grading analyses by sedimentation (NQ 2501-025);
- nine (9) limit tests (standard NQ 2501-092);
- eleven (11) moisture content determinations (NQ 2501-170 standard);
- four (4) consolidation tests (ASTM D 2435 standard);
- ten (10) shear strength tests using the cone penetrometer (NQ 2501-110 standard).

2. ETS Laboratory

- six (6) triaxial tests (CU), consolidated and undrained (ASTM D4767)
- three (3) triaxial tests (CD), consolidated and drained (ASTM D7181);
- four (4) water content and limit determinations (NQ 2501-092; NQ 2501-170 standard);
- four (4) shear strength tests using the cone penetrometer (NQ 2501-110 standard).

3. AGAT Laboratory

- seven (7) tests to determine the acid generation potential.

For the 2020 work, representative samples of the soils in place were selected in order to carry out the following laboratory analyses:

4. ABS Group Laboratory

- four (4) grading analyses by sieving (LC 21-040);
- four (4) limit tests (NQ 2501-092 standard);
- one (1) consolidation test (ASTM D 2435 standard);
- six (6) shear strength tests using the cone penetrometer (NQ 2501-110 standard).

The distribution of the laboratory tests is summarized in Tables 10 and 11. For the 2019 mandate, laboratory testing was conducted between 3 May and 12 June 2019 by Englobe. Triaxial testing was conducted between 10 May and 19 September 2019. For the 2020 mandate, laboratory testing was conducted between 15 August and 12 October 2020.

The results of these tests were used to confirm the classification of the soils encountered on the site and to evaluate the properties of the subsoil. The results of the geotechnical analyses performed by Englobe, ETS, Groupe ABS and AGAT are presented in Appendix C.

The samples collected from the drillholes will be retained for a period of six (6) months from the termination date of the laboratory tests, after which they will be disposed of by us unless otherwise notified by the customer.

Table 10 : Summary of location and depth of samples for laboratory testing, 2019 work

Identification	Particle size	Sedimentation	Limits	Water content	Consolidation	Triaxial	C_u	Acid generation
BH-BBA-19-01	4.6-5.2 m	4.6-5.2 m	-	-	-	-	-	-
BH-BBA-19-02	0.8 - 1.5 m	0.8 - 1.5 m	-	-	-	-	-	-
BH-BBA-19-03	2.3 - 2.9 m	2.3 - 2.9 m	-	-	-	-	-	-
BH-BBA-19-04	0.8 - 1.5 m	0.8 - 1.5 m	-	-	-	-	-	-
BH-BBA-19-05	1.5 - 2.3 m	1.5 - 2.3 m	-	-	-	-	-	-
BH-BBA-19-06B	2.3 - 3.0 m	2.3 - 3.0 m	-	-	-	-	-	-
BH-BBA-19-07	2.9 - 3.4 m	2.9 - 3.4 m	-	-	-	-	-	-
BH-BBA-19-09	-	-	6.1-6.7 m	6.1-6.7 m	-		6.1-6.7 m 7.6-8.2 m	-

Identification	Particle size	Sedimentation	Limits	Water content	Consolidation	Triaxial	C_u	Acid generation
BH-BBA-19-10	-	-	10.7-11.3 m	10.7-11.3 m	7.6-8.2 m		7.6-8.2 m 10.7-11.3	-
BH-BBA-19-12	9.9 - 10.7 m	9.9 - 10.7 m	5.3 - 6.1 m	5.3 - 6.1 m	-		-	-
BH-BBA-19-13	3.0 - 3.8 m	-	-	-	-			-
BH-BBA-19-15	-	-	9.1-9.9 m	9.1-9.9 m	-		9.1 - 9.9 m	-
BH-BBA-19-16	-	-	3.1-3.8 m	3.1-3.8 m	-		3.1-3.8 m 4.6 -5.3 m	-
BH-BBA-19-18	6.1 - 6.9 m	6.1 - 6.9 m	3.1-3.8 m 4.6-5.3 m	3.1-3.8 m 4.6-5.3 m	3.1-3.8 m		3.1-3.8 m 4.6-5.3 m	-
BH-BBA-19-20	6.1 - 6.7 m	6.1 - 6.7 m	6.1 - 6.7 m	6.1-6.7 m	-		4.6-5.3 m	-
BH-BBA-19-21	9.1 - 9.9 m 4.6 -5.2	9.1 - 9.9 m 4.6 -5.2	-	4.6-5.2 m	-		-	-
BH-BBA-19-23	-	-	-	-	-	-	-	6.9-7.6 m
BH-BBA-19-24	-	-	-	-	-	-	-	3.8-4.6 m
BH-BBA-19-25	-	-	-	-	-	-	-	4.6-5.3 m
BH-BBA-19-26	-	-	-	-	-	-	-	3.8-4.6 m
BH-BBA-19-27	-	-	-	-	-	-	-	6.9-7.6 m
BH-BBA-19-28	-	-	-	-	-	-	-	5.3-6.1 m
BH-BBA-19-29	-	-	-	-	-	-	-	4.6-5.3 m
BH-BBA-19-30	-	-	1.5-2.3 m 2.3-3.1 m	1.5-2.3 m 2.3-3.1 m	2.3-3.1 m		1.5-2.3 m 2.3-3.1 m	-
BH-BBA-19-31	8.4 - 9.1 m 6.9-7.6 m	8.4 - 9.1 m 6.9-7.6 m	3.1-3.8 m 4.6-5.3 m	3.1-3.8 m 4.6-5.3 m	3.1-3.8 m		3.1-3.8 m 4.6-5.3 m	-

Table 11: Summary of location and depth of samples for laboratory testing, 2020 work

Identification	Particle size	Limits	Consolidation	C_u
BH-BBA-20-01	3.04 - 3.66 m	6.86 - 7.47 m	6.86 - 7.47 m	6.86 - 7.47 m
BH-BBA-20-02	7.62 - 8.23 m	3.04 - 3.66 m	-	3.04 - 3.66 m
BH-BBA-20-03	4.52 - 5.18 m	2.29 - 2.89 m	-	2.29 - 2.89 m
BH-BBA-20-04	5.33 - 5.94 m	3.04 - 3.66 m	-	1.52 - 2.13 m 3.04 - 3.66 m

4. RESULTS OF SURVEYS AND TESTS

4.1.1 General

The subsurface conditions encountered at the Bachelor tailings management area are described in the following sections. Soil descriptions are based on visual observations supplemented by laboratory test results. It is important to note that the encountered soil conditions and thicknesses may vary between the survey sites.

Throughout the site, the natural soil stratigraphy consists of a layer of topsoil or peat, followed by a thin layer of very loose, brown, fine sand, sometimes mixed with topsoil, sometimes with silt, then a very soft to stiff clay deposit, a transitional layer of mostly silt, and then a till horizon consisting of sand, silt and gravel. The clay is quite heterogeneous. The clay is sometimes very soft or very sandy. The more sandy clays are associated with lower water contents.

The following paragraphs describe the general state of the stratigraphy of each of the zones taking into account the natural soil and existing infrastructures.

In zone 1a (south dike), the surface layer consisted of a thin layer of topsoil or peat, followed by a layer of fine sand sometimes silt with a trace of pebbles which was followed by till. In drillholes BH-BBA-19-03, BH-BBA-19-07 a layer of road backfill was encountered on the surface with a thickness varying from 0.76 m to 2.74 m respectively. The presence of clay was not encountered in this area. The thickness of the fine sand varies from 0.76 to 1.52 m. The fine sand layer is in a very loose to compact state, according to N-indices between 2 and 20. The thickness of the till varies from 0.76 to 5.18 m. The till layer is in a compact to very dense state, with N values between 25 and R (refusal).

In zone 1b (west dike), clay soil was encountered in the area of drillholes BH-BBA- 19-12, BH-BBA-19-30, BH-BBA-19-31, BH-BBA-20-01, BH-BBA-20-02, BH-BBA-20-03 and BH-BBA-20-04 (in the middle of the valley). However, in drillholes BH-BBA-19-11 and BH-BBA-19-13, clay soils were not encountered. The thickness of the clay layer varies between 4.6 and 7.60 m. According to the test results, the shear strength describes a very soft to hard clay. The clay is followed by a till layer with thicknesses ranging from 0.56 to 4.83 m. In zone 1b, a layer of road backfill and dike backfill 0.76 m and 3.81 m thick was encountered in drillholes BH-BBA-19-13 and BH-BBA-20-01 respectively.

In zone 2a (north dike), a minor infrastructure composed of road or dike backfill is encountered with a thickness varying from 0.76 to 2.30 m. Clay soils were encountered under the dike backfill in drillholes BH-BBA-19-18, BH-BBA-19-20 and BH-BBA-19-21 (in the centre of the dike). However, in drillholes BH-BBA-19-17 and BH-BBA-19-22, clay soils were not encountered (at both abutments). The thickness of the clay soil varies between 0.66 and 11.35 m and the clay is in a very soft and firm state. Due to access difficulties caused by a swamp in this zone, drillhole BH-BBA-19-19 could not be completed during the geotechnical campaign. This may be a more critical location that will need further geotechnical investigation. In zone 2a, the clay was followed by a till layer with a thickness varying from 0.6 to 4.6 m.

In zone 2b (internal dike), clayey soils were encountered under the road and dike backfill with a thickness varying between 2.3 and 6.0 m. The thickness of the clayey soil varies between 1.5 and 4.6 m. In this zone, the clay is in a firm to very stiff state. The clay was followed by a layer of till.

In zone 2c (middle dike), clay soils were encountered under water and a thin layer of tailings at a depth of about 1.5 m. The thickness of the clay soil varies between 1.5 and 9.4 m. In this zone, the clay is in a soft to very stiff state. The clay was followed by a layer of till.

In zone 3, seven (7) drillholes (BH-BBA-19-23 to BH-BBA-19-29) were drilled in the solid tailings management area. Thin layers of waste rock were encountered near the surface of the tailings. The drillholes were stopped at 7.62 m and observation wells were installed to monitor the groundwater level. Tailings may be found at a depth of 7.62 m. The groundwater level in the solid tailings management area was located at approximately 4.5-5.0 m depth at the time of the geotechnical investigation. The analysis of the particle size of the tailings was not part of the BBA 2019 geotechnical program, however existing data on the particle size of the tailings (performed by GHD (2016) and Golder Associés (2007)) show that tailings are approximately 80-90% silt and clay and 10-20% sand. The standard Proctor test conducted by GHD (2016) showed a maximum dry density of 1666 kg/m3 and an optimum moisture content of 17.7%.

Groundwater levels were variable at the site. Except at the solid tailings management area, in most cases it was encountered at a depth of less than 3 m.

4.1.2 Underground conditions

The detailed stratigraphy inferred from the drillhole data, described in detail in each of the drill reports in Appendix D, is explained in the following sections.

4.2 Dike and road backfill

In zones 1 and 2, road backfill ranges with thicknesses from 0.76 to 2.74 m in drillholes BH-BBA-19-03 (0.76 m), BH-BBA-19-07 (2.74 m), BH-BBA-19-13 (1.52 m), BH-BBA-19-14 (0.76 m), BH-BBA-19-15 (1.52 m), BH-BBA-19-16 (1.52 m), BH-BBA-19-17 (1.52 m), BH-BBA-19-20 (0.76 m), BH-BBA-19-21 (2.29 m) and BH-BBA-19-22 (0.76 m) were encountered. The road backfill is generally made of crushed stones, which are in a very dense state according to N indices of R (refusal). Dike backfills were also encountered in zone 1b in drillhole BH-BBA-20-01 (3.81 m). The dike backfills are in a loose to very dense condition with N-indices ranging from 8 to 100.

The dike backfills were encountered mainly in zone 2 in drillholes BH-BBA-19-14 (0.76 m), BH-BBA-19-15 (4.58 m), BH-BBA-19-18 (1.53 m) and BH-BBA-19-20 (1.53 m) with thicknesses ranging from 0.76 to 4.58 m. The dike backfill is generally made up of sand and gravel with traces of pebbles. This material lies in a very loose to very dense state, according to N-indices from 3 (zone 2a, BH-BBA-19-20) to 56 (zone 2b, BH-BBA-19-15).

4.3 Topsoil

A surface layer of topsoil up to 0.2 m was encountered in the majority of the drillholes. The topsoil is highly compressible, moist to saturated and very loose. Pieces of wood were encountered in the surface layer of road backfill in drillholes BH-BBA-19-07 and BH-BBA-19-12 (zones 1a and 1b, respectively).

Topsoil and wood chips were also reported in existing geotechnical reports (e.g., Golder Associés, 2007). According to Golder (2007), the organic content was estimated to be 33% of the dry weight of the sample and the water content was 156%.

In some drillholes (BH-BBA-19-07, BH-BBA-19-14, BH-BBA-19-16, BH-BBA-19-17, BH-BH-BBA-19-18, BH-BBA-19-22, BH-BBA-19-30 and BH-BBA-19-31) the topsoil was mixed with either sand and pebble or clay and silt topsoil.

4.4 Shallow silty sand layer

Below the topsoil horizon, particularly to the south of the site (zone 1a), a natural layer of silty sand with traces of gravel and silty sand and gravel with traces of clay was encountered in thicknesses of 0.10 m to 2.90 m, respectively. "N" values of 2 (zone 1a, BH-BBA-19-02, BH-BBA-19-04, BH-BBA-19-05, and BH-BBA-19-06 at 0.3 m from depth) and 20 (zone 1a, BH-BBA-19-03 at 1.2 m depth) were measured. "N" index values of 9 and 3 to 5 were measured in zone 2a (BH-BBA-19-18 at depth of 1.9 m) and zone 2b (BH-BBA-19-14 at depth of 2.3 m) respectively for soils consisting of sand and pebbles mixed with organic soils.

4.5 Unconsolidated till

To the south in zone 1a (south dike) at drillholes BH-BBA-19-01 to BH-BBA-19-07, the upper sand layer is followed by a granular till deposit, with thicknesses ranging from 0.25 to 4.4 m, down to the bedrock. "N" values of 25 and greater than 100 were measured in the till deposit in zone 1a.

In zone 1b (west dike) at drillholes BH-BBA-19-11 and BH-BBA-19-13, the upper sand layer is also followed by the till deposit down to the bedrock. In the other drillholes, the till deposit was encountered under the clay. "N" values of 19 and greater than 100 were measured in the till deposit in zone 1b.

In zone 2a (north dike) at drillholes BH-BBA-19-17 and BH-BBA-19-22, the upper sand layer is also followed by the till deposit to the bedrock. In the other drillholes, the till deposit was encountered under the clay. "N" values of 7 and greater than 100 were measured in the till deposit in zone 2a.

In zone 2b and 2c (inner and middle dikes), the till deposit was encountered under the clay layer. "N" values of 5 (drillhole BH-BBA-19-16 at depth of 5.7 m) and more than 100 were measured in the till deposit in zone 2b and 2c.

The predominant composition of the till in zone 1a is silty sand with some gravel and traces of clay. In one sample, the quantity of gravel reached 33.5%. The till just below the clay (6.9 m-7.6 m) in zone 1b consists of 23% gravel, 11% sand and 64% silt. From 8.4 m to 9.1 m in zone 1b at depth, the till composition changes to 16% gravel, 64% sand and 18% silt.

In zones 2a and 2b, the till is composed of more gravel. The amount of gravel and silt can be as high as 60% (zone 2a) and 43% (zone 2b).

A summary of the particle size distribution of the soil samples collected at the site is presented in Figure 1 and Table 12.

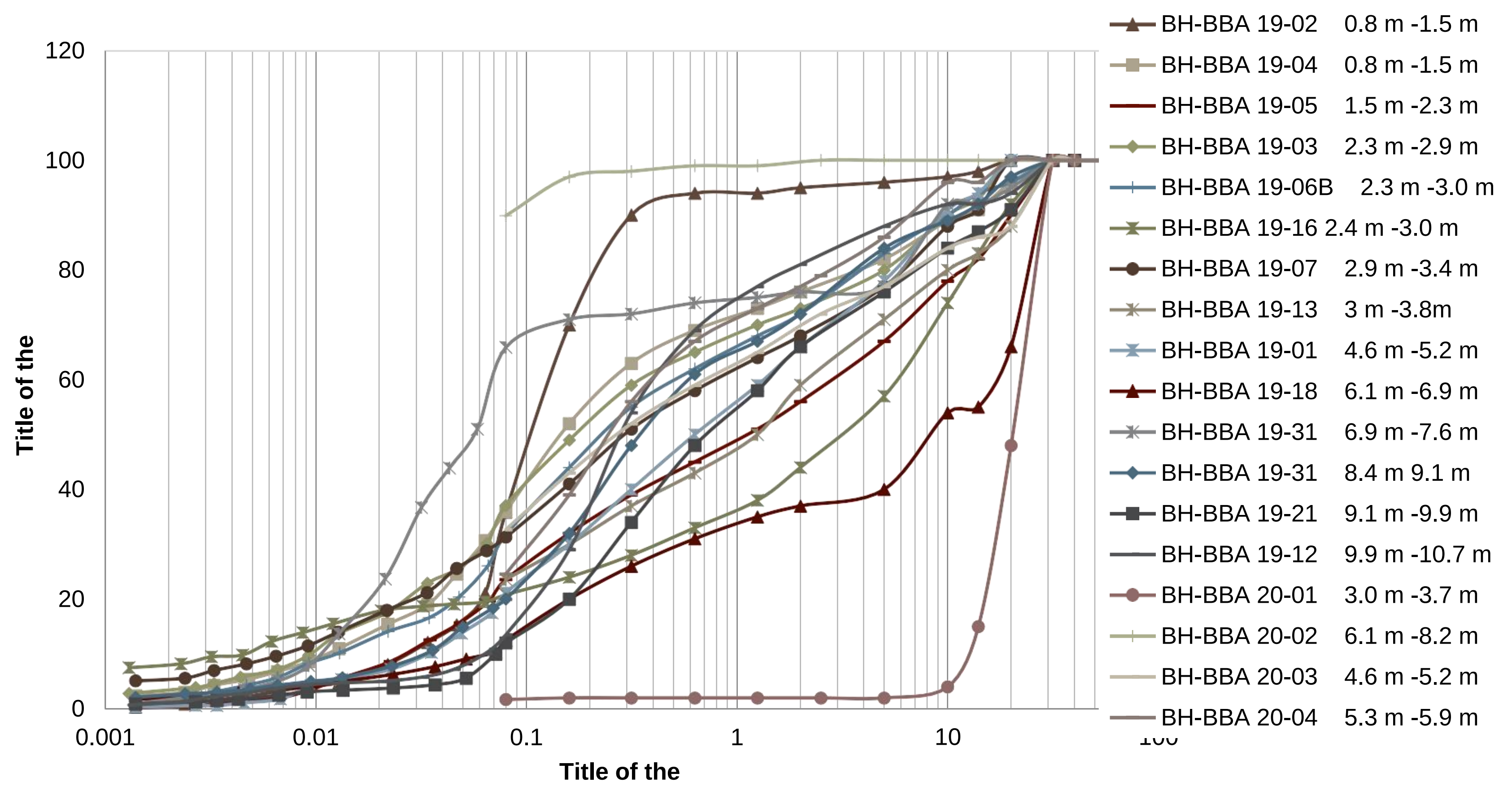

Figure 1: Particle size analysis of sampled granular soils, Bachelor site

Table 12: Particle size distribution of soil samples, Bachelor site

Samples	Depth	Pebbles	Gravel	Sand	Silt	Clay	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_u	C_c	Description
BH-BBA 19-02	0.8 -1.5	0	4.5	59.6	35.3	0.6	0.028	0.076	0.13	5	1.59	Silty sand, traces of gravel and clay
BH-BBA 19-04	0.8 -1.5	0	17.8	46.2	33.2	2.8	0.011	0.062	0.264	24	1.32	Silty sand, some gravel, traces of clay
BH-BBA 19-05	1.5 -2.3	0	33.5	42.9	23.3	0.3	0.026	0.133	2.881	111	0.24	Silty sand and gravel, traces of clay
BH-BBA 19-03	2.3 -2.9	0	19.9	43	33.8	3.4	0.009	0.065	0.363	40	1.29	Silty sand, some gravel, traces of clay
BH-BBA 19-06B	2.3-3.0	0	17.5	50.7	29.6	2.2	0.013	0.075	0.505	39	0.86	Silty sand, some gravel, traces of clay
BH-BBA 19-07	2.9-3.4	0	22.6	46.1	25.9	5.4	0.007	0.072	0.779	111	0.95	Gravelly silty sand, traces of clay
BH-BBA 19-13	3.0-3.8	0	29.2	47.2	23.6		-	0.158	2.637	-	-	Gravelly silty sand, traces of clay
BH-BBA 19-01	4.6-5.2	0	21.9	56.9	20.8	0.4	0.034	0.161	1.305	38	0.58	Gravelly silty sand, traces of clay
BH-BBA 19-18	6.1-6.9	0	60.3	27.2	10.6	1.9	0.062	0.521	16.443	265	0.27	Sandy gravel, some silt, traces of clay
BH-BBA 19-31	6.9-7.6	0	23	11.1	64.3	1.6	0.01	0.026	0.071	7	0.95	Gravelly silt, some sand, traces of clay
BH-BBA 19-31	8.4-9.1	0	15.8	64.2	17.5	2.5	0.032	0.141	0.586	18	1.06	Sand, some silt and a little gravel, trace of clay
BH-BBA 19-21	9.1-9.9	0	23.7	64.3	10.9	1.1	0.072	0.258	1.383	19	0.67	Gravelly sand, some silt, trace of clay
BH-BBA 19-16	2.3 m -3.0 m	0	42.8	36.4	12.8	8	0.005	0.407	5.597	1119	5.92	Gravel and sand, some silt, trace of clay
BH-BBA 20-01	3.0 m -3.7 m	0	98	0.3	1.7		14	18	23	2	1.01	Gravel, trace of sand and clay
BH-BBA 20-02	6.1 m -8.2 m	0	0	11.1	89.9							Clay and silt, with some sand

Samples	Depth	Pebbles	Gravel	Sand	Silt	Clay	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_u	C_c	Description
BH-BBA 20-03	4.6 m -5.2 m	0	33	44.3	32.7							Silty and clayey sand and gravel
BH-BBA 20-04	5.3 m -5.9 m	0	14	61.4	24.6							Silty sand, some gravel, traces of clay

4.6 Tailings

In zone 3, at drillholes BH-BBA-19-23 to BH-BBA-19-29, tailings consisting mainly of silt and clay with variable proportions of sand were observed over an estimated thickness of about 7.6 m.

Drillholes in the tailings management area (zone 3) were equipped with observation wells to measure groundwater disturbance. These drillholes had a maximum depth of 7.6 m. Tailings may be present below the depth of 7.62 m.

The tailings are in a very loose to compact state with “N" index values varying between 1 and 18 measured in BH-BBA-19-27. Seven (7) tests of the acid generation potential were conducted by AGAT. According to the results obtained, the tailing samples submitted for testing are not acid-producing.

Table 13: Summary of chemical analyses on tailings

Samples	Total Sulphur (%)	Maximum acidity potential (AP) Kg CaCO3	Gross neutralization potential (NP) Kg CaCO3	Net neutralization potential (NNP) Kg CaCO3	Potentially acid generating
BH-BBA-19-23	0.71	22.2	111	89	Non-producer
BH-BBA-19-24	0.63	19.7	88	69	Non-producer
BH-BBA-19-25	0.84	26.3	85	59	Non-producer
BH-BBA-19-26	0.68	21.3	95	74	Non-producer
BH-BBA-19-27	0.61	19.1	78	58	Non-producer
BH-BBA-19-28	0.71	22.2	101	79	Non-producer
BH-BBA-19-29	0.63	19.7	118	98	Non-producer

Mechanical characterization tests (relative density, Proctor, particle size, and permeability) of the tailings were not part of the 2019 BBA geotechnical campaign. They were measured by others (GHD, 2016 and Golder Associés, 2007). The relative grain density of the tailings is 2.77 and the permeability is in the range of 1.0 x 10_{-8} m/s to 5.0 x 10_{-8} m/s. The particle sizing of the tailings performed by GHD (2016) and Golder Associés (2007) shows that the tailings consist of approximately 80-90% silt and clay and 10-20% sand. The standard Proctor test conducted by GHD (2016) indicated a maximum dry density of 1666 kg/m_3 and an optimum moisture content of 17.7%.

4.7 Clay deposit

A varved and heterogeneous clay deposit was encountered on the site, notably under the peat layer and sometimes on the surface. The clay deposit was mainly encountered in the central part of the valley to the north and west. Clay is absent in zone 1a (south dike, drillholes BH-BBA-19-01 to BH-BBA-19-07). It was also non-existent in the drillholes

BH-BBA-19-11 and BH-BBA-19-13 in zone 1b and BH-BBA-19-17 and BH-BBA-19-22 in zone 2a. At the locations where it can be found in the drillholes, the clay soils reach thicknesses between 0.71 m (BH-BBA-19-08, zone 2c) and 11.35 m (BH-BBA-19-20, zone 2a). Table 14 summarizes the observed thicknesses of this horizon for each of the drillholes.

The clay in the upper part of the deposit is mainly brown and stiff and is overconsolidated, it becomes grey, saturated and firm to soft (sometimes very soft) in some layers. The upper part is normally called the crust. The crust has a stiff to firm shear strength. In most cases, the measured shear strength ranges from 35 kPa to 100 kPa.

The clay beneath the crust is firm to very soft and slightly overconsolidated with a preconsolidation pressure between 85 kPa in zone 2c (middle dike) and 150 kPa in zone 1b (west dike). In zone 1b, a sample taken near the surface (depth of 2.75 m) had a preconsolidation pressure of 235 kPa.

The shear strength in the soft clay was measured as low as 4 kPa in drillhole BH-BBA-19-31 (zone 1b) west of the site.

Table 14: Thickness of clay soils

Drill hole	Thickness of clay soils (m)	Drill hole	Thickness of clay soils (m)
BH-BBA-19-08	0.71	BH-BBA-19-16	1.52
BH-BBA-19-09	3.96	BH-BBA-19-18	2.97
BH-BBA-19-10	9.14	BH-BBA-19-20	11.35
BH-BBA-19-12	5.3	BH-BBA-19-21	0.76
BH-BBA-19-14	1.52	BH-BBA-19-30	3.81
BH-BBA-19-15	4.63	BH-BBA-19-31	7.61
BH-BBA-20-01	8.86	BH-BBA-20-03	5.18
BH-BBA-20-02	6.09	BH-BBA-20-04	5.33

4.7.1 Results of the shear strength tests

Tables 15 and 16 present the results obtained for the in situ and laboratory shear strength tests performed, and the encountered degrees of consistency.

The consistency of the clay deposit varies from stiff to firm and soft according to in situ measurements. But laboratory measurements have shown that the consistency of the clay varies from hard to very soft. According to the in situ and laboratory tests using the vane tester, the clay deposit has shear strengths (C_u) varying mostly between 14 kPa and 100 kPa in drillholes BH-BBA-19-09 and BH-BBA-19-10 in zone 2c (on the internal dike), between 4 kPa and

134 kPa in BH-BBA-19-12, BH-BBA-19-30, BH-BBA-19-31 and BH-BBA-20-03 in zone 1b (on the west dike), between 27 kPa and 100 kPa in drillholes BH-BBA-19-14, BH-BBA-19-15, and BH-BBA-19-16 in zone 2b (on the middle dike), and between 16 kPa and 42 kPa in drillholes BH-BBA-19-18 and BH-BBA-19-20 in zone 2a (on the north dike).

The clay was classified in the moderately sensitive to sensitive category based on in situ vane tester measurements. However, laboratory tests show that the clay sensitivity ranges from insensitive to extremely sensitive. In addition, the in-situ tests provided slightly higher shear strength values compared to the laboratory measurements. This could be related to the additional disturbance of the clay during sampling and handling.

Table 15: In-situ shear strength test results

Drill hole	Depth	C_u (kPa)	C_{ur} (kPa)	Sensitivity	Consistency	Zone
BH-BBA-19-09	5.33	81	23	3.5	Stiff	2c
BH-BBA-19-09	5.64	77	17	4.5	Stiff	2c
BH-BBA-19-09	6.86	53	12	4.4	Stiff	2c
BH-BBA-19-09	7.16	50	12	4.2	Stiff	2c
BH-BBA-19-09	8.38	42	10	4.2	Firm	2c
BH-BBA-19-09	8.68	100	-	-	Stiff	2c
BH-BBA-19-10	5.33	81	23	3.5	Stiff	2c
BH-BBA-19-10	6.86	60	15.5	3.9	Stiff	2c
BH-BBA-19-10	7.16	54	14.5	3.7	Stiff	2c
BH-BBA-19-10	8.38	42	10	4.2	Firm	2c
BH-BBA-19-10	8.68	38.5	10.5	3.7	Firm	2c
BH-BBA-19-10	9.91	34.5	8.5	4.1	Firm	2c
BH-BBA-19-10	10.21	32.5	7.5	4.3	Firm	2c
BH-BBA-19-10	11.43	31	6.5	4.8	Firm	2c
BH-BBA-19-10	11.74	100	-	-	Stiff	2c
BH-BBA-19-12	3.35	34.5	5	6.9	Firm	1b
BH-BBA-19-12	4.89	44	5.5	2.8	Firm	1b
BH-BBA-19-14	4.11	27	8.5	3.2	Firm	2b
BH-BBA-19-14	4.41	100	-	-	Stiff	2b
BH-BBA-19-15	10.21	61.5	10	6.2	Stiff	2b
BH-BBA-19-15	10.52	59.5	15.5	3.8	Stiff	2b

Drill hole	Depth	C_u (kPa)	C_{ur} (kPa)	Sensitivity	Consistency	Zone
BH-BBA-19-16	4.11	100	-	-	Stiff	2b
BH-BBA-19-16	4.41	96	31.5	3.0	Stiff	2b
BH-BBA-19-18	4.11	21	6	3.5	Soft	2a
BH-BBA-19-18	4.42	21	5	4.2	Soft	2a
BH-BBA-19-20	5.49	19	6	3.2	Soft	2a
BH-BBA-19-20	5.79	21	5	4.2	Soft	2a
BH-BBA-19-20	7.01	42	7.5	5.6	Firm	2a
BH-BBA-19-20	7.31	32.5	6	5.4	Firm	2a
BH-BBA-19-20	8.53	30.5	13.5	2.3	Firm	2a
BH-BBA-19-20	8.83	34.5	11.5	3	Firm	2a
BH-BBA-19-30	4.11	63.5	10.5	6.0	Stiff	1b
BH-BBA-19-30	4.41	73	13.5	5.4	Stiff	1b
BH-BBA-19-31	2.6	77	10.5	7.3	Stiff	1b
BH-BBA-19-31	2.9	80.5	10.5	7.7	Stiff	1b
BH-BBA-19-31	3.42	45	12	3.7	Firm	1b
BH-BBA-19-31	4.11	13.5	3	4.5	Soft	1b
BH-BBA-19-31	4.41	25	4	6.3	Soft	1b
BH-BBA-19-31	5.64	27	4	6.8	Firm	1b
BH-BBA-19-31	5.94	42	18	2.3	Firm	1b
BH-BBA-20-01	4.72	48	16	3	Firm	1b
BH-BBA-20-02	4.72	38	7	5.4	Firm	1b
BH-BBA-20-02	5.03	43	12	3.6	Firm	1b
BH-BBA-20-03	3.20	48	9	5.1	Firm	1b
BH-BBA-20-03	3.50	67	14	4.6	Stiff	1b

Table 16: Results of laboratory shear strength tests

Drill hole	Depth	C_u (kPa)	C_{ur} (kPa)	Sensitivity	Consistency	Zone
BH-BBA-19-09	6.45	24	2	12	Soft	2c
BH-BBA-19-09	7.98	14	1.8	8	Soft	2c
BH-BBA-19-10	11.05	25	2.7	9	Soft	2c
BH-BBA-19-10	7.95	24	1.5	16	Soft	2c
BH-BBA-19-15		35	3.4	10.4	Firm	2b
BH-BBA-19-16	3.35	191	9.4	20	Very stiff	2b
BH-BBA-19-18	3.45	16	3	5	Soft	2a
BH-BBA-19-18	4.60	21	1.7	12.5	Soft	2a
BH-BBA-19-20	4.93	28	3.6	8	Firm	2a
BH-BBA-19-30	2.20	526	322.7	2	Hard	1b
BH-BBA-19-30	2.65	49	12.3	4	Firm	1b
BH-BBA-19-31	3.56	46	4.8	10	Firm	1b
BH-BBA-19-31	4.60	4.1	1.3	3.1	Very soft	1b
BH-BBA-20-01	7.30	27.7	1.2	23	Firm	1b
BH-BBA-20-01	7.00	27.63	1.68	16.5	Firm	1b
BH-BBA-20-02	3.4	18.7	0.8	22.2	Soft	1b
BH-BBA-20-03	2.6	19.23	0.98	19.8	Soft	1b
BH-BBA-20-04	2.0	261.7	53.1	4.93	Hard	1b

4.7.2 Results of limit, moisture content and particle size tests

Sixteen (16) limit tests and eighteen (18) moisture content determinations were performed on the clay samples. According to the results obtained, the natural water content and the plasticity index of the clay vary between 21% and 79% and between 9% and 44% respectively. The plasticity of the clay changes from low to high plasticity.

Table 17 summarizes the results of the consistency limits.

Table 17: The limits of consistency of clay

Drill hole	D (m)	W (%)	W_L (%)	W_P (%)	I_P	I_L	Classification	Zone
BH-BBA-19-09	6.40 to 6.50	79	80	36	44	1.0	CH	2c
BH-BBA-19-10	11.00 to 11.10	45	48	25	23	0.9	CL	2c
BH-BBA-19-12	5.50 to 5.60	21	24	15	9	0.6	CL	1b
BH-BBA-19-15		60.7	65	24	42	0.9	CH	2b
BH-BBA-19-16	3.30 to 3.40	27	32	18	14	0.7	CL	2b
BH-BBA-19-18	3.40 to 3.50	51	68	26	42	0.6	CH	2a
BH-BBA-19-18	4.60 to 4.70	36.7	33	15	18	1.2	CL	2a
BH-BBA-19-20	6.20 to 6.30	48	44	23	21	1.2	CL	2a
BH-BBA-19-30	2.14 to 2.24	30	58	25	33	0.2	CH	1b
BH-BBA-19-30	2.60 to 2.70	41	45	22	23	0.8	CL or OL	1b
BH-BBA-19-31	3.51 to 3.61	43	43	21	22	1.0	CL or OL	1b
BH-BBA-19-31	4.60 to 4.70	34.2	33	17	17	1.0	CL or OL	1b
BH-BBA-20-01	6.80 to 7.40	53.4	50	22	28	1.12	CH	1b
BH-BBA-20-02	3.05 to 3.66	39.9	37	17	20	1.15	CL	1b
BH-BBA-20-03	2.30 to 2.90	38.7	39	18	21	1.0	CL	1b
BH-BBA-20-04	3.05 to 3.66	46.8	40	19	21	1.3	CL	1b

D: depth of samples

In some Shelby tubes, the presence of sand and silt did not allow for boundary and shear strength tests to be performed. For such a sample, a particle size analysis and a moisture content determination were performed. The following table summarizes the results of the particle size analysis and water content on the clay samples with sand and silt.

Table 18: Particle size distribution of soil samples recovered from Shelby tubes

Samples	D (m)	Gravel	Sand	Silt	Clay	W (%)	D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	Description	Zone
BH-BBA 19-20	6.20 to 6.30	0	2.8	50.5	46.7	48.3	-	0.004	0.004	Clay and silt, trace of sand	2a
BH-BBA 19-21	4.57 to 5.18	28	46.5	23.6	1.9	6.6	0.029	0.11	1.102	Sand, some gravel and silt, trace of clay	2a

D: depth of samples

According to the ETS laboratory results, the sandier clays are associated with lower water contents. The heterogeneity of the clay can be shown with a profile of water content versus depth. Figure 2 shows the variation of natural water content with depth in a Shelby tube in drillholes BH-BBA-19-15 and BH-BBA-19-30.

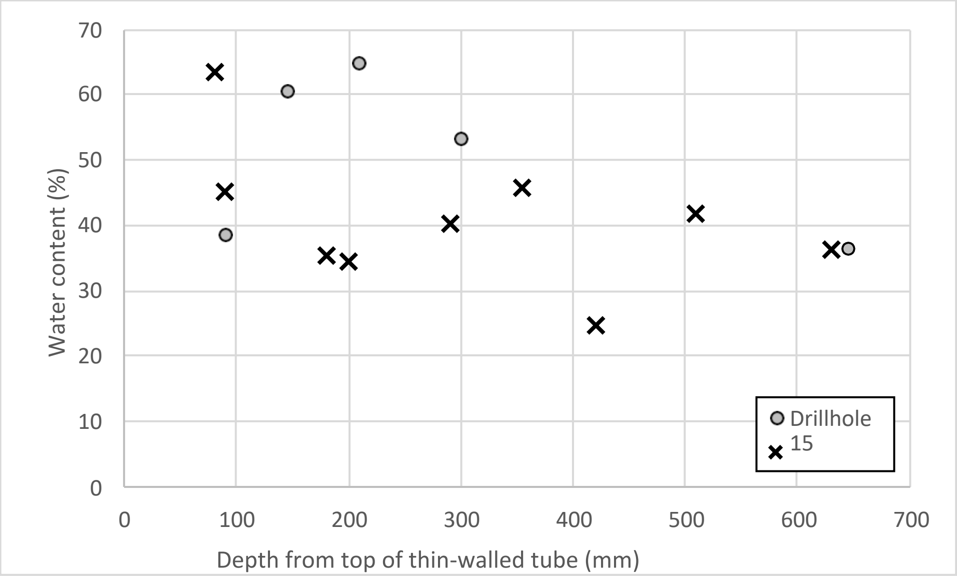

Figure 2: Natural water content variability (Drillholes BH-BBA-19-15 and BH-BBA-19-30, ETS laboratory)

4.7.3 Oedometer consolidation test results

Five (5) Oedometer consolidation tests were performed on clay samples collected from drillholes BH-BBA-19-10 (zone 2c), BH-BBA-19-18 (zone 2a), BH-BBA-19-30 (zone 1b), BH-BBA-19-31 and BH-BBA-20-01 (zone 1b). The consolidation parameters are presented in Table 19. The clay in the upper part of the site (crust) is overconsolidated and the clay at depth is slightly overconsolidated. As shown in Table 19, preconsolidation pressures ranging from 85 to 235 kPa were obtained. The highest preconsolidation pressure (235 kPa) is related to the clay sample taken at a depth of 2.7 to 2.8 m. For more details on the consolidation parameter, see Appendix C.

Table 19: Consolidation parameters

Drill hole	D (m)	W (%)	σ'_{v0} (kPa)	σ'_p (kPa)	C_c	C_r	e_0	Condition	Zone
BH-BBA-19-18	3.5 to 3.6	63.3	49.5	110	0.99	0.031	1.774	overconsolidated	2a
BH-BBA-19-30	2.7 to 2.8	7.3	40.0	235	0.28	0.030	0.588	overconsolidated	1b
BH-BBA-19-10	8.0 to 8.1	84.1	41.0	85	1.53	0.049	2.338	overconsolidated	2c
BH-BBA-19-31	3.46	40.9	54.6	95	0.51	0.022	1.194	overconsolidated	1b
BH-BBA-20-01	7.04 to 7.14	52.6	73	150	0.74	0.06	1.49	overconsolidated	1b

D: depth of samples

4.7.4 Results of the triaxial tests

Triaxial tests were conducted at the ÉTS laboratory. Specimens were chosen to be representative of the range of water contents measured during the extraction of thin-walled tubes.

The triaxial shear tests were performed with three different stress paths:

- Isotropic consolidation of 150 kPa with undrained shear (CU-150);
- Isotropic consolidation of 350 kPa with undrained shear (CU-350);
- Isotropic consolidation of 350 kPa with drained shear (CD-350).

The three stress paths were applied to three pairs of drillholes representative of the soils present in three parts of the study site (drillholes BH-BBA-19-10 and BH-BBA-19-15, BH-BBA-19-18 and BH-BBA-19-20, BH-BBA-19-30 and BH-BBA-19-31). In total, eight triaxial shear tests were performed.

The procedure for drained and undrained triaxial shear tests is based on ASTM D4767 and D7181.

Table 20 presents a summary of the results obtained during the consolidation of the specimens.

Table 20: Consolidation results

Specimen	**Type of test**	**ΔV_c (cm^3)**	**Compressibility (kPa^{-1})**	**c_v (m^2/year)**
BH-BBA-19-15-B	CU-150	11.1	4.7×10^{-4}	10.1
15-C	CU-350	22.1	3.6×10^{-4}	19.6
15-D	CD-350	19.6	3.4×10^{-4}	16.3
BH-BBA-19-18-B	CU-150	13.4	6.7×10^{-4}	3.3
18-D	CU-350	17.9	3.1×10^{-4}	17.7
BH-BBA-19-30-C	CU-200	9.4	3.2×10^{-4}	20.0
30-B	CU-350	20.5	3.5×10^{-4}	16.6
30-A	CD-350	22.1	3.5×10^{-4}	12.9

Figure 3 shows the stress paths for all triaxial shear tests. Despite the variability of the water content that was described in Section 4.7.2, it is noted that all of the tests lead to a consistent failure envelope. The envelope that is plotted in Figure 3 corresponds to an internal friction angle $\phi' = 30°$ and zero effective cohesion, a result consistent with those observed with marine clays for tests in the normally consolidated condition (Leroueil et al. 1985).

The drained tests give results that appear more variable than those of the undrained tests (Figure 3). There are two explanations for this observation. First, we note that the maximum deviator stress for drained tests is reached for large deformations (Figure 4). Moreover, the deviator stress continues to increase while drawing closer to the stopping criterion of the D7181 standard (ε = 15%). Stresses in the specimen are less well known for large deformations due to the distortion of the specimens. The higher deviator stress at failure for specimen 18D is probably associated with the very sandy nature of the specimens in drillholes BH-BBA-19-18 and BH-BBA-19-20. It can be seen that specimen 18D has the lowest initial water content of all specimens. The end of the stress path in specimen 18D corresponds to an angle $\varphi' = 35°$.

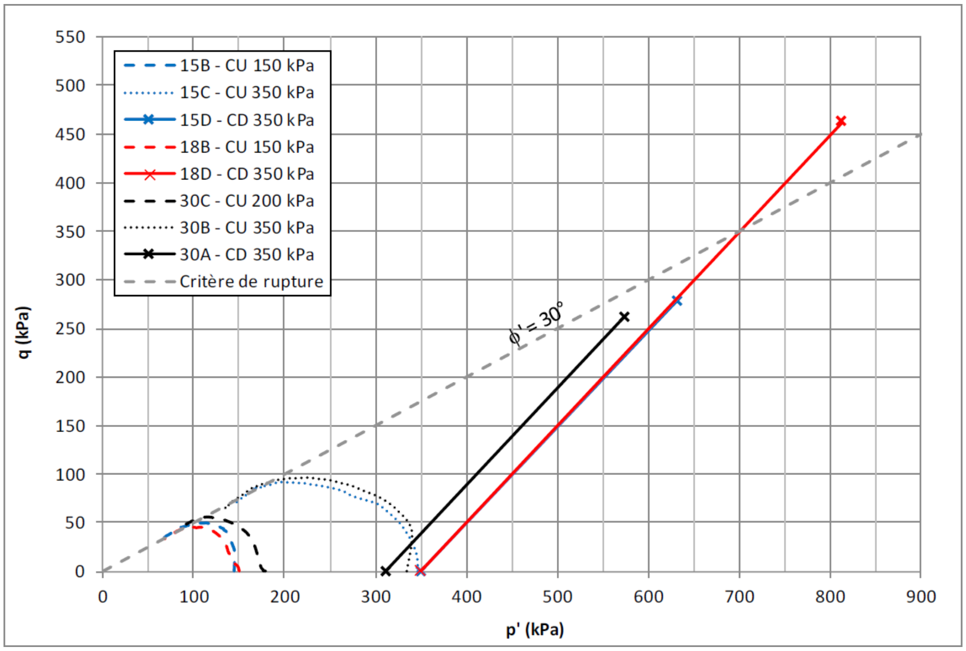

Figure 3: Stress path for all triaxial shear tests

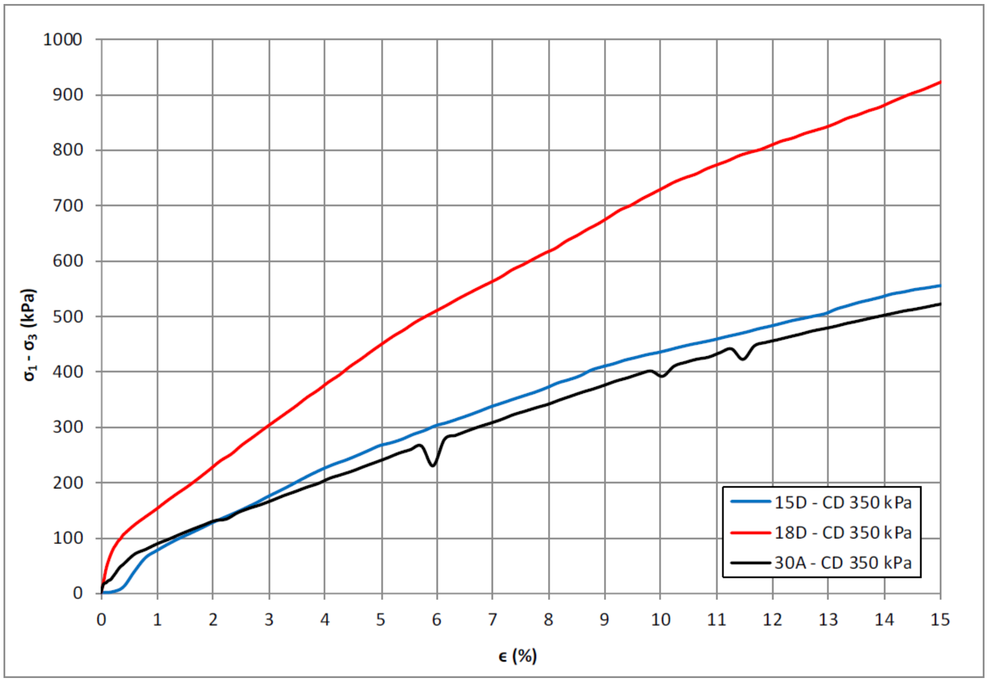

Figure 4: Relationship between deviator stress and axial resilience for drained tests with a consolidation stress of 350 kPa.

Figures 5 and 6 show the deviator stress and pore pressure for the undrained tests, respectively. The results are representative of normally consolidated clays with contracting behaviour. Positive pore pressures were generated for all specimens. These results are consistent with the volume decreases that were observed for the drained tests (Figure 7).

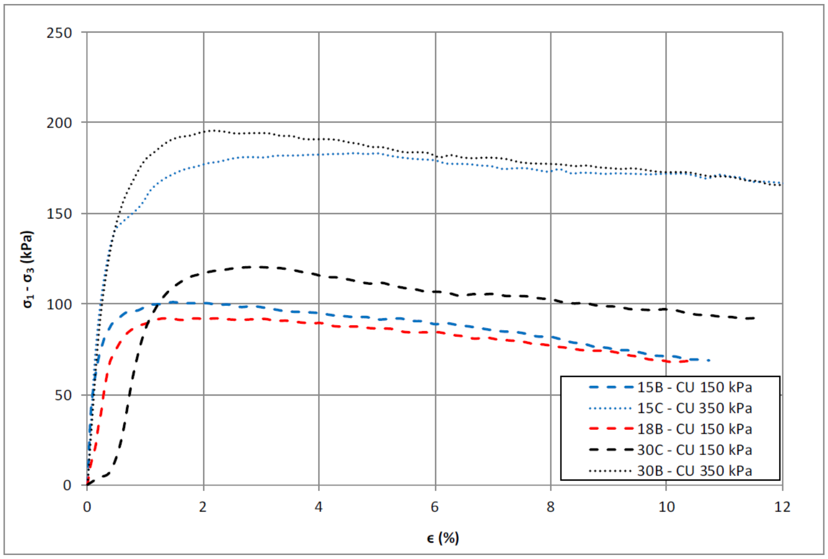

Figure 5: Deviator stress for undrained tests

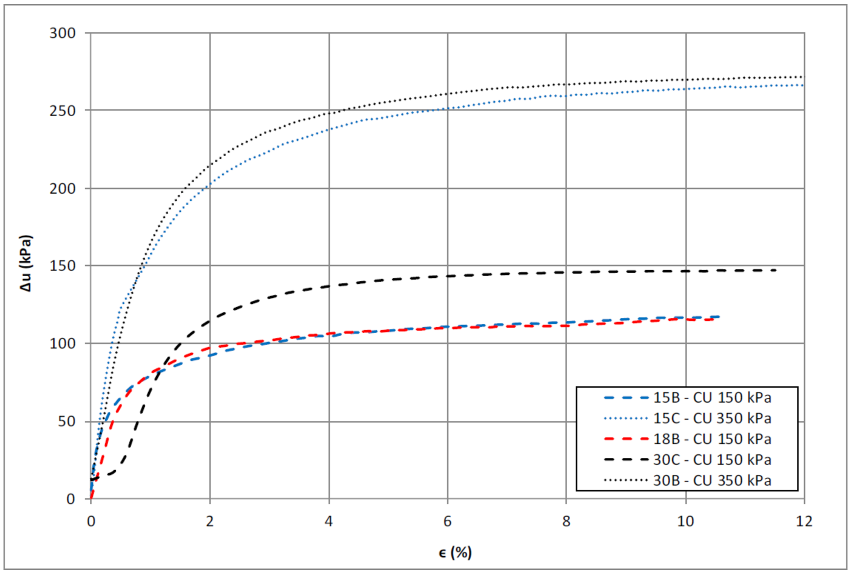

Figure 6: Pore pressure for undrained tests

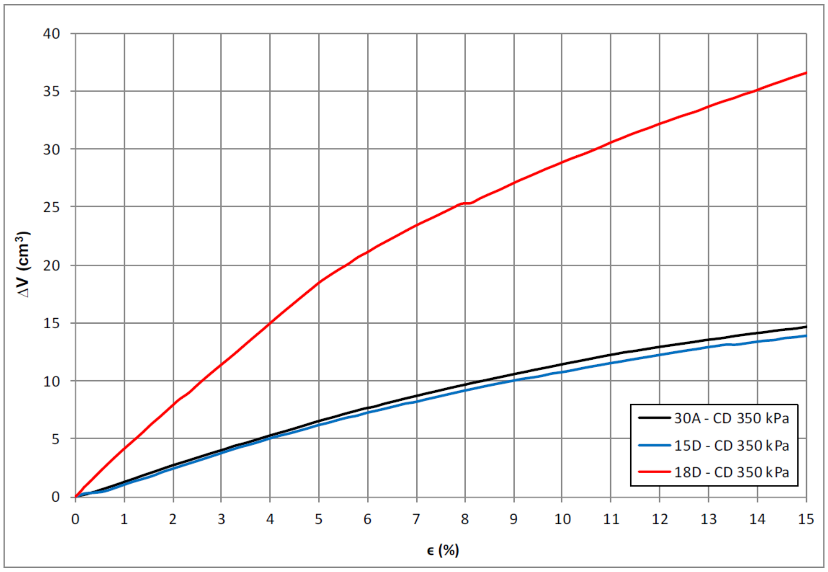

Figure 7: Relationship between volume change and axial resilience for drained tests with a consolidation stress of 350 kPa

4.8 Water table

Groundwater levels at the site were variable. To the south, it was encountered at the depth of 0.92 to 2.9 m. The level was deeper in some drillholes and in some, the water table was not reached. To the north, groundwater was encountered at a depth between 0.76 and 2.3 m. In the solid tailings, groundwater was encountered at a depth between 3.81 and 6.86 m. On the west side, it was encountered at a depth between 0.8 and 3.0 m. Table 21 summarizes the groundwater depths at the site.

Table 21: Groundwater depth

ID	Zone	Water depth (m)	ID	Zone	Water depth (m)
BH-BBA19-01	1a	2.23	BH-BBA19-16	2b	0.76
BH-BBA19-02	1a	Dry	BH-BBA19-17	2a	Dry
BH-BBA19-03	1a	2.80	BH-BBA19-18	2a	2.29
BH-BBA19-04	1a	Dry	BH-BBA19-20	2a	0.76
BH-BBA19-05	1a	Dry	BH-BBA19-21	2a	2.29
BH-BBA19-06	1a	0.9	BH-BBA19-22	2a	Dry
BH-BBA19-07	1a	2.89	BH-BBA19-23	3	4.57
BH-BBA19-08	2c	0	BH-BBA19-24	3	4.57

ID	Zone	Water depth (m)	ID	Zone	Water depth (m)
BH-BBA19-09	2c	0	BH-BBA19-25	3	5.33
BH-BBA19-10	2c	0	BH-BBA19-26	3	4.57
BH-BBA19-11	1b	0.8	BH-BBA19-27	3	3.81
BH-BBA19-12	1b	2.67	BH-BBA19-28	3	6.86
BH-BBA19-13	1b	2.60	BH-BBA19-29	3	?
BH-BBA19-14	2b	2.95	BH-BBA19-30	1b	3.05
BH-BBA19-15	2b	5.33	BH-BBA19-31	1b	3.05

Note: water depths were recorded just after the drillholes were completed, on 26 March and 10 April 2019

5. CONCLUSION AND RECOMMENDATIONS

After the analysis of the results of the drillholes and tests carried out at the Bachelor mine site, the following conclusions were reached:

- In zone 1a (under the south dike), the site stratigraphy consisted of a layer of vegetated soil and silty sand, followed by a till horizon. Clay does not exist in zone 1a under the south dike;
- The compactness of the silty sand overlying the clay varies from very loose to compact. A silty sand with very loose compactness was encountered at very shallow depths (0.3 m in zone 1a);
- In the other areas, for the majority of the drillholes, the till horizon was encountered under the clay. At drillholes BH-BBA-19-11 and BH-BBA-19-13 (zone 1b) and BH-BBA-19-17 and BH-BBA-19-22 (zone 2a), clay soil was not encountered, the upper sand layer being followed by a granular till deposit;
- The predominant composition of the till is silty sand with gravel and traces of clay. But in some samples, the amount of gravel and silt can reach 60% and 64% respectively. Till compactness varies from compact to very dense in zones 1a, 1b and 2c, and from loose to very dense in zones 2a and 2b;
- Clay soil is encountered mainly in the central part of the valley, towards the north and west (in zones 2a, 2b, 2c and 1b). The thickness of the clay layer is minimal on the eastern edge of the site;
- Due to access difficulties caused by a swamp in this area, drillhole BH-BBA-19-19 could not be completed during the geotechnical campaign. This may be a more critical location that needs more geotechnical investigation;

- The thickness of the clay soil varies between 0.6 m and 11.35 m in zone 2a, between 2.3 and 6.0 m in zone 2b, and between 1.5 and 9 m in zone 2c. In zone 1b (in the center of the west dike), a clay soil layer varying in thickness from 4.6 m to 7.6 m was observed;
- The consistency of the clay varies from very stiff to very soft. The clay deposit has shear strengths ranging from 14 kPa to 100 kPa in zone 2c (on the inner dike), from 4 kPa to 134 kPa in zone 1b (on the western dike), from 27 kPa and 100 kPa in zone 2b (on the middle dike), and between 16 kPa and 42 kPa in zone 2a (on the north dike). The sensitivity of the clay changes from low to extremely sensitive. The plasticity of the clay varies from low to high;
- The clay beneath the crust is firm to very soft and slightly overconsolidated with a preconsolidation pressure between 85 kPa in zone 2c (middle dike), and 110 to 150 kPa in zone 1b (west dike). In zone 1b, a sample taken from the crust (depth of 2.75 m) had a preconsolidation pressure of 235 kPa;
- The recompression index, C_r, compression index, C_c, and preconsolidation pressure, P'_c, were required to estimate the anticipated soil deformations under the loading of the future dam. This information was obtained from consolidation tests;
- The depth of bedrock is shallow on the south side, but its depth increases as it moves north;
- The tailing samples submitted for testing are not acid-producing. The particle sizing of the tailings (performed by others) shows that the tailings consist of approximately 80-90% silt and clay and 10-20% sand. The tailings appear to be too fine for the construction of dikes. But the dry portion (above the water table) can be used for geomembrane protection;
- The clays in the Bachelor site are heterogeneous and varved with a water content that varies mainly between 30 and 65%. The presence of sandier horizons was observed;
- The results of the triaxial tests will provide information on the short and long term behaviour of the clay when subjected to loading. This result can be used to optimize the stability banks needed to ensure the stability of the dikes. The results of the triaxial tests show that the clay is normally consolidated with a contracting behaviour;
- Based on the triaxial test results provided in Appendix D, it is possible to estimate the future undrained shear strength and consolidation time required to achieve this undrained shear strength that will occur based on the anticipated future consolidation under the weight of the projected dikes.

This information is needed to assess whether the laminations could present a weak horizontal plane that could lower the safety factor of a dike. Direct shear testing is recommended to obtain results on the resistance to undrained shear of the varved clay when subjected to horizontal shear forces. The results of the ongoing investigations provide the data necessary to assess the geotechnical capacity of the site to support the proposed development.

The most important element regarding the construction of the dikes is the undrained condition of the foundation clay. The stability of the foundation must be studied in detail during the engineering design of the dikes. Dike constructions should be made so that excessive pore pressures have sufficient time to dissipate before adding a new loading stage. Appropriate geotechnical instruments should be designed to monitor clay behaviour and the dissipation of excessive pore pressure. Stabilization dikes can be used as an option to achieve the required stability of the west, north, middle and inner dikes.

We recommend using dry tailings, deposited in the solid tailings management area between the middle and internal dikes, for geomembrane protection. This option increases the surface area of Pond 1; therefore, given its larger surface area, it is possible to reduce the height of the inner and middle dikes to accommodate the required volumes.

6. OTHER CONSIDERATIONS

This report was prepared for Bonterra in order to assess the subsurface and foundation conditions of the tailings maintenance areas of the Bachelor mine. Our comments are limited to the assessed site and the topics covered.

The comments in this report are intended to provide guidance to design engineers. The number of test holes required to determine local subsurface conditions between test sites, which may affect construction costs, construction techniques, sequencing, equipment and scheduling, etc., would actually be greater than what was done for design purposes. With this in mind, any contractor bidding on or undertaking work should decide on their own research, as well as their own interpretations of factual soil data and groundwater observations, in order to draw their own conclusions about how subsurface and groundwater conditions may affect them.

The mandate for the geotechnical assessment of this project has already been presented in this report. If there are changes, such as the location of the infrastructure, the information obtained during this assessment may be insufficient. In this case, the revised design information should be reviewed by this office and, if necessary, further field work and reporting may be required. It is recommended that BBA should review the foundation plans before finalizing the design.

Although this assessment has commented on excavation procedures, the presence of conditions, which would be difficult to establish from small test holes, may affect the type and nature of construction and dewatering procedures, etc., that the contractor would have to implement. For example, these conditions include local and seasonal fluctuations in the water table, erratic changes in the soil profile between tests, thin layers of soil with low or high permeability relative to the overall soil mass, and possibly sources of relatively high reloading, etc.

Assessment and commentary is necessarily ongoing as new information on subsurface conditions becomes available. For example, in keeping with the availability of more accurate information regarding conditions between test holes when construction is underway. The interpretation between tests, as well as the recommendations in this report, must therefore be verified by field inspections in order to validate the information to be used during the construction phase.

The information contained in this report does not reflect this project's environmental impact and has not been addressed in this report, given that it is beyond the scope and terms of reference. If specific information is required, additional testing may be necessary.

This is a merely preliminary report, based on limited exploration such as to answer specific questions posed by the customer. This report has not been prepared in order to meet the needs of design professionals, contractors, or any other party, and any use of this report by them without the assistance of the soils and foundation engineer who prepared it constitutes improper use, which could lead to incorrect assumptions, erroneous conclusions, and other related problems.

We believe that the results obtained during this investigation, including in situ and laboratory tests, will contribute to the design of the infrastructure in the Bachelor mine.

QC2-18: GHG AND CLIMATE CHANGE REPORT (BOILY, 2022)

GHG QUALIFICATION

DETAILS OF THE GHG BALANCE OF THE BACHELOR MINING PROJECT

ENV0784-1502-02_EN

GCM Reference No.: 21-0696-0784

Prepared by:	Isabelle Boily, Eng., OIQ No.: 144229 Groupe VLD
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1.0 BACKGROUND AND LIMITS OF THE ASSESSMENT

This document presents the detailed greenhouse gas (GHG) emission calculations for the Bachelor mine site redevelopment project to process gold ore from the Barry deposit exclusively. All of the emissions directly linked to the development, construction, operational and restoration work carried out are considered in the GHG emission balance. It should be noted that after review of the project, it was decided to exclude the operation of the Moroy deposit from the project. This update of the GHG balance therefore seeks to update the GHG quantification following this change.

This includes the emissions occurring on site or off site (e.g. transport of chemicals, etc.). Indirect emissions linked to the use of electricity are also included in the assessment.

To assess the impact of the increase in the project's GHG balance, the GHG emissions were calculated for the situation currently authorized (hereinafter current use), and for the future use (1,800 tpd of milling of ore from the Barry deposit).

2.0 GLOBAL WARMING POTENTIAL

Each GHG retains heat at a given intensity. This capacity can be compared to the capacity of CO_2 to perform the same function. This means that the emissions of each GHG are converted into "tonnes of carbon dioxide equivalent" (t CO_2 eq), accounting for their global warming potential (GWP).

The gases for which the emissions were estimated include CO_2, CH_4 and N_2O.

Table 1. Global Warming Potential

Greenhouse gas	Chemical formula	GWP – 100-year horizon
Carbon dioxide	CO_2	1
Methane	CH_4	25
Nitrogen protoxide	N_2O	298

Source: 4th Report of the IPCC

3.0 CONSTRUCTION PHASE

The construction phase includes the following activities: expansion of the tailings management area, upgrade of the transportation road from the Barry site to the Bachelor site, and construction of a new road section west of the tailings management area (southwest access). Deforestation is considered as a single activity during the construction phase.

The estimated GHG emission sources in this phase are:

- deforestation (loss of the carbons sinks and diesel combustion by forestry equipment);
- diesel combustion by vehicles and heavy machinery.

The following emission sources are part of the sources excluded from the quantification:

- loss of wetlands;
- use of explosives during the construction phase;
- road transportation of new equipment and construction materials.

The assessment of the emissions from the excluded sources is detailed in section 6.0.

3.1 Expansion of the Tailings Management Area

Expansion of the tailings management area will be carried out in Year 0, Year 1 and Year 2. This work will last four months each year. The equipment use period will be 12 hours a day. The mobile equipment will use only diesel and its annual consumption will be detailed in Table 2. The GHG emissions associated with this equipment are presented in section 3.6.

Table 2. Equipment Planned for Expansion of the Tailings Management Area

Equipment	Number of units	Diesel consumption rate[1] L/h	Total diesel consumption L/an
Heavy truck	5	73.5	529,379
Crawler excavator	3	40.3	173,939
Bulldozer	2	25.1	72,264
Compactor	1	23.6	33,947

[1] The detailed calculations of the consumption rate of each mobile equipment unit of the project are detailed in Appendix 1.

3.2 Upgrade of the Transportation Road and Construction of a New Section

The road work will last six months, except for the brush clearing work, which lasts two months. The equipment use period will be 12 hours a day. The mobile equipment will use only diesel and its annual consumption will be detailed in Table 2. The GHG emissions associated with this equipment are presented in section 3.6.

Table 3. Equipment Planned for Road Work

Equipment	Number of units	Diesel consumption rate L/h	Total diesel consumption L/an
Heavy truck	6	73.5	952,882
Crawler excavator	3	40.3	260,908
Bulldozer	2	25.1	108,397
Brush cutter/excavator	2	15.2	21,847

3.3 Expansion of the Ore Processing Complex

The expansion of the complex will last six months, except for the use of a heavy truck, which will last three months, and the use of the concrete pump and the boom truck, which is estimated at 45 days for each equipment unit. The equipment use period will be 12 hours a day. The mobile equipment will use only diesel and its annual consumption will be detailed in Table 2. The GHG emissions associated with this equipment are presented in section 3.6.

Table 4. Equipment Planned for Expansion of the Complex

Equipment	Number of units	Diesel consumption rate L/h	Total diesel consumption L/an
Heavy truck	1	73.5	79,407
Concrete pump	1	29.5	15,917
Boom truck	1	29.5	15,917
Crawler excavator	1	40.3	86,969
Scissor lift	2	1.3	5,827
Telescopic forklift	2	12.8	55,459
Crane	1	27.8	60,028
Compactor	1	23.6	50,921
Bulldozer	1	25.1	54,198

Diesel consumption by the cement mixers is estimated according to the total number of kilometres they travel. The total volume of concrete necessary for construction was estimated at 4,000 m^3.

$$T_{cement\ mixer} = \frac{4000\ m^3}{8m^3} \times (2 \times 95\ km) \times 0.39 \frac{L}{km} = 37{,}363\ \frac{L}{yr}$$

- $T_{\text{cement mixer}}$: diesel consumption by the cement mixers (L/yr)
- 8 m^3: volume of concrete in a cement mixer
- 95 km: distance between the plant, located in Lebel-sur-Quévillon, and the Bachelor site
- 0.39 L/km: fuel consumption by a cement mixer. The detailed calculation of fuel consumption can be found in Appendix 1.

3.4 Deforestation

The deforestation required will mainly be performed in the construction phase during construction of the new southwest access and expansion of the Bachelor complex. To account for the needs for machinery traffic and work, an additional 15-metre buffer zone has been added to the footprint of the deforestation infrastructure.

This activity will lead to the elimination of 39.6 ha of softwood and mixedwood forests, 33.7 ha (85%) of which will be composed of mature forests.

3.4.1 Loss of carbon sinks

The loss of carbon sinks is estimated with the equation provided by the MELCC, which comes from the 2006 IPCC Guidelines (2019). The calculation parameters used are presented in Table 6.

$$GHG\ (t\ CO_2\ eq) = N_H \times t_{DMh} \times (1 + T_x) \times CC \times \frac{44}{12}$$

- GHG (t CO_2 eq): CO_2 eq emissions attributable to deforestation (t)
- N_H: number of deforested hectares (ha)
- t_{DMh}: tonnage of dry materials per hectare (dry t/ha)
- T_X: underground biomass rate relative to aerial biomass (-)
- CC: carbon content of dry wood (tonnes of C/dry t)
- 44/12: ratio of molecular mass of CO_2 to molecular mass of C (tonnes of CO_2 / tonnes of C)

Table 5. Parameters Used for Calculation of CO_2 Emissions Attributable to Deforestation

Parameter	Value	Source
N_H	39.6	Total area of deforested forest stands in hectares.
T_{DMh}	53.46	According to the proportion: mature forests (62.9 T_{DMh} x 85%) and 15% young boreal forests (< 20 years). There is no parameter for young boreal forests. IPCC, 2019. *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 - Agriculture, Forestry and Other Land Use.* Value obtained from Table 4.7
T_X	0.39	The majority of the stand is less than 75 years old. T_x = 0.39 (boreal coniferous forest ≤ 75 years) IPCC, 2019. *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 - Agriculture, Forestry and Other Land Use.* Value obtained from Table 4.4
CC	0.47	Default value provided by the MELCC from the 2006 IPCC Guidelines for Greenhouse Gas Inventories– Volume 4: Agriculture, forestry and other land uses.

$$GHG\ (t\ CO_2\ eq) = 39.6\ ha \times 53.46 \frac{t\ sec}{ha} \times (1 + 0.39) \times 0.47 \frac{tonnes\ C}{t\ sec} \times \frac{44}{12} = 5\ 071 \frac{t\ CO_2\ eq}{yr}$$

The emissions due to losses of carbon sinks are 5,071 tonnes of CO_2 eq.

3.4.2 Fuel consumption of forestry equipment

Of the 39.6 hectares to be deforested, about 71.2% (28.2 ha) are associated with timber harvesting and 28.8% (11.4 ha) with brush clearing. The assessment of diesel consumption for brush clearing is described in section 3.2.

For timber harvesting, fuel consumption by deforestation equipment was estimated by using a fuel consumption rate characteristic of deforestation activities in general.

The mean value presented in Table 6 is calculated from an American study that addressed the consumption data based on four cases for forest work. It includes the diesel consumption associated with felling, conditioning, sorting, loading and transport of trees.

$$T_C = N_H \times \frac{t_{MS}}{D_B} \times CD$$

- T_C: fuel consumption for deforestation equipment (L)
- N_H: number of deforested hectares (ha)

- t_{DMh}: tonnage of dry materials per hectare (dry t/ha)
- D_B: density of dry wood (dry t/m^3 of wood)
- CD: diesel consumption rate linked to deforestation (L/m^3 of wood)

Table 6. Parameters for Calculation of Diesel Consumption of Forestry equipment

Parameter	Value	Source
N_H	28.2	Area of harvested timber in hectares.
T_{DMh}	53.46	According to the proportion: mature forests (62.9 T_{DMh} x 85%) and 15% young boreal forests (< 20 years). There is no parameter for young boreal forests. IPCC, 2019. *Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4 - Agriculture, Forestry and Other Land Use.* Value obtained from Table 4.7
D_B	0.44	Density of kiln-dried Black Spruce (Kennedy 1965). This species is mostly present on the land to be deforested
CD	7.9 L/m^3 of wood	Corresponds to mean diesel consumption for deforestation work (see Table 2 of the study: diesel consumption ranges from 5.20 – 6.59 gal/100 ft^3 of wood). Excerpt from the study by Johnson et al. 2005.

$$T_C = 28.2\ ha \times \frac{53.46\,\frac{t\ sec}{ha}}{0.44\ \frac{t\ sec}{m^3}} \times 7.9\,\frac{L}{m^3} = 27{,}068\ L$$

Diesel consumption by forestry equipment is 27,068 litres. The GHG emissions associated with this equipment are presented in section 3.6.

The end use of the cut wood is indeterminate and the parameters that would allow estimating of the emissions are undefined or, at best, very speculative at this stage of the project. In the absence of clear information regarding its actual use, the indirect emissions associated with processing of cut wood were excluded from the GHG balance for this project.

3.5 GHG Emission Factors Based on the Emission Source

The fuel emission factors used for the construction phase are presented in Table 7.

Table 7. GHG Emission Factors – Construction Phase

Source	Emission factor		
	CO_2	CH_4	N_2O
Motor vehicles and heavy machinery	2,680.5 g/L	0.15 g/L	0.075 g/L

Sources: ECCC, 2021. National Inventory Report 1990–2019 - Part 2, Annex 6, Table A6.1-14

The GHG emissions coming from a mobile combustion source were calculated by multiplying the annual fuel consumption by the appropriate emission factors.

$$E_{GHG} = T_C \times \frac{EF_S}{10^6}$$

- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- T_F: total annual fuel (L/yr)
- EF_S: gas emission factor (CO_2, CH_4 or N_2O) for fuel combustion (g/L)
- 10^6: conversion factor from grams to tonnes

The results obtained then are posted in CO_2 eq according to the warming potential of CO_2, CH_4 and N_2O.

$$E_{CO_2}\,\mathrm{eq} = \sum (E_{GHG} \times GWP_{GHG})$$

- E_{CO2} eq : total CO_2 eq emissions by type of emission source (t/yr)
- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- GWP_{GHG}: global warming potential by GHG type (-)

3.6 Construction Phase GHG Emissions

Table 8 presents the GHG emissions of the emission sources presented in the previous sections. The expansion of the tailings management area considers only one of the three four-month work periods, but this annual total is carried over each year for three years in the summary of the project's GHG emissions in section 7.0.

Table 8. ***Construction Phase GHG Emissions – Year 0***

Activity	**Source**			**GHG emissions (mt/yr)**			
				CO_2	**CH_4**	**N_2O**	**CO_2 eq**
Expansion of the tailings management area (4 months)	Heavy truck	D	M	1,419	0.08	0.04	1,433
	Crawler excavator	D	M	466	0.03	0.01	471
	Bulldozer	D	M	194	0.01	0.01	196
	Compactor	D	M	91	0.01	0.003	92
Upgrade of the Transportation Road and Construction of a New Section	Heavy truck	D	M	2,554	0.14	0.07	2,579
	Crawler excavator	D	M	699	0.04	0.02	706
	Bulldozer	D	M	291	0.02	0.01	293
	Brush cutter/excavator	D	M	59	0.003	0.002	59
Expansion of the Ore Processing Complex	Heavy truck	D	M	213	0.01	0.01	215
	Concrete mixer	D	M	100	0.01	0.003	101
	Concrete pump	D	M	43	0.002	0.001	43
	Boom truck	D	M	43	0.002	0.001	43
	Crawler excavator	D	M	233	0.01	0.01	235
	Scissor lift	D	M	16	0.001	0.0004	16
	Telescopic forklift	D	M	149	0.01	0.004	150
	Crane	D	M	161	0.01	0.005	162
	Compactor	D	M	136	0.01	0.004	138
	Bulldozer	D	M	145	0.01	0.004	147
Deforestation	Forestry equipment	D	M	73	0.004	0.002	73
	Loss of carbon sinks	D	F	5,071	0.00	0.00	5,071
Total				**12,155**	**0.40**	**0.20**	**12,224**

D: Direct / I: Indirect / M: Mobile / F: Fixed

4.0 OPERATIONAL PHASE

The operational phase, lasting 10 years, includes transport of ore from the Barry site to the Bachelor site and its processing. Ore extraction from the Barry site is not part of the assessment. In the current situation, the operation of the Bachelor Mine is considered in the calculations because it is part of the Bachelor site. In the future situation, the Bachelor Mine will no longer be operated.

The estimated GHG emission sources in this phase are:

- trucking ore from the Barry site to the Bachelor site;
- maintenance of the haulage road;
- diesel and gasoline combustion by vehicles and other machinery;
- propane combustion mainly as a heating source;
- electricity consumption;
- use of explosives (current situation only)

The following emission sources are part of the sources excluded from the quantification:

- treatment of sanitary wastewater;
- road transport of septic tank sludge;

- road transport of various inputs;
- road transport of fuel and propane;
- road transport of finished products;
- road transport of domestic waste;
- road transport of other waste.

The assessment of the emissions from the excluded sources is detailed in section 6.0.

To estimate the emissions due to the increase in the milling rate, the following sections describe the various emission sources according to a milling rate of 800 mt per day for the current situation and 1,800 mt per day for the future situation.

4.1 Employee transport

The gasoline vehicles circulating on the entire site are minivans for round trips between the Barry site and the Bachelor site and a shuttle between the camp and the complex. Fuel consumption was 62,177 litres for 2017 according to the IQEA report.

The client considers that fuel consumption for transport of employees will be similar to that of the baseline year, 67,177 litres.

Consumption is unchanged between the current and future situations. Emissions due to gasoline consumption are therefore nil in Table 28 of section 7, which presents the increase in GHG emissions compared to the current situation.

4.2 Propane Consumption

In the current situation, heating of the mine drifts is the main source of propane consumption. This fuel is also used in smaller quantities for the refinery furnace, heating of buildings (crushing shop, garage, dry house, core bank) and the camp kitchen). Propane consumption was 574,521 litres for 2017 according to the IQEA report.

For the future situation, there will no longer be propane consumption for heating of the Bachelor Mine, because it will no longer be operated. The other heating equipment operating on propane will be replaced with equipment operating on electricity. The only equipment consuming propane will be the camp kitchen. Consumption is estimated at 7,571 litres per year, i.e. two tank fillings annually.

Propane consumption is reduced considerably between the current and future situations. Emissions caused by propane consumption are negative in Table 27 of section 7.0, which presents the increase in GHG emissions compared to the current situation.

4.3 Explosives

The following equation allows calculation of the quantity of explosives for an extraction rate of 800 tonnes/day for the current situation:

$$Q_{EXP} = T_{EXT} \times duration \times F_{EXP}$$

- Q_{EXP}: quantity of explosives required per day (kg/day)
- T_{EXT}: extraction rate of waste rock and ore (t/day)
- Duration: number of days of annual operation

- F_{EXP}: use of explosives factor per tonne of extracted material (kg/t)

$$Q_{EXP} = 1071\ \frac{t}{day} \times 365\ \frac{days}{yr} \times 1.12\ \frac{kg}{t} = 437{,}824\ \frac{kg}{yr}$$

Bonterra uses two types of explosives in the following proportions: 85% ANFO (AMEX™) and 15% cartridge explosives (Magnafrac Plus). GHG emissions are due to the fuel contained in the explosive. The type of cartridge explosives used by Bonterra does not contain fuel. Only the quantity of ANFO explosive must be considered in the GHG emission calculations.

$$Q_{ANFO\_2400} = 437{,}824\ kg\ \times\ 85\% =\ 372{,}150\ \frac{kg}{yr}$$

Because the Bachelor Mine will no longer be operated in the future situation, there will be no use of explosives on the site. Emissions due to explosives are therefore negative in Table 28 of section 7.0, which presents the increase in GHG emissions compared to the current situation.

4.4 Electricity

The main energy source on the Bachelor site is electricity from the Hydro-Québec grid. It is used for operation of equipment intended for treatment and discharge of industrial water, tailing storage, operation of the ore processing mill and heating of administration buildings and worker camps. The machinery in the Bachelor Mine operates on compressed air or batteries, and thus essentially with electricity.

Current consumption is about 2,250 kWh. The increase in the milling rate will also increase electricity consumption. The client plans to replace the two existing power lines with a new power line. The new consumption will be 5,933 kWh. The GHG emissions are estimated for annual electricity consumption of 51,973,080 kWh.

In case of a power failure, there are two backup generators. A generator's monthly consumption is 200 L of diesel per month. Annual consumption is therefore 4,800 L/yr. It is estimated that their use will be similar between the current and future situations. Emissions due to use of generators are therefore nil in Table 28 of section 7.0, which presents the increase in GHG emissions compared to the current situation.

4.5 Diesel Consumption – Current Situation

For the current situation, diesel consumption by the mobile equipment is estimated at 311,899 litres according to the 2017 IQEA report. The equipment used are a wheel loader, an ore transport truck and the equipment used for dry piling in the tailings administration area, i.e. a tractor and trucks.

4.6 Diesel Consumption – Future Situation

4.6.1 Ore trucking

Ore is trucked 365 days a year. For a milling rate of 1,800 mt per day, this will require 43 round trips per day. A 25% reduction of transport (i.e. 32 round trips per day) will be applied during the two weeks of the moose hunt and transport will be stopped completely for two weeks in spring during the goose hunt. The annual distance travelled will be 3,286,580 km. The diesel consumption of the ore transport trucks is estimated at 0.625 L/km, which would bring annual consumption to 2,054,113 L/yr.

4.6.2 Other mobile equipment

This section presents the other mobile equipment using diesel for the future operation of the site. The mobile equipment already present on the site will have the same rate of use as it currently does. Its diesel consumption will be the same as during the baseline year, 311,899 litres according to the 2017 IQEA report. Ore transport from the waste rock piles to the grinding section will require the addition of a wheel loader. It will be used 365 days a year over a 12-hour period.

Year-round maintenance of the ore haulage road includes grading and snow removal. These activities have a duration of 6 months each. For road grading, an average speed of 10 km/h is considered in the estimate of annual consumption. The mobile equipment will use only diesel and its annual consumption will be detailed in Table 9. The GHG emissions associated with this equipment are presented in section 4.8.

Table 9. Other mobile equipment

Equipment	Number of units	Diesel consumption rate[1]	Total diesel consumption L/an
Mobile Equipment	n/a	n/a	311,899
Wheel loader	1	23.0 L/h	100,740
Grader	1	17.9 L/h	47,140
Snow plow	1	0.47 L/km	18,735

[1] The detailed calculations of the consumption rate of each mobile equipment unit of the project are detailed in Appendix 1.

4.6.3 Brush clearing on the haulage road

Brush clearing of the Bachelor-Barry haulage road must be performed every three years. The use of a brush cutter is considered for one month over a 24-hour period. Annual diesel consumption is estimated at 10,924 litres.

The quantity of wood and tailings associated with this activity is difficult to quantify because it will depend on the growth rate of the trees and vegetation on the roadside. The emissions associated with the loss of carbon sinks for this activity were excluded from the GHG balance for this project.

4.7 GHG Emission Factors Based on the Emission Source

The emission factors used for the construction phase are presented in Table 11.

Table 10. GHG Emission Factors – Operational Phase

Source	Emission factor		
	CO_2	CH_4	N_2O
Light gasoline vehicles[1]	2,307.3 g/L	0.56 g/L	0.028 g/L
Heavy motor vehicles and machinery[1]	2,680.5 g/L	0.15 g/L	0.075 g/L
Propane equipment[2]	1,515.0 g/L	0.024 g/L	0.108 g/L
Explosives[3]	0,189 t/t	n/a	n/a
	CO_2 eq		
Electricity[4]	1.5 g/kWh		

Sources: [1] ECCC (2021). National Inventory Report 1990–2019 - Part 2, Annex 6, Table A6.1-14
[2] ECCC (2021). National Inventory Report 1990–2019 - Part 2, Annex 6, Table A6.1-4
[3] MAC [Mining Association of Canada] (2014). Towards Sustainable Mining Energy and Greenhouse Gas Emissions Management: Reference Guide. Appendix D – Conversion Tables, Emissions Factors, and Global Warming Potentials. Ottawa, ON: MAC, 119 p. Available: https://mining.ca/resources/guides-manuals/energy-and-ghg-emissions-management-reference-guide/
[4] ECCC (2021). National Inventory Report 1990–2019 - Part 3, Annex 13, Table A13-6

The GHG emissions coming from gasoline, diesel and propane consumption must be calculated by multiplying the annual fuel consumption by the appropriate emission factors.

$$E_{GHG} = T_C \times \frac{EF_S}{10^6}$$

- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- T_F: total annual fuel (L/yr)
- EF_S: gas emission factor (CO_2, CH_4 or N_2O) for fuel combustion (g/L)
- 10^6: conversion factor from grams to tonnes

The GHG emissions from the use of explosives must be calculated by using the appropriate emission factor.

$$E_{GHG} = Q_{ANFO} \times \frac{EF_{GHG}}{1000}$$

- E_{GHG}: GHG emissions according to the source category (t/yr)
- Q_{ANFO}: quantity of ANFO used per day (kg/yr)
- EF_{GHG}: GHG type emission factor (t/t)
- 1000: conversion factor from kilograms to tonnes

The results obtained then are posted in CO_2 eq according to the warming potential of CO_2, CH_4 and N_2O.

$$E_{CO_2}\, eq = \sum (E_{GHG} \times GWP_{GHG})$$

- E_{CO2} eq : total CO_2 eq emissions by type of emission source (t/yr)
- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- GWP_{GHG} : global warming potential by GHG type (-)

The GHG emissions from electricity consumption must be calculated by using the appropriate emission factor. The emissions calculated are already expressed in CO_{2e} eq.

$$E_{CO_2 2}\, eq. = C_{EL} \times \frac{EF_{EL}}{10^6}$$

- E_{CO2} eq total CO_2 eq emissions by electricity (t/yr)
- C_{EL}: total annual electricity consumed (kWh/yr)
- EF_{EL}: emission factor for electricity consumption (g/kWh)
- 10^6: conversion factor from grams to tonnes

4.8 Operational Phase GHG Emissions

Table 12 and Table 13 present the GHG emissions of the emission sources presented in the previous sections for the current and future situations.

Table 11. Operational Phase GHG Emissions – Current Situation (800 mt)

Activity	Source			GHG emissions (mt/yr)			
				CO_2	CH_4	N_2O	CO_2 eq
Employee transport	Various gasoline vehicles	D	M	143	0.03	0.002	145
Underground ore extraction, industrial process, administration buildings and worker camp	Mobile equipment and heavy machinery	D	M	836	0.05	0.02	844
	Propane consumers	D	F	870	0.01	0.06	889
	Explosives	D	F	70	0.00	0.00	70
	Electricity	I	F	30	0.00	0.00	30
	Generator	D	F	13	0.001	0.0004	13
Total				**1,963**	**0.10**	**0.09**	**1,991**

D: Direct / I: Indirect / M: Mobile / F: Fixed

Table 12. Operational Phase GHG Emissions – Future Situation (1,800 mt)

Activity	Source			GHG emissions (mt/yr)			
				CO_2	CH_4	N_2O	CO_2 eq
Ore trucking	Heavy truck	D	M	5,506	0.31	0.15	5,560
Annual maintenance work	Grader	D	M	126	0.01	0.004	128
	Snow plow	D	M	50	0.003	0.001	51
Employee transport	Various gasoline vehicles	D	M	143	0.03	0.002	145
Underground ore extraction, industrial process, administration buildings and worker camp	Mobile equipment and heavy machinery	D	M	1,106	0.06	0.03	1,117
	Propane consumers	D	F	11	0.0002	0.001	12
	Explosives	D	F	0	0.00	0.00	0
	Electricity	I	F	78	0.00	0.00	78
	Generator	D	F	13	0.001	0.0004	13
Total				7,035	0.42	0.19	7,102

D: Direct / I: Indirect / M: Mobile / F: Fixed

Table 14 presents the GHG emissions of the emission sources recurring every 2 or 3 years.

Table 13. Operational Phase GHG Emissions – Future Situation (1,800 mt) Recurring Activity

Activity	Source			GHG emissions (mt/yr)			
				CO_2	CH_4	N_2O	CO_2 eq
Spot maintenance work (every 3 years)	Brush cutter/excavator	D	M	29	0.002	0.001	30

D: Direct / I: Indirect / M: Mobile / F: Fixed

5.0 DISMANTLING PHASE

The dismantling phase includes closure and restoration of the Moroy and Bachelor sites. Two situations are assessed - the complete closure of the site and the closure of the facilities related to expansion of the site only. Although this latter scenario is not likely to occur, this assessment will allow assessment of the contribution of the expansion of infrastructure and the increase in the mill's processing capacity to the project's GHG balance.

5.1 Mobile Equipment

5.1.1 Complete closure of the sites

The closure and rehabilitation of the sites will last eighteen months. For the following equipment, the duration of use is three months: the scissor lifts, the telescopic forklifts, the cranes and the forklifts. The equipment use period will be 12 hours a day. The mobile equipment will use diesel and propane.

Their annual consumption is detailed in Table 14. The GHG emissions associated with this equipment are presented in section 5.3

Table 14. Equipment Planned for Complete Closure Work

Equipment	Number of units	Diesel consumption rate L/h[1]	Total diesel consumption L/h
Heavy truck	3	73.5	966,116
Crawler excavator	2	40.3	352,709
Bulldozer	2	25.1	219,804
Wheel loader	1	23.0	100,740
Scissor lift	2	1.3	2,913
Telescopic forklift	2	12.8	27,729
Crane	2	27.8	60,028
Equipment	**Number of units**	**Propane consumption rate L/h[1]**	**Total propane consumption L/h**
Forklift	2	3.71	8,019

[1] The detailed calculations of the consumption rate of each mobile equipment unit of the project are detailed in Appendix 1.

5.1.2 Closure of the expansion only

To estimate the closure and rehabilitation work for the expansion only, it is assumed that the duration of equipment use applies in proportion to the area to be restored. Use of the crane was considered negligible, because it is more associated with dismantling of the buildings, most of which are already constructed.

Thus, the work would be assessed every five months. For the following equipment, the duration of use would be one month: the scissor lifts, the telescopic forklifts and the forklifts. The equipment use period would be 12 hours a day. The mobile equipment would use diesel and propane. Their annual consumption is detailed in Table 14. The GHG emissions associated with this equipment are presented in section 5.3.

Table 15. Equipment Planned for Closure of the Expansion Only

Equipment	Number of units	Diesel consumption rate L/h	Total diesel consumption L/h
Heavy truck	3	73.5	397,034
Crawler excavator	2	40.3	144,949
Bulldozer	2	25.1	90,331
Wheel loader	1	23.0	41,400
Scissor lift	2	1.3	971
Telescopic forklift	2	12.8	9,243
Crane	0	27.8	n/a
Equipment	**Number of units**	**Propane consumption rate L/h**	**Total propane consumption L/h**
Forklift	2	3.71	2,673

5.2 GHG Emission Factors Based on the Emission Source

The emission factors used for the dismantling phase are presented in Table 17.

Table 16. GHG Emission Factors – Dismantling Phase

Source	Emission factor		
	CO_2	CH_4	N_2O
Motor vehicles and heavy machinery	2,680.5 g/L	0.15 g/L	0.075 g/L
Propane off-road vehicle	1,515.0 g/L	0.64 g/L	0.087 g/L

Sources: ECCC, 2021. National Inventory Report 1990–2019 - Part 2, Annex 6, Table A6.1-14

The GHG emissions coming from a mobile combustion source were calculated by multiplying the annual fuel consumption by the appropriate emission factors.

$$E_{GHG} = T_C \times \frac{EF_S}{10^6}$$

- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- T_F: total annual fuel (L/yr)
- EF_S: gas emission factor (CO_2, CH_4 or N_2O) for fuel combustion (g/L)
- 10^6: conversion factor from grams to tonnes

The results obtained then are posted in CO_2 eq according to the warming potential of CO_2, CH_4 and N_2O.

$$E_{CO_2}\, eq = \sum (E_{GHG} \times GWP_{GHG})$$

- E_{CO2} eq : total CO_2 eq emissions by type of emission source (t/yr)
- E_{GHG}: GHG emissions according to the source category (CO_2, CH_4, N_2O) (t/yr)
- GWP_{GHG} : global warming potential by GHG type (-)

5.3 Dismantling Phase GHG Emissions

Table 18 presents the emissions for the first year of the dismantling phase. As described in section 5.1.1, the first four equipment units of the table have a lifecycle of 18 months.

Table 17. Dismantling Phase GHG Emissions - Complete Closure

Activity	Source			GHG emissions (mt/yr)			
				CO_2	CH_4	N_2O	CO_2 eq
Closure and rehabilitation of the sites	Heavy truck	D	M	2,590	0.14	0.07	2,615
	Crawler excavator	D	M	945	0.05	0.03	955
	Bulldozer	D	M	589	0.03	0.02	595
	Wheel loader	D	M	270	0.02	0.01	273
	Scissor lift	D	M	8	0.0004	0.0002	8
	Telescopic forklift	D	M	74	0.004	0.002	75
	Crane	D	M	161	0.01	0.005	162
	Forklift	D	M	12	0.005	0.0007	12
Total				4,650	0.26	0.13	4,695

D: Direct / I: Indirect / M: Mobile / F: Fixed

Table 18. Dismantling Phase GHG Emissions - Expansion Only

Activity	Source			GHG emissions (mt/yr)			
				CO_2	CH_4	N_2O	CO_2 eq
Closure and rehabilitation of the sites - expansion only	Heavy truck	D	M	1,064	0.06	0.03	1,075
	Crawler excavator	D	M	389	0.02	0.01	392
	Bulldozer	D	M	242	0.01	0.01	244
	Wheel loader	D	M	111	0.01	0.003	112
	Scissor lift	D	M	3	0.0001	0.0001	3
	Telescopic forklift	D	M	25	0.001	0.001	25
	Crane	D	M	n/a	n/a	n/a	n/a
	Forklift	D	M	4	0.002	0.0002	4
Total				1,837	0.10	0.05	1,855

D: Direct / I: Indirect / M: Mobile / F: Fixed

6.0 EXCLUDED EMISSION SOURCES

The following section presents the sources excluded from the GHG quantification. A justification is given for each exclusion.

Accidents and Malfunctions

The level of uncertainty related to accidents and malfunctions that could occur does not allow the associated GHG emissions to be estimated.

Loss of Wetlands

The construction phase will lead to the loss of 6.76 ha of wetlands and shore environments by drainage. The method adopted to estimate GHG emissions is based on the loss of dissolved organic carbon (DOC) from drained organic soils (IPCC, 2013).

The following equation allows calculation of the CO_2 emission factor due to export of DOC from drained organic soils:

$$EF_{COD} = COD_{flux\ naturel} \times (1 + \Delta COD_{drainé}) \times Frac_{COD-CO_2}$$

- EF_{DOC}: emission factor for the DOC of a drained site (tonnes of C/ha-yr)
- $DOC_{natural\ flow}$: flow of DOC from undrained natural organic soils
- (Tonnes of C/ha-yr)
- $\Delta DOC_{drained}$: proportional increase in DOC flow from drained sites compared to undrained sites (-)
- $Frac_{DOC-CO2}$: conversion factor for the proportion of DOC converted into CO_2 after export from drained sites (-)

Table 19. Calculation Parameters for the CO_2 Emission Factor for the DOC of a Drained Site

Parameter	Value	Source
$DOC_{natural\ flow}$	0.08	IPCC (2014). 2013 Supplement to 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands. Chapter 2, Table 2.2, p. 2.20.
$\Delta DOC_{drained}$	0.6	
$Frac_{DOC-CO2}$	0.9	
EF_{DOC}	0.12	

The emissions then can be determined by multiplying the calculated emission factor by the area.

$$CO_2 - C_{DOC} = \sum_{c,n} (A \times EF_{DOC})_{c,n}$$

- CO_2-C_{DOC}: CO_2-C emissions due to the loss of DOC from drained organic soils (tonnes of C/yr)
- A: area of drained organic soils in a soil use category in climate zone c and nutritional state n (ha)
- EF_{DOC}: emission factors for annual CO_2 emissions due to the loss of DOC from drained organic soils, by climate zone and this nutritional state n (tonnes of C/ha-yr)

$$CO_2 - C_{DOC} = 6.76\ ha\ \times 0.12 \frac{tonnes\ C}{ha \cdot yr} = 0.8 \frac{tonnes\ C}{yr}$$

The carbon emissions then must be converted into tonnes of CO_2 equivalent.

$$CO_2\ eq = \ 0.8 \frac{tonnes\ C}{yr} \times \frac{44}{12} = 2.86 \frac{t\ CO_2}{yr}$$

- 44/12: ratio of molecular mass of CO_2 to molecular mass of C (-)

The total CO_2 emissions due to the loss of wetlands are 2.86 tonnes of CO_2 eq. These emissions are considered negligible because they represent 0.004% of the project's total emissions. A table at the end of this section presents the GHG emission sources considered negligible for this project.

Use of Explosives During the Construction Phase

It is difficult to estimate the total quantity of explosives required during the construction phase. Their use is forecast during construction of the new southwest access and the expansion of the Bachelor complex. However, it is possible to affirm that the quantity of explosives will be less than the quantity used during an operating year of the current situation (372,150 kg), which annually generates 70.34 tonnes of CO_2 eq. The contribution of the emissions due to the use of explosives during the construction phase is considered negligible because it represents 0.10% of the project's total emissions.

Haulage of New Equipment and Construction Materials

Transport of materials and new specialized equipment that will compose the mill contributes to the project's GHG balance, but the emissions are negligible compared to those of the project as a whole. To estimate the emissions, it is assumed there will be fewer than 200 shipments of materials and equipment. The needs for granular materials for the foundations, for example, are considered in the use of heavy trucks.

The consumption rate for freight transport is determined from the data of a European document (European Chemical Transport Association (ECTA), Guidelines for Measuring and Managing CO_2 Emission from Freight Transport Operations, Table 2). This table indicates the CO_2 equivalent emission factor depending on the freight load transported and the percentage of the time the truck is empty. For a truck transporting 25 tonnes of freight, but returning empty to the point of origin, the emission factor is 70.3 g CO_2 eq/t-km. This factor is converted into a diesel consumption rate by dividing it by the Diesel GHG emission factor into CO_2 eq.

$$\frac{70.3\,\frac{g\ CO_2\ eq}{t \cdot km}}{2706.6\,\frac{g\ CO_2\ eq}{L}} = 0.026\,\frac{L}{t \cdot km}$$

The diesel consumption rate is 0.026 L/t-km. A mean distance of 710 km is then assumed for all deliveries (e.g. Montréal – Desmaraisville).

$$T_C = 200\ shipments \times 710\ km\ \times 2\ \times 0.026\,\frac{L}{t \cdot km} = 7{,}377\,\frac{L}{yr}$$

Annual diesel consumption is estimated at 7,377 litres. The emissions associated with fuel consumption would be 19.97 tonnes of CO_2 eq. The contribution of the emissions due to the transport of equipment and materials during the construction phase is considered negligible because it represents 0.02% of the project's total emissions.

Treatment of Sanitary Wastewater

The sanitary water of the Bachelor site is treated by a system of septic tanks and disposal fields (Wood, 2019, vol. I, p. 8-284). The drained sludge is transported to Chibougamau by a subcontractor (Wood, 2019, vol. I, p. 3-62).

The septic tanks generate CH_4 resulting from anaerobic degradation. The disposal fields and wastewater treatment plants produce and emit N_2O during biological treatment (MDDEFP, 2012). The wastewater is considered to be of biogenic origin, so the CO_2 emissions are not taken into account for calculation of GHG emissions (IPCC, 2006, vol. 5, chapter 6, p. 6.7).

For the current situation, the volume of sludge calculated is the maximum produced because it is calculated according to the maximum capacity of the camp (162 workers). For the future situation, the volume of sludge is calculated for 45 workers.

The CH_4 emissions from the septic tanks are calculated according to the following method:

$$E_{CH_4} = \left[(P \times BOD) - BOD_{Sludge}\right] \times EF_{CH_4} \times 0.001$$

- E_{CH4}: CH_4 emissions attributable to wastewater treatment (tonnes of CH_4/yr)
- P: total population served by the septic tanks
- BOD: biological demand in the wastewater (kg of BOD/person-yr)
- BOD_{Sludge}: quantity of BOD in the drained sludge (kg of BOD/yr)
- EF_{CH4}: CH_4 emission factor (kg of CH_4/kg BOD)
- 0.001: conversion factor from kilograms to tonnes

where

$$DBO_{Sludge} = Drained\ sludge\ \times BOD_{mean}$$

- Drained sludge: Total annual volume of sludge collected in all septic tanks. (m^3/yr)
- BOD_{mean}: Mean BOD determined by Health Canada (kg of BOD/m^3)

The CH_4 emissions then must be converted into tonnes of CO_2 equivalent.

$$E_{CO_2} = E_{CH_4} \times GWP_{CH_4}$$

- E_{CO2}: emissions expressed in CO_2 equivalent (tonnes of CO_2/yr)
- GWP_{CH4}: global warming potential by GHG type

Table 20. Percentage Calculation for CH_4 Emissions Attributable to Wastewater Treatment

Parameter	Value	Source
C	162	Total population served by the wastewater treatment facilities (current situation).
C	45	Total population served by the wastewater treatment facilities (future situation).
BOD	21.9	BOD = (0.06 kg of BOD/person) x (365 days/yr) ECCC, National Inventory Report 1990-2019, Part 2, 2021, p. 207.
Drained sludge:	8.16	Total annual volume of sludge collected in all septic tanks (current situation). Source: GCM (2020)
Drained sludge:	2.27	Volume of sludge collected calculated in proportion to the number of workers Future situations
BOD_{mean}	7.50	MDDEFP (2012), p.26. Available: https://www.environnement.gouv.qc.ca/programmes/climat-municipalites2/guide-inventaire-GES.pdf
FF_{CH4}	0.3	MELCC (2019). Guide de quantification des émissions de gaz à effet de serre (Greenhouse gas emissions quantification guide), Table 22.
GWP_{CH4}	25	4th Report of the IPCC

Example of current situation

$$E_{CH_4} = \left[\left(162\ pers.\times 21.9\frac{kg\ BOD}{pers.\cdot yr}\right) - 8.16\frac{m^3}{yr}\times 7.5\frac{kg\ BOD}{m^3}\right]\times 0.3\frac{kg\ CH_4}{kg\ BOD}\times 0.001\frac{t}{kg}$$

$$E_{CH_4} = 1.046\frac{t\ CH_4}{yr}$$

$$E_{CO_2} = 1.046\frac{t\ CH_4}{yr}\times 25 = 26.15\frac{t\ CO_2\ eq}{yr}$$

For the current situation, the total CO_2 eq emissions due to anaerobic degradation in the septic tanks are 26.15 tonnes of CO_2 eq. For the future situation, the CO_2 eq emissions are 7.26 tonnes.

The N_2O from the disposal fields are calculated according to the following method:

$$E_{N_2O} = EF_{N_2O}\times N\times\frac{44}{28}\times 0.001$$

- E_{N2O}: N_2O emissions attributable to wastewater treatment (tonnes of N_2O/yr)
- EF_{N2O}: N_2O emission factor (kg of N_2O /kg of BOD)
- N: Quantity of nitrogen present in the wastewater (kg of N/yr)
- 44/28: Stœchiometric factor used to convert molecular nitrogen into N_2O (-)
- 0.001: conversion factor from kilograms to tonnes

where

$$N = Proteins \times P \times F_{NPR} \times N_{housekeeping} \times F_{NC}$$

- Proteins: Annual protein consumption per person (kg/person/yr)
- P: Total population served by the wastewater treatment facilities
- F_{NPR}: Nitrogen fraction in the protein (kg of N/kg of protein)
- $N_{housekeeping}$: Additional nitrogen fraction from housekeeping products (-)
- F_{NC}: Protein fraction not consumed (-)

The CH_4 emissions then must be converted into tonnes of CO_2 equivalent.

$$E_{CO_2} = E_{N_2O} \times GWP_{N_2O}$$

- E_{CO2}: emissions expressed in CO_2 equivalent (tonnes of CO_2/yr)
- GWP_{N2O}: global warming potential by GHG type

Table 21. Calculation Parameters for N_2O Emissions from the Disposal Fields

Parameter	Value	Source
FF_{N2O}	0.0045	Value for a septic tank + disposal field MELCC (2019). Guide de quantification des émissions de gaz à effet de serre (Greenhouse gas emissions quantification guide), Table 23.
Proteins	67.74	ECCC, National Inventory Report 1990-2016 - Part 2. Page 194
C	162	Total population served by the wastewater treatment facilities (current situation).
C	45	Total population served by the wastewater treatment facilities (future situation).
F_{NPR}	0.16	IPCC (2009) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5, Chapter 6, page 6.38.
$N_{housekeeping}$	1.1749	IPCC (2009) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5, Chapter 6, Table 6.10A.
F_{NC}	1.1350	IPCC (2009) Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 5, Chapter 6, Table 6.10A.
GWP_{N2O}	298	4th Report of the IPCC

Example of current situation

$$N = 67.74 \frac{kg}{pers.\cdot yr} \times 162\ pers. \times 0.16 \frac{kg\ N}{kg\ prot.} \times 1.1749 \times 1.135 = 2341.4 \frac{kg\ N}{yr}$$

$$E_{N_2O} = 0.0045 \frac{kg\ N_2O}{kg\ N} \times 2341.4 \frac{kg\ N}{yr} \times \frac{44}{28} \times 0.001 = 0.0166 \frac{t\ N_2O}{yr}$$

$$E_{CO_2} = 0.0166 \frac{t\ N_2O}{yr} \times 298 = 4.93 \frac{t\ CO_2\ eq}{yr}$$

For the future situation, the N_2O emissions by the disposal fields are 1.37 tonnes of CO_2 eq.

The N_2O emissions from the wastewater treatment plant are calculated according to the same method as the disposal fields. However, the N_2O emission factor is replaced with the centralized aerobic treatment station factor.

Table 22. Calculation Parameters for N_2O Emissions from the Wastewater Treatment Plant

Parameter	Value	Source
FF_{N2O}	0.016	Value for a centralized aerobic treatment station MELCC (2019). Guide de quantification des émissions de gaz à effet de serre (Greenhouse gas emissions quantification guide), Table 23.

Example of current situation

$$E_{N_2O} = 0.016 \frac{kg\ N_2O}{kg\ N} \times 2341.4 \frac{kg\ N}{yr} \times \frac{44}{28} \times 0.001 = 0.0589 \frac{t\ N_2O}{yr}$$

$$E_{CO_2} = 0.0589 \frac{t\ N_2O}{yr} \times 298 = 17.54 \frac{t\ CO_2\ eq}{yr}$$

For the future situation, the N_2O emissions by the wastewater treatment plant are 4.87 tonnes of CO_2 eq.

Table 23. Summary Table of Sanitary Wastewater Treatment Emissions

Current situation			
Emission source	**CH_4 (t/yr)**	**N_2O (t/yr)**	**CO_2 eq (t/yr)**
Septic Tank	1.0460	n/a	26.15
Disposal fields	n/a	0.0166	4.93
Treatment plant	n/a	0.0589	17.54
Total	1.0460	0.0754	48.63
Future situations			
Emission source	**CH_4 (t/yr)**	**N_2O (t/yr)**	**CO_2 eq (t/yr)**
Septic Tank	0.2906	n/a	7.26
Disposal fields	n/a	0.0046	1.37
Treatment plant	n/a	0.0164	4.87
Total	0.2906	0.0210	13.51

The annual emissions caused by sanitary wastewater treatment are 48.63 tonnes of CO_2 eq for the current situation and 13.51 tonnes of CO_2 eq for the future situation. There is a reduction of emissions caused by sanitary wastewater treatment between the current and future situations.

Transport of Septic Tank Sludge

As specified in the document "Addendum – Answers to COMEX Questions and Comments", Bonterra preventively drains the septic tanks twice a year. On average, two siphon trucks per visit are required to empty all the septic systems at the Bachelor site. The number of emptying operations per year will remain the same for the future situation.

The sludge is transported by a specialized supplier located in Chibougamau. The round trip is estimated at two hours. Considering the fuel consumption rate of 24.5 L/h for a 350 hp truck, annual consumption of 392.5 L/yr is obtained.

$$T_C = 4\,round\ trips \times 2\,h \times 2 \times 24.5\frac{L}{h} = 392.5\frac{L}{yr}$$

The emissions associated with diesel consumption would be 1.06 tonnes of CO_2 eq.

Transport of Inputs for the Operational Phase

Several chemicals are used in the operational phase. The dosage of each chemical is detailed in the document "Addendum – Answers to COMEX Questions and Comments". A total annual tonnage of chemicals was calculated for the current situation (564 tonnes/yr) and the future situation (1,270 tonnes/yr).

The consumption rate for freight transport is determined from the data of a European document (European Chemical Transport Association (ECTA), Guidelines for Measuring and Managing CO_2 Emission from Freight Transport Operations, Table 2). This table indicates the CO_2 equivalent emission factor depending on the freight load transported and the percentage of the time the truck is empty.

For chemical transport, it is assumed that the truck transports 15 tonnes of freight and returns empty to the point of origin. The emission factor is 105.3 g CO_2 eq./t-km. This factor is converted into a diesel consumption rate by dividing it by the diesel GHG emission factor in CO_2 eq.

$$\frac{105.3\,\frac{g\ CO_2\ eq}{t \cdot km}}{2706.6\ \frac{g\ CO_2\ eq}{L}} = 0.039\frac{L}{t \cdot km}$$

The diesel consumption rate is 0.039 L/t-km. The origin of the inputs is variable. A minimum distance of 710 km is assumed for all deliveries (e.g. Montréal – Desmaraisville).

$$T_{C\_current} = \frac{564\ tonnes\ produced}{15\ t/transport} \times 710\ km\ \times 2\ \times 0.039\frac{L}{t \cdot km} = 2{,}079\frac{L}{yr}$$

$$T_{C\_future} = \frac{1{,}270\ tonnes\ products}{15\ t/shipment} \times 710\ km\ \times 2\ \times 0.039\frac{L}{t \cdot km} = 4{,}678\frac{L}{yr}$$

The total emissions for road transport of inputs are 5.63 tonnes of CO_2 eq for the current situation and 12.66 tonnes of CO_2 eq for the future situation.

Transport for Fuel and Propane During the Operational Phase

For the current situation, the number of shipments is determined according to the number of invoices issued in 2017 for propane, gasoline and diesel.

For the future situation, as described in section 4.2, there will be two fillings of the propane tank per year. There is no change in gasoline consumption, as described in section 4.1. The number of shipments is identical. For the number of diesel shipments, current and future total consumption are compared. The total number of shipments for the current situation is 167 compared to 227 for the future situation.

Table 24. Number of Fuel and Propane Shipments

	Current situation	Future situations
Propane	117	2
Gasoline	25	25
Diesel	25	200
Total	167	227

The suppliers' distance from Desmaraisville is an average of 250 km. Assuming a diesel consumption rate of 24.5 L/h for a 350 hp truck and an average speed of 80 km/h, the following annual consumptions are obtained:

$$T_C = \frac{167\ shipments\ \times 250\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 25{,}605\frac{L}{yr}$$

$$T_C = \frac{227\ shipments \times 250\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 34{,}805\frac{L}{yr}$$

The emissions associated with diesel consumption for transport of fuel and propane are 69.30 tonnes of CO_2 eq for the current situation and 94.20 tonnes of CO_2 eq for the future situation.

Transport of Finished Products

Currently, the number of shipments of finished products is one shipment per month. For the future situation, the number of shipments will have a frequency ranging from once every two weeks to one week per week. The finished products must be delivered to Ottawa, located 600 km from Desmaraisville. Assuming a diesel consumption rate of 24.5 L/h for a 350 hp truck and an average speed of 80 km/h, the following annual consumptions are obtained:

$$T_C = \frac{12\ shipments \times 600\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 4{,}416\frac{L}{yr}$$

$$T_C = \frac{52\ shipments \times 600\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 19{,}135\frac{L}{yr}$$

The emissions associated with diesel consumption for transport of finished products are 11.95 tonnes of CO_2 eq for the current situation and 51.79 tonnes of CO_2 eq for the future situation.

Transport of Domestic Waste

As described in the document "Addendum – Answers to COMEX Questions and Comments", the number waste containers shipped for disposal was 66 in 2017 and the number estimated for the future situation is 80 containers. The distance between Desmaraisville and the Lebel-sur-Quévillon technical landfill is about 90 km. Considering a fuel consumption rate of 24.5 L/h for a 350 hp truck and an average speed of 80 km/h, annual consumption of 3,643 L/year is obtained for the current situation and 4,416 L/year for the future situation.

$$T_{C\_current} = \frac{66\ shipments \times 90\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 3{,}643\frac{L}{yr}$$

$$T_{C\_future} = \frac{80\ shipments \times 90\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 4{,}416\frac{L}{yr}$$

The emissions associated with diesel consumption are 9.86 tonnes of CO_2 eq for the current situation and 11.95 tonnes of CO_2 eq for the future situation.

Transport of Other Types of Waste

The other types of waste include used oils, other hazardous materials, metals and tires. In the document "Addendum – Answers to COMEX Questions and Comments", it is estimated that collections for used oils, other hazardous materials and metals are considered identical between the current and future situations. For tires, the number of collections is variable from year to year. For the estimate of emissions, 40 collections per year are assumed for all of this waste. The average distance travelled is 280 km, excluding the lowest value. Considering a fuel consumption rate of 24.5 L/h for a 350 hp truck and an average speed of 80 km/h, annual consumption of 6,869 L/yr is obtained.

$$T_C = \frac{40\ shipments \times 280\ km \times 2 \times 24.5\frac{L}{h}}{80\ km/h} = 6{,}869\frac{L}{yr}$$

The emissions associated with diesel consumption would be 18.59 tonnes of CO_2 eq.

Summary Table

The table on the next page presents the GHG emissions from excluded sources according to the project's lifecycle.

The quantification of GHG seeks to determine the emissions due to the Bachelor mine site redevelopment project to process gold ore from the Barry deposit. The value of the emissions in the table is therefore the result of subtraction of future emissions and current emissions.

Transport of septic tank sludge and transport of other waste do not vary between the current and future situations, which explains why the associated GHG emissions are nil in the table. The emissions caused by sanitary wastewater treatment decrease between the current and future situations, because the quantity of sludge generated decreases according to the workforce reduction. The emissions are therefore negative.

Table 25. Estimate of Annual GHG Emissions from Excluded Sources (Expansion and Increase of the Milling Rate)

ACTIVITÉ	CO2 éq. (tm/an)														CONTRIBUTION DES ÉMISSIONS (%)
	Construction	Exploitation										Démantèlement		TOTAL	
	Année 0	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9	Année 10	Année 11	Année 12		
Pertes de milieux humides	2.86													2.86	0.004
Utilisation d'explosifs phase construction	70.34													70.34	0.10
Transport nouveaux équipements et matériaux de construction	19.97													19.97	0.03
Traitement des eaux usées sanitaires		-35.12	-35.12	-35.12	-35.12	-35.12	-35.12	-35.12	-35.12	-35.12	-35.12			-351.19	-0.50
Transport boues de fosses septiques														0.00	0.00
Transport d'intrants		7.03	7.03	7.03	7.03	7.03	7.03	7.03	7.03	7.03	7.03			70.34	0.10
Transport carburant/propane	24.90	24.90	24.90	24.90	24.90	24.90	24.90	24.90	24.90	24.90	24.90			273.89	0.39
Transport produits finis		39.84	39.84	39.84	39.84	39.84	39.84	39.84	39.84	39.84	39.84			398.39	0.57
Transport déchets domestiques	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09			23.01	0.03
Transport autres déchets														0.00	0.00
TOTAL ANNUEL	**120.15**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**38.74**	**0.00**	**0.00**	**507.59**	**0.73**

7.0 SUMMARY OF THE PROJECT'S GHG EMISSIONS

The following table presents the GHG emissions of all activities on the Bachelor site, including expansion and increase of the milling rate.

Table 26. Estimate of Annual Greenhouse Gas Emissions Estimation by Emission Source During the Bachelor Project's Lifecycle (Operation 1800 T)

ACTIVITÉ	CO2 éq. (tm/an)														CONTRIBUTION DES ÉMISSIONS (%)
	Construction	Exploitation										Démantèlement		TOTAL	
	Année 0	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9	Année 10	Année 11	Année 12		
Agrandissement du parc à résidus	2 191	2 191	2 191											6 573	6.92
Mise à niveau de la route de transport et construction d'un nouveau tronçon	3 638													3 638	3.83
Agrandissement du complexe de traitement de minerai	1 250													1 250	1.32
Déboisement - équipement	73													73	0.08
Déboisement - perte des puits de carbone	5 071													5 071	5.34
Camionnage du minerai		5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560			55 597	58.53
Transport d'employés	145	145	145	145	145	145	145	145	145	145	145	145	72	1 811	1.91
Exploitation - équipement mobile diesel		1 295	1 295	1 295	1 295	1 295	1 295	1 295	1 295	1 295	1 295			12 951	13.63
Exploitation - propane		12	12	12	12	12	12	12	12	12	12			117	0.12
Exploitation - explosifs		0	0	0	0	0	0	0	0	0	0			0	0.00
Exploitation - électricité		78	78	78	78	78	78	78	78	78	78			780	0.82
Exploitation - génératrice		13	13	13	13	13	13	13	13	13	13			130	0.14
Travaux d'entretien débroussaillage				30			30			30				89	0.09
Fermeture et remise en état des sites												4 695	2 219	6 914	7.28
TOTAL ANNUEL	**12 369**	**9 293**	**9 293**	**7 132**	**7 102**	**7 102**	**7 132**	**7 102**	**7 102**	**7 132**	**7 102**	**4 840**	**2 291**	**94 994**	**100**
Source directe et mobile	7 297	9 191	9 191	7 029	7 000	7 000	7 029	7 000	7 000	7 029	7 000	4 840	2 291	88 896	93.58
Source directe et fixe	5 071	25	25	25	25	25	25	25	25	25	25	0	0	5 318	5.60
Source indirecte et fixe	0	78	78	78	78	78	78	78	78	78	78	0	0	780	0.82

The following table presents the increases in GHG emissions compared to the current situation according to the project's lifecycle. The value of the emissions in the table is therefore the result of the different between future emissions and current emissions.

Table 27. Estimate of Annual GHG Emissions by Emission Source During the Bachelor Project's Lifecycle (Expansion and Increase of the Milling Rate)

ACTIVITÉ	CO2 éq. (tm/an)														CONTRIBUTION DES ÉMISSIONS (%)
	Construction	Exploitation										Démantèlement		TOTAL	
	Année 0	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9	Année 10	Année 11	Année 12		
Agrandissement du parc à résidus	2 191	2 191	2 191											6 573	9.44
Mise à niveau de la route de transport et construction d'un nouveau tronçon	3 638													3 638	5.22
Agrandissement du complexe de traitement de minerai	1 250													1 250	1.80
Déboisement - équipement	73													73	0.11
Déboisement - perte des puits de carbone	5 071													5 071	7.28
Camionnage du minerai		5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560	5 560			55 597	79.81
Transport d'employés		0	0	0	0	0	0	0	0	0	0			0	0.00
Exploitation - équipement mobile diesel		451	451	451	451	451	451	451	451	451	451			4 510	6.47
Exploitation - propane		-878	-878	-878	-878	-878	-878	-878	-878	-878	-878			-8 775	-12.60
Exploitation - explosifs		-70	-70	-70	-70	-70	-70	-70	-70	-70	-70			-703	-1.01
Exploitation - électricité		48	48	48	48	48	48	48	48	48	48			484	0.69
Exploitation - génératrice		0	0	0	0	0	0	0	0	0	0			0	0.00
Travaux d'entretien débroussaillage				30			30			30				89	0.13
Fermeture et remise en état des sites												1 855		1 855	2.66
TOTAL ANNUEL	**12 224**	**7 302**	**7 302**	**5 141**	**5 111**	**5 111**	**5 141**	**5 111**	**5 111**	**5 141**	**5 111**	**1 855**	**0**	**69 661**	**100**
Source directe et mobile	7 153	8 202	8 202	6 040	6 011	6 011	6 040	6 011	6 011	6 040	6 011	1 855	0	73 585	105.63
Source directe et fixe	5 071	-948	-948	-948	-948	-948	-948	-948	-948	-948	-948	0	0	-4 407	-6.33
Source indirecte et fixe	0	48	48	48	48	48	48	48	48	48	48	0	0	484	0.69

As described in their gasoline consumption section (section 4.1) and the frequency of use of generators (section 4.4) do not change between the current and future situations. The GHG emissions associated with these two sources are nil in the table. For emissions associated with the use of explosives (section 4.2), and those associated with propane consumption (section 4.2), the emissions are negative because the quantity of explosives and propane used decreased between the current and future situations.

The total GHG emissions of the Bachelor mine site redevelopment project to treat gold ore from the Barry deposit are 69,661 tonnes of CO_2 eq.

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APPENDIX 1

CALCULATION OF FUEL CONSUMPTION OF MOBILE EQUIPMENT

Calculation of Fuel Consumption of Mobile Equipment

Off-road Equipment

Diesel consumption by off-road equipment was estimated according to the MELCC method. It is possible to estimate consumption from the BSFC factor, which represents diesel consumption (in pounds) of equipment by horsepower (hp) and per hour of use. A transitional adjustment factor must be added to the BSFC according to the type of mobile equipment.

The equipment operates at a variety of speeds and loads. It rarely operates over long periods at its rated horsepower. A load factor (LF) is therefore used to account for the effect of operation when idling and on partial load, and of transitional operation.

$$C_{DY} = \frac{BSFC}{\rho} \times P_Y \times FAT_Y \times FC_Y \times 0{,}4536$$

- C_{DY}: Diesel consumption of an equipment unit (L/h)
- BSFC: diesel consumption rate according to the horsepower of the equipment (lb/hp-h)
- ρ: density of diesel fuel (0.85 kg/L)
- P_Y: rated horsepower of the engine of equipment Y (hp)
- TAF_Y: transitional adjustment factor of equipment Y (-)
- LF_Y: mean load factor of equipment Y (-)
- 0.4536: conversion factor of mass units (kg/lb)

Diesel Consumption of Off-road Equipment

Equipment type	hp	BSFC[1]	TAF[1]	LF[2]	Diesel (L/h)
Heavy truck	630	0.367	1.01	0.59	73.5
Crawler excavator	345	0.367	1.01	0.59	40.3
Bulldozer	215	0.367	1.01	0.59	25.1
Compactor	202	0.367	1.01	0.59	23.6
Brush cutter/excavator	130	0.367	1.01	0.59	15.2
Boom truck	350	0.367	1.00	0.43	29.5
Scissor lift	25	0.408	1.18	0.21	1.3
Telescopic forklift	110	0.367	1.01	0.59	12.8
100-tonne crane	330	0.367	1.00	0.43	27.8
Wheel loader	272	0.367	1.01	0.59	31.7
Grader	153	0.367	1.01	0.59	17.9
Concrete pump	350	0.367	1.00	0.43	29.5

Sources: [1]US EPA [UNITED STATES ENVIRONMENTAL PROTECTION AGENCY] (2021). Exhaust and Crankcase Emission Factors for Nonroad Compression-Ignition Engines in MOVES3.0.2, EPA-420-R-21-021.

[2]US EPA [UNITED STATES ENVIRONMENTAL PROTECTION AGENCY] Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, EPA-420-R-10-016.

The fuel consumption of certain equipment could be validated with data from the literature for equipment with horsepower (hp) similar to the equipment assessed. The values are similar to those calculated with the equipment of fuel consumption for the wheel loader. According to the data from the literature, consumption varies in an interval of 15 to 23 L/h, which is less than the calculated value. The upper value of the interval, 23 L/h, is therefore used to estimate the GHG of the wheel loader.

Road Vehicles (Concrete Mixer, Truck and Snow Plow)

The fuel consumption due to road transport is estimated according to the horsepower of the engine, estimated according to the data from the literature.

$$Q_{DY} = \frac{P_Y}{C_P} \times 2684{,}5 \times \frac{1000}{10^6}$$

- Q_{DY}: diesel consumption of a vehicle (L/h)
- P_Y: rated horsepower of the engine of equipment Y (hp)
- C_v: calorific value of diesel (38.3 GJ/kL)
- 2684.5: conversion factor of horsepower units (kJ/h/hp)
- 10^6: conversion factor from kJ to GJ
- 1000: conversion factor from kL to L

For the snow plow and the concrete mixers, fuel consumption is estimated according to the number of kilometres travelled in a year. The calculated fuel consumption is therefore divided by the vehicle's average speed.

The diesel consumption by road transport by truck is difficult to quantify. Several parameters must be considered (type of truck used for transport, load transported, etc.). A simplified method therefore was used to do an approximation. As shown in the explanations of the excluded sources, all of the emissions due to road transport of freight are negligible (less than 3%) compared to the project’s total emissions.

Diesel Consumption of Road Vehicles

Equipment type	hp	Diesel (L/h)	Average speed (km/h)	Diesel (L/km)
Snow plow	405	28.4	60	0.47
Concrete mixer	505	35.4	90	0.39
Transport truck	350	24.5		

Forklift Operating on Propane

According to the information on the Supérieur Propane website, the propane volume contained in a tank for a forklift is 29.7 litres and fuel autonomy is about 8 hours. The propane consumption rate is therefore 3.71 L/h.

APPENDIX 2

DETAILED TABLE OF GHG EMISSIONS ACCORDING TO THE PROJECT'S LIFECYCLE – EXPANSION ONLY

ACTIVITY	mt/yr	Construction	Operational										Dismantling		TOTAL
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	
Expansion of the Tailings Management Area	CO_2 eq	2,191	2,191	2,191											6,573
	CO_2	2,170	2,170	2,170											6,510
	CH_4	0.12	0.12	0.12											0.36
	N_2O	0.06	0.06	0.06											0.18
Upgrade of the Transportation Road and Construction of a New Section	CO_2 eq	3,638													3,638
	CO_2	3,603													3,603
	CH_4	0.20													0.20
	N_2O	0.10													0.10
Expansion of the Ore Processing Complex	CO_2 eq	1,250													1,250
	CO_2	1,238													1,238
	CH_4	0.07													0.07
	N_2O	0.03													0.03
Deforestation - equipment	CO_2 eq	73													73
	CO_2	73													73
	CH_4	0.004													0.004
	N_2O	0.002													0.002
Deforestation - loss of carbon sinks	CO_2 eq	5,071													5,071
	CO_2	5071													5,071
	CH_4														
	N_2O														
Ore trucking	CO_2 eq		5,560	5,560	5,560	5,560	5,560	5,560	5,560	5,560	5,560	5,560			55,597
	CO_2		5,506	5,506	5,506	5,506	5,506	5,506	5,506	5,506	5,506	5,506			55,060
	CH_4		0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31			3.08
	N_2O		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15			1.54
Transport of employees	CO_2 eq		0	0	0	0	0	0	0	0	0	0			0
	CO_2														
	CH_4														
	N_2O														
Operation - diesel mobile equipment	CO_2 eq		451	451	451	451	451	451	451	451	451	451			4,150
	CO_2		447	447	447	447	447	447	447	447	447	447			4,466
	CH_4		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02			0.25
	N_2O		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01			0.12
Operation - propane	CO_2 eq		-878	-878	-878	-878	-878	-878	-878	-878	-878	-878			-8,775
	CO_2		-859	-859	-859	-859	-859	-859	-859	-859	-859	-859			-8,589
	CH_4		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.14
	N_2O		-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06			-0.61
Operation - explosives	CO_2 eq		-70	-70	-70	-70	-70	-70	-70	-70	-70	-70			-703
	CO_2		-70	-70	-70	-70	-70	-70	-70	-70	-70	-70			-703
	CH_4														
	N_2O														
Operation - electricity	CO_2 eq		48	48	48	48	48	48	48	48	48	48			484
	CO_2		48	48	48	48	48	48	48	48	48	48			484
	CH_4														
	N_2O														
Operation - generator	CO_2 eq		0	0	0	0	0	0	0	0	0	0			0
	CO_2														

ACTIVITY	mt/yr	Construction	Operational										Dismantling		TOTAL
		Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	
	CH_4														
	N_2O														
Brush clearing maintenance work	CO_2 eq				30			30			30				89
	CO_2				29.28			29.28			29.28				88
	CH_4				0.002			0.002			0.002				0.005
	N_2O				0.001			0.001			0.001				0.002
Closure and rehabilitation of the sites	CO_2 eq												1,855		1,855
	CO_2												1,837		1,837
	CH_4												0.10		0.10
	N_2O												0.05		0.05
ANNUAL TOTAL	**CO_2 eq**	**12,224**	**7,302**	**7,302**	**5,141**	**5,111**	**5,111**	**5,141**	**5,111**	**5,111**	**5,141**	**5,111**	**1,855**		**69,661**
	CO_2	12,155	7,242	7,242	5,101	5,072	5,072	5,101	5,072	5,072	5,101	5,072	1,837		69,138
	CH_4	0.40	0.44	0.44	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.10		3.94
	N_2O	0.20	0.17	0.17	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.05		1.43
Direct and mobile source	CO_2 eq	7,153	8,202	8,202	6,040	6,011	6,011	6,040	6,011	6,011	6,040	6,011	1,855		73,585
	CO_2	7,084	8,123	8,123	5,982	5,953	5,953	5,982	5,953	5,953	5,982	5,953	1,837		72,875
	CH_4	0.40	0.45	0.45	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.10		4.08
	N_2O	0.20	0.23	0.23	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.05		2.04
Direct and fixed source	CO_2 eq	5,071	-948	-948	-948	-948	-948	-948	-948	-948	-948	-948			-4,407
	CO_2	5,071	-929	-929	-929	-929	-929	-929	-929	-929	-929	-929			-4,221
	CH_4		-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01			-0.14
	N_2O		-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06			-0.61
Indirect and fixed source	CO_2 eq,		48	48	48	48	48	48	48	48	48	48			484
	CO_2		48	48	48	48	48	48	48	48	48	48			484
	CH_4														
	N_2O														

QC2-21: ELECTRIFICATION OPPORTUNITY STUDY (ASDR, 2022)

BONTERRA

Bonterra Resources

ASDR

Electrification opportunity for the Bachelor site

Report

20150

Ing.
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2022-06-14

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PROJECT DESCRIPTION:	Electrification opportunity
LOCATION:	Bachelor project and Barry project
ASDR PROJECT N°:	20150
CUSTOMER PROJECT N°:	N/A
OWNER:	Bonterra Resources Inc.

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1 INTRODUCTION

The aim of this study is to respond to the ministry's request: QC-21.

> *“The promoter must present an opportunity study for the electrification of its mining activities. This study will specify the electrical equipment already planned for the project as well as a detailed study of the possibilities of electrification of other project activities. The promoter must also demonstrate and justify which mining activities will not or cannot be electrified.”*

This report presents the analysis of the current operations and the results of the mining electrification opportunity study for the following project:

> Processing project for gold ore from the Barry and Moray projects at the Bachelor site and increase of the milling rate from 800 to 2,400 tonnes per day by Bonterra Resources.

Two areas of opportunity were identified as the best opportunities for electrification of the customer's mining operations since they represent the two main sources of fossil fuel consumption and therefore the greatest potential for improvement.

As such, the study of electrification opportunities focuses primarily on two options: the replacement of propane heating loads by equipment running solely on electricity and the transportation of ore by diesel trucks between the customer’s various sites, namely the Barry and Bachelor/Moray projects.

These two options have been analysed in more detail in the following sections, to demonstrate the potential improvements and the activities that cannot feasibly be electrified at this time.

In addition to this is another electrification option that is presented in section 5 as a recommendation to be explored, namely the electrification of light vans.

2 DESCRIPTION OF THE CURRENT SITUATION

Firstly, the Bachelor/Moray site is currently supplied by two electrical lines, a first substation of a maximum of 1500 kVA supplied from Quevillon and a second substation of a maximum of 5000 kVA supplied from Waswanipi. The customer's consumption for these 2 substations is respectively about 1100 kVA for the Quevillon substation and 3500 kVA for the Waswanipi substation.

The power supply from the two substations is therefore already practically saturated by the customer's mining operations, which explains the earlier choices to use certain non-electric heating loads.

Bonterra Resources plans to add a new 11 MW power line to replace the two existing power supplies that feed the Bachelor/Moray site. The customer expects to use 65% of this power in its mining operations, which will make approximately 4 MW of electricity available to address electrification opportunities, such as replacing some propane heating loads with electric loads.

Also, the Moray mine site has a remaining life of approximately 5 years, which has a major impact on the project’s profitability and the viability of significant changes on the level of the site.

Secondly, the Barry site, located 110 kilometres from the customer's main operating site, is currently not supplied by a power grid.

As such, the opportunities for electrification of the Barry site are dependent on the addition of a nearby 120kV power line. However, the construction of this line does not depend on the customer's projects, but rather on other mining companies and localities in the vicinity that have not yet decided on the construction of such a power line.

3 ELECTRIFICATION OF THE BACHELOR HEATING SYSTEMS

The Bachelor ore processing plant site currently uses propane heating equipment since the electrical supply is limited and electric heating of the entire site is not possible. Thus, the equipment listed in section 3.1 currently operates on propane. This is also the case for the underground ventilation heating system, a 13M BTU installation.

3.1 Current equipment

For this study, the following propane heating loads were estimated:

1. Underground heating
    a. 1 system: 13M BTUs
2. Crusher
    a. 2 systems: 2x 250,000 BTU
3. Refinery
    a. 1 system: 1M BTUs
4. Garage/mechanical workshop
    a. 1 system: 250,000 BTUs
5. Dry house
    a. Wall heating of the dry: 2x 105,000 BTUs
    b. Hot water tanks: 2x 47,000 BTU
    c. Central heating of the dry: 110,000 BTUs
6. Core bank
    a. 1 system 300,000 BTUs
7. Warehouse
    a. Dry house tank: 250,000 BTUs

3.2 Design criteria

The following design criteria were used for the study of electrical loads.

1. In order to make the conversion between propane and electric heating, a factor of 3412.142 BTUs / kW was used.
2. The power factor of the electrical loads has been defined as 1 since they are only heating loads.
3. The current required to supply the loads was calculated at a nominal voltage of 600V.

3.3 Results of the preliminary analysis

The results presented in the following table show the required capacities in kW per building, in order to replace propane heating loads with electric equipment.

These values do not necessarily represent capacities of commercially available equipment, therefore the capacity requirements by sector may be subject to change depending on available products.

Summary				
Section	**Description**	**Propane Power (BTU/H)**	**Electrical power (kW)**	**Average current at 600V (A)**
1	Underground heating	13000000	3810	3666
2	Crushers	500000	147	141
3	Refinery	1000000	293	282
4	Garage	250000	73	71
5	Dry house	414000	121	117
6	Core bank	300000	88	85
7	Warehouse	250000	73	71
	Total	**16 M**	**4605**	**4431**

Table 1: Conversion of power requirements

The main issue for the replacement of these loads with electrical equipment is the available electrical capacity.

Indeed, given the load required to replace all propane heating equipment with electric equipment, certain choices must be made by the customer in order to prioritize the replacement of some components.

As can be seen in the previous table, the replacement of the underground heating alone represents a load of approximately 4MW.

However, in mining projects, this type of equipment typically runs on propane because of the efficiency and amount of electricity required, even for sites with access to a greater electrical capacity.

Furthermore, since this system is already present and functional, and the Moray mine has a remaining lifespan of approximately 5 years, replacing this system would not be cost effective and therefore does not represent a viable electrification opportunity.

The replacement of all other heating loads with electric equipment can be considered and represents a feasible electrification opportunity.

4 TRANSPORTATION OF ORE BY TRUCK BETWEEN BARRY AND BACHELOR

This opportunity represents a large amount of fossil fuel that is currently being used to transport ore by 50-tonne capacity trucks between the customer's various mine sites and its processing plant. Therefore, truck-based transportation of 50 tonnes of ore between sites is a fossil fuel intensive option in a context of increasing processing production at the Bachelor site.

Indeed, the quantity of diesel fuel projected under the maximum production scenario of 2400 tonnes per day is just under 1.8 M L/yr.

4.1 Current customer situation

The Barry mine site is located approximately 110 km from the Bachelor ore processing site, via isolated logging roads. This represents a distance of approximately 220 km round trip, in addition to the distance to the extraction site. Setting aside for now the fact that the Barry site does not currently have access to an electrical power supply, it is not possible to reload the trucks elsewhere than at the Bachelor site.
In addition, trucks are required to travel this distance several times during a single shift.

Long-distance transport on isolated logging roads in very cold climates is a hazard for truckers in case of breakdowns. Replacing fuel trucks with electric trucks would require a large enough battery capacity and immaculate reliability to mitigate possible risks as workers could experience breakdowns in an isolated environment with no available support.

The customer's needs in terms of ore transportation require a truck with a minimum of 300 km of autonomy and impeccable reliability in order to make the round trip between the mining sites and the ore processing plant without any risk of breakdown. In addition, the battery recharge time must be fast enough to allow the truck to make more than one trip during a shift.

Current technologies have also demonstrated a significant loss of charge in winter for electric vehicles, making the range of these vehicles unpredictable, as well as the dangers to which the drivers of these trucks would be exposed on isolated roads.

In addition, these new vehicles bring new technology that requires maintenance by a workforce specialised in these new technologies that is not available locally in this region, but rather in large cities hundreds of kilometres away.

4.2 Options available on the market

There are currently some truck options developed by companies, but only for underground operations. However, the makeup of trucks for underground use is quite different from trucks used on the surface, mainly due to the different working environments between the two sectors and the proximity of the support, which becomes a critical issue on isolated routes.

A prototype truck with a capacity of 40 tonnes is currently being designed in Quebec and should make its first road tests in 2022-2023. Although this truck does not exactly meet the customer's needs, operating trucks with a capacity of 50 tonnes, this advance represents a true innovation and could be extended to larger capacity trucks in the future.

This prototype anticipates the use of a 400 KW/H battery, which is 4 times the capacity of the batteries of electric cars currently on the market, which are of a maximum of 100 KW/This makes it more complicated to replace an entire fleet of diesel trucks with electric trucks because of the immense capacity required by the power line feeding the customer's site.

The information about the 40-tonne truck in design comes from the article written on 10 November 2020 by Normand Gosselin of Électricité Plus magazine.

4.3 Results of the preliminary analysis

As such, while the current market is working in the direction of electrification of mining haulage trucks and has already made huge strides in this area over the past few years, the currently available options are not appropriate for the customer's intended use. Also, the reliability of these trucks is still far from being proven.

The electrification of heavy haulage trucks will therefore be a field of research that should be monitored very closely for the next few years, but in the short term, it is not realistic to consider replacing the fleet of 50-tonne trucks that will transport ore between the customer's various mining sites and its processing plant on remote roads in an area far removed from the workforce specialised in this kind of technology.

In addition, the electrical capacity required to recharge such trucks would be very considerable, and impossible to implement with the customer's current infrastructures.

5 ELECTRIFICATION OPPORTUNITY RECOMMENDATION

5.1 Electrification of light vans

While it is unrealistic to consider replacing the fleet of heavy trucks at this time, the replacement of van-type vehicles could represent a real opportunity for electrification in the coming years.

Indeed, several vehicle manufacturers plan to offer options by the end of 2022 or in 2023. These new vans could help reduce the environmental footprint of the customer’s operations. Most of these new models promise a range of at least 300 km, which would allow the customer to use them for on-site activities but also to travel from one site to another.

However, the market for electric vehicles is in very high demand and delivery times for this type of vehicle can be as long as one year. It goes without saying that the launch of new models of vans may also cause endless delays due to the availability of products.

This solution therefore seems feasible, provided that the van models promised by manufacturers actually see the light of day in the next few years, that the availability of these vehicles improves greatly, and that the reliability of these vehicles is superior to that of current electric vehicles.

5.2 Current customer situation

However, the customer's situation is very different from sites located near cities. Indeed, this new technology would require a skilled workforce to service these vans that the customer does not have, unlike more traditional gasoline-powered vehicles where the customer already has the expertise. It would therefore have to send the vehicles off-site to major cities several hundred kilometres away in order to have major maintenance performed.

The availability of charging stations in the vicinity of the customer’s sites is also very limited. In fact, neighboring towns such as Chapais and Lebel-sur-Quévillon each have about 2 kiosks but are located more than 100 kilometres from the customer's site.

Moreover, as the Barry site is currently supplied with electricity, the customer would only be able to install charging stations at the Bachelor/Moray site. That being said, the Moray site has an operating life of under 5 years.

As such, given that no charging station is available in the vicinity, and that 110 kilometres separate the customer's sites, it is unthinkable to conceive of replacing the customer's fleet of light vans with fully electric vehicles that should travel a minimum of 220 kilometres round trip before being able to charge up, in a very cold climate and on a remote road.

Moreover, the current timeframes would not allow the customer to obtain this type of vehicle for several months, even years.

Also, as in the case of heavy trucks, a study of the electrical network would be required in order to ensure that the capacity of the power line would be large enough to allow the installation of charging stations that are sufficiently efficient in terms of charging the vans since, for the moment, the customer's electrical supply is already very limited at the Bachelor/Moroy site, and non-existent at the Barry site.

6 CONCLUSIONS

In conclusion, the Bachelor/Moray and Barry sites do present some electrification opportunities that are feasible in the medium to long term, although in all cases, the capacity of the power supply line represents a major constraint. The addition of a 120kV line in the vicinity would give the customer more alternatives, but the addition of this line is not dependent on Bonterra Resources, the customer.

As such, some propane heating loads can indeed be replaced by electric loads once the customer's new 11MW power line is in place. Replacing underground heating with electric heating is not feasible and is not economical for reasons of efficiency and electrical capacity.

With respect to inter-site transport by trucks with a capacity of 50 tonnes, electrification of this sector is unrealistic at this time due to the lack of options available on the market and the potential danger for workers travelling on isolated roads. Some stakeholders are currently working on developing electric trucks, but these changes are not for the near future.

As for the fleet of light vehicles, such as vans, the technology is just beginning to prove itself in urban locations, but while already showing failures such as drastic charge loss in winter. Moreover, for an isolated region such as the one where the customer's sites are located, where the infrastructures are very limited, the replacement of gasoline vehicles with electric vehicles poses a huge risk to the safety of the users of these vehicles and to the viability of this change. Also, the specialised maintenance of these vehicles requires skilled labour that is not present in the region, so the vehicles will have to be sent outside to perform this maintenance.

Ultimately, until technology improves and a new power line is built in the vicinity of the customer's sites, the customer can make some modifications to the propane heating system. However, the electrification of its other mining activities is not currently being considered, but may be reconsidered in the future when there is a new power line, charging stations around the sites, a workforce specialised in electric vehicles and when the technology has improved.

QC2-22: SOIL CHARACTERIZATION REPORT (GCM, 2022)

Val-d'Or (Quebec)

BACHELOR SITE

SOIL CHARACTERIZATION REPORT

ENV0266-1514-00

GCM Reference N°: 20-0696-0266

2022-07-07

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C. Sampling plans

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1.0 BACKGROUND

As part of the environmental and social impact assessment and review process under Title II of the Environmental Quality Act for the Barry and Moroy gold ore processing project at the Bachelor site and the milling rate increase, a first set of questions dated May 2020 was submitted to Bonterra. All of the questions were answered through a response document sent to the COMEX on 2 November 2020, as well as an addendum document to the response document sent to the COMEX during the week of 15 March 2021. Some questions asked Bonterra to take actions between now and the filing of the application for authorization under Section 22 of the EQA. One of them, specifically QC-53, indicates that an environmental characterization study must be provided for all of the sectors targeted by the proposed expansion, development, construction or repair work. The characterization study had to be carried out in accordance with the *Land Characterization Guide* and take the history of use into consideration (Environmental Site Assessment – ESA – phase I). The purpose of this characterization report is therefore to describe the soil sampling work and its results.

2.0 OBJECTIVES

According to Appendix III of the *Règlement sur la protection de la réhabilitation des terrains*, gold ore mining (NAICS code 21222) is an activity that is likely to contaminate soil and groundwater. As such, during construction, development and/or repair of facilities, environmental characterization of the soil is notably intended to ensure the proper management of the excavated materials (soil/overburden). The project to process gold ore and increase the milling rate of the Barry and Moroy projects at the Bachelor site includes the addition of certain infrastructures on the mine site (e.g. tanks, conveyors, etc.), the construction of a new access to the west, the expansion of existing infrastructures (e.g. ore stockpiles, tailings management area) and the construction of a new overburden dump. Environmental characterization of soils is therefore required to ensure that soils are properly managed and that permanent installations are not built on contaminated soils beyond the regulatory limits applicable to the site depending on the activity. Another objective of the study is to describe the quality of the soils around the operations before the expansion of the site and the increase of the milling rate. Particular attention was also paid to the validation of airborne contamination risks.

3.0 METHODOLOGY

3.1 Sampling strategy

In order to establish the sampling strategy, the following documents were consulted:

- Environmental site assessment phase I (GCM Consultants, 2021) – Appendix A:

  This document identifies the risks of contamination in the sectors where the redevelopment work will be carried out, namely: the presence of backfill of unknown nature, airborne contamination from past and present mining operations (including the ore processing plant and tailings management area) and the presence of ore stockpiles.

- Plans of the proposed infrastructures - Appendix B :

  Identifies areas where excavation and permanent infrastructures will be erected.

The sampling methodology is based on the *Guide de caractérisation des terrains* (Publications du Québec, 2003).

In order to validate the quality of the soils in the sectors targeted by the work, two (2) approaches were applied, namely:

- Sampling in six (6) trenches (TR) on the mine site in the sectors of the projected infrastructures likely to require excavation:
  - Composite sampling of the trench wall for each distinct backfill stratum.
  - The analytical parameters were metals, cyanide, sulphur, petroleum hydrocarbons ($C_{10}C_{50}$), polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds.
- Surface sampling on the periphery of the mine site in areas affected by work by means of a manual auger or round shovel, i.e. twenty-four (24) ST stations:
  - Spot sampling on the surface.
  - All samples were taken from a depth of more than 5 centimetres.
  - The analysis parameters for this monitoring will be:
    - Metals and sulphur for all samples.
    - Petroleum hydrocarbons ($C_{10}C_{50}$) and polycyclic aromatic hydrocarbons (PAH) for every other station.
    - Cyanide for all surface samples (0-5 cm).
    - When the concentration of HP C_{10}-C_{50} is below the detection limit, at least 10% of the samples should be analyzed for VOC.As such, VOC analysis was performed on three samples.

  - Sampling of the surface layer of mineral soil (0-5 centimetres) on eleven (11) stations distributed throughout the study area in order to validate the potential impact of airborne contamination. These samples were analyzed for metals, sulphur and cyanide determined by the nature of the activity taking place on the site, i.e. the extraction and processing of gold ore.

All samples were taken in accordance with the *Guides d'échantillonnage à des fins d'analyses environnementales of the Centre d'expertise en analyse environnementale du Québec* (MDDEP 2008 and 2010). The VOC analysis was also conducted in accordance with *Section 5.3.3 Échantillon pour l'analyse des composés organiques volatils* Update (MDDELCC, 2016).

The location of the sampling stations is shown in the plans attached in Appendix C.

3.2 Cleaning of sampling tools

In accordance with the methodology identified in the *Guide d'échantillonnage à des fins d'analyses environnementales : Cahier 1 – Généralités* (MDDEP, 2008), the tools used to collect the samples were cleaned prior to sample collection following these steps:

- Rinse with 10% nitric acid (HNO3).
- Three (3) rinses with purified water.
- One (1) acetone rinse, two (2) hexane rinses, then one (1) more acetone rinse.
- Rinse with purified water to remove all traces of acetone and drain off excess.

The usual precautions and the use of appropriate PPE were observed when handling the solvents. All washing residues were recovered for storage, transportation and disposal according to the applicable laws and regulations.

3.3 Description of the samples

Each sample was accompanied by a field description of the particle size composition of the soil based on visually estimated particle size, as well as all details relevant to a proper description of the sample such as soil colour, presence of visual clues of contamination, presence of any non-soil material or any other item deemed appropriate.

The description of the environment in which the sample was collected was also noted with all relevant details. For each collected sample, the information was recorded on a descriptive sheet, in accordance with the methodology identified in the *Guide d'échantillonnage à des fins d'analyses environnementales : Cahier 5 – Échantillonnage des sols* (MDDEP, 2010). The description sheets are presented in Appendix D.

3.4 Laboratory analysis

All chemical analyses on the soil samples were performed by a laboratory accredited by the MELCC, signed by chemists who are members of the Ordre des chimistes du Québec.

The analytical program for soils was determined on the basis of the contaminants that may be present on the site, the use of the site, and the recommendations of the *Guide de caractérisation des terrains*. Details of the analytical program are presented in Section 3.1 of this report.

The analysis certificates are available in Appendix E.

3.5 Storage of samples

Once collected, the soil samples were kept cool at approximately 4°C using a cooler and ice packs in compliant, airtight containers and, as much as possible, protected from light. They were properly packaged and transported to the laboratory.

3.6 Quality assurance and quality control (QA/QC)

A quality assurance/quality control (QA/QC) program for analytical results was applied during this field characterization. The quality controls include duplicate analyses on 10% of the samples to assess the replicability of the measurements. A field blank was also conducted for VOCs. Method blank analyses were also performed in the laboratory to detect possible contamination of samples during laboratory processing and reference material analyses to determine the accuracy of the obtained values.

4.0 RESULTS

4.1 Surveys

A total of six (6) observation trenches and twenty-four (24) soil survey sites were targeted for this study. These were strategically located to cover the highest risk areas and the risk assessment of airborne contaminants from activities performed on the site. The trenches were made with a Komatsu PC 290 LS backhoe (TR-01 to TR-06), while surface surveys were carried out manually with a hand auger or round shovel (ST-07 to ST-30).

4.2 Sampling

The soil sampling campaign was carried out from 9 to 11 November 2021 by Christine Beaumier and Stéphany Paquin-Desjardins.

The trenches were cut in the previously identified risk sectors in order to obtain a better overall view of the contamination potential and the general stratigraphy, over a larger surface. At each of the trenches, composite samples were taken at distinct depths according to the stratigraphy of the soils.

Surface sampling on the periphery of the mine site in the sectors targeted by the work was done using a hand auger or round shovel, for a total of twenty-four (24) stations ST. Sampling of the surface layer of mineral soil (0-5 centimetres) was also conducted at eleven (11) stations throughout the study area so as to validate the potential impact of airborne contamination.

A photographic report of the different areas sampled is presented in Appendix F.

4.3 Soil stratigraphy

In general, the stratigraphy encountered during the trench (TR) surveys is as follows:

1. A layer of surface gravel (0-40 cm).
2. A layer of gravel, brown sand and pebbles with an average thickness of 80 cm.
3. Followed by a layer of brown sand with pebbles up to 150 cm, the maximum depth reached in the trenches.
4. A natural mineral horizon consisting mainly of clay (TR-01 to TR-03), but also sometimes of silty sand (TR-04) or even gravelly sand (TR-05).
5. The bedrock was reached at 40 cm (TR-06).
6. Angular blocks are present in the 100 cm to 150 cm horizon (TR-02).

With regard to surface sampling, the stratigraphy encountered during the manual surveys (ST) is as follows:

1. A typical layer of fibric OM on the surface (0-10 cm).
2. Followed by a layer of varying grey sand (10-20 cm).

3. Finished with a layer of grey sand sometimes silty and varying orange (20-40 cm).
4. Typical soils of a Podzol.
5. At station ST-8, below the fibric OM layer (0-5 cm), a brown sand layer with gravel (0-3/4) and pebbles was observed (5-40 cm). The source could be backfill.
6. At station ST-9, the presence of brown sand and pebble backfill was observed in the horizon (0-30 cm).
7. At station ST-12, the soil encountered is of anthropogenic origin, a layer of orange-brown sand with gravel (0-3 cm), followed by a layer of grey sand and gravel with many pebbles (3-30 cm).
8. At station ST-27, the soil encountered is of anthropogenic origin, a layer of orange-brown sand with gravel (0-5 cm), followed by a layer of grey sand and gravel (5-35 cm). The rock was reached at 35 cm.
9. At station ST-28, rock was reached at 28 cm, preceded by a layer of orange silty sand (0-28 cm).
10. At station ST-11, a water inflow was observed when the sample reached the rock, at 40 cm.

4.4 Generic criteria for soils

The generic soil criteria in the *Guide d'intervention – Protection des sols et réhabilitation des terrains* (Beaulieu, 2019) are used to assess the extent of contamination and to set decontamination goals for a given use. Criteria B and C of the *Guide d'intervention correspond respectively to the values of Appendices I and II of the Règlement sur la protection et la réhabilitation des terrains* (RPRT).

Criteria A, B and C are defined as follows:

1. **Criterion A:** Background levels for inorganic parameters and quantification limits for organic parameters.
2. **Criterion B:** The maximum acceptable limit for residential lots or lands where certain institutional uses can be found (primary or secondary educational institutions, daycare centres, hospitals, residential and long-term care centres, rehabilitation centres, child or youth protection centres, detention centres) and the first metre of play areas in municipal parks.
3. **Criterion C:** Acceptable limits for industrial, commercial, non-sensitive institutional and recreational lands (bicycle paths and municipal parks, except for the first metre of play areas), as well as those intended to form the base of a roadway or sidewalk along the edge of a roadway.

The limit values that are therefore applicable are the standards of Appendix II of the RPRT, corresponding to criteria C of the *Guide d'intervention based on the maintenance of the current industrial use* taking place on the mine project site. It should be noted that upon closure of the project, the site will be subject to a closure and redevelopment plan (restoration plan).

4.5 Analysis results

The analytical results obtained for the soil samples collected in the 2021 campaign are presented in Table 1 below. The results were compiled by Mrs. Stéphanie Marchand and verified by Mrs. Jessica Morin of GCM Consultants.

For the exploratory trenches (TR) and sampling stations (ST), all forty-one (41) samples and for all analytical parameters, the results are lower than criterion C of the *Guide d'intervention* and the limit value of Appendix II of the RPRT.

For the analytical parameters related to industries for contamination with petroleum products (C10-C50, VOCs and PAH), the analytical results are all below criterion A. No visual or olfactory signs of contamination were observed during soil sampling in the exploratory trenches and sampling stations.

With regard to metals, the analytical results are all below criterion A (<A) for the following parameters, Ba, Cd, Cr, Sn, Hg, Ni and Zn.

The parameters with results in the B-C range are as follows:

- **Ag** (1) : TR-06(30)
- **Co** (1) : TR-04(100)
- **Mn** (1) : TR-04(100)
- **Se** (4): TR-02(100), TR-04(100), TR-05(100), ST-09(5-20)

The parameters with results in the A-B range are as follows:

- **CN$_t$** (1) : TR-01A(80)
- **As** (1) : TR-01A(80)
- **Cu** (3) : TR-03(100), TR-04(100), TR-05(100)
- **M0** (2) : ST-18 (5-20), TR-04(100)
- **Pb** (1): TR-04(100)
- **S$_t$** (12) **:** ST-08(5-20), ST-09(0-5), ST-10(5-20), ST-13(5-20), ST15(5-20), ST-16(5-20), ST-21(0-5), ST-21(5-20), ST-22(5-20), TR-02(100), TR-03(100), TR-04(100)
- **Se** (14): ST-07(0-5), ST-08(5-20), ST-09(0-5), ST-12(5-20), ST-13(0-5), ST-13(5-20), ST-15(5-20), ST-16(5-20), ST-21(0-5), ST-21(5-20), ST-27(0-5), ST-29(5-20), TR-01A(80), TR-03(100)

A cyanide concentration of 3.1 mg/kg, i.e. in the A-B range, is noted for trench TR-01, which is located in the area of the ore processing plant, where cyanide is used in the process. The addition of tanks is planned in this area.

Values above Criterion A are also noted for several parameters in Trench TR-04. The latter is located in an area of the site where various storage activities have taken place. This area will be dedicated to the location of the future ore stockpile.

4.6 QA/QC program

The H2lab laboratory performed the request analyses in the context of this soil characterization by referring to the Liste des méthodes suggérées pour la réalisation des analyses en laboratoire and the Liste des méthodes d'analyse relatives à l'application des règlements découlant de la Loi sur la qualité de l'environnement published by the MELCC. The detection limits were found to be below the applicable quality criteria. The laboratory has its own QA/QC program. The results of this verification will be included in the analysis certificates presented in Appendix E. The examination of the analysis certificates shows that all the quality controls give results within the analytical performance criteria. That indicates that the quality of the results conforms to the expectations. All the method blank measurements gave results below the detection limit. All the analyses of reference materials revealed that the measurements were over 80% accurate, within the analytical performance criteria. Control samples (field duplicates) were taken at 10% of the total number of samples to verify replicability and accuracy of results. As such, since forty-one (41) samples were collected, four (4) samples underwent duplicate analysis.

Comparison of observed concentrations between soil samples DUP-1, DUP-2, DUP- 3, DUP-4 and their respective samples ST-16(5-20), TR-06(30), ST-07(0-5) and ST-28(5-20) identified that the deviations between the duplicate and the samples are generally less than 30%, which is the expected deviation considering the variability of the distribution of parameters in a soil. For some parameters, the deviation was greater than 30%, but the results are still below criterion A. Other deviations greater than 30% and above criterion A were observed for selenium at DUP1 and DUP3, and for silver at DUP2.

In general, the results from the QA/QC program confirm the replicability and accuracy of the analyses, both in the laboratory and in the field.

Table 1: Results

Parameters	Results (mg/kg)																																													Soil criteria (mg/kg) *		
	Sampling station																																	Trench													
	ST-07 (0-5)	ST-07 (5-20)	ST-08 (5-20)	ST-09 (0-5)	ST-09 (5-20)	ST-10 (5-20)	ST-11 (0-5)	ST-11 (5-20)	ST-12 (5-20)	ST-13 (0-5)	ST-13 (5-20)	ST-14 (5-20)	ST-15 (0-5)	ST-15 (5-20)	ST-16 (5-20)	ST-17 (0-5)	ST-17 (5-20)	ST-18 (5-20)	ST-19 (5-20)	ST-20 (5-20)	ST-21 (0-5)	ST-21 (5-20)	ST-22 (5-20)	ST-23 (0-5)	ST-23 (5-20)	ST-24 (5-20)	ST-25 (0-5)	ST-25 (5-20)	ST-26	ST-27 (0-5)	ST-27 (5-20)	ST-28 (5-20)	ST-29 (5-20)	ST-30 (5-20)	TR-01-A (80)	TR-01-B (100)	TR-02 (10	TR-03 (100)	TR-04 (1	TR-05 (1	TR-06 (3	DUP 1 ST-16 20)	DUP2 TR-06	DUP 3 ST-07 (0-5)	DUP 4 ST-28 (5-20)	Criteri A	Criteri B	Criteri C
# H2Lab certificate	RNC34175	RNC34176	RNC34172	RNC34193	RNC34174	RNC34195	RNC34194	RNC3277	RNC34192	RNC34162	RNC34163	RNC34190	RNC34159	RNC34160	RNC34157	RNC34155	RNC34156	RNC34154	RNC34153	RNC34152	RNC34179	RNC34178	RNC34151	RNC34181	RNC34180	RNC34182	RNC34184	RNC34183	RNC34238	RNC34188	RNC34187	RNC34186	RNC3418	RNC341 1	RNC341 4	RNC341 5	RNC341 9	RNC341	RNC341	RNC341 0	RNC341 7	RNC341	RNC341 6	RNC341	RNC341	-	-	-
Humidity (%)	-	21.92	-	-	4.46	-	-	22.65	-	-	31.46	-	-	25.55	-	-	19.68	-	15.15	-	-	19	-	-	25.1	-	-	26.71	-	-	5.49	-	28.86	-	2.54	3.35	5.31	1.82	6.93	4.41	4.02	-	4.39	22.69	-	-	-	-
Petroleum hydrocarbons C10-C50	-	<100	-	-	<100	-	-	<100	-	-	<100	-	-	<100	-	-	<100	-	<100	-	-	<100	-	-	<100	-	-	<100	-	-	<100	-	<100	-	<100	<100	<100	<100	<100	<100	<100	-	<100	<100	-	100	700	3500
Metals																																																
Silver (Ag)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	34	<2	<2	<2	<2	2	20	40
Arsenic (As)	1.78	3.16	3.24	4.94	4.54	2.92	1.04	1.28	1.97	2.24	1.87	1.95	1.9	3.06	<0.05	<0.05	<0.05	<0.05	0.93	1.95	1.67	1.77	1.42	2.07	2.29	1.37	<0.05	<0.05	3	0.9	0.2	0.28	2.43	2.55	23.48	1.27	2.26	4.45	4.11	3.17	2.85	<0.05	2.73	1.42	<0.05	6	30	50
Barium (Ba)	19.47	31.25	19.03	57.95	56.58	89.26	19.48	11.78	21.1	33.86	31.02	24.45	9.43	39.36	11.96	5.27	8.67	12.22	7.59	8.91	7.94	8.48	10.66	13.28	20.45	11.29	11.96	9.39	15.92	22.68	17.98	16.47	41.11	46.71	33.15	21.73	85.14	96.93	54.04	40.3	63.39	12.82	58.73	14.74	16.4	340	500	2000
Cadmium (Cd)	<0.005	0.05	0.02	<0.005	<0.005	0.03	0.13	0.06	0.08	0.12	0.03	0.03	0.1	0.12	0.1	0.05	0.13	<0.005	0.13	0.03	0.03	<0.005	0.13	0.03	<0.005	<0.005	0.03	0.08	0.19	0.01	0.08	0.08	0.08	0.11	<0.005	0.03	0.1	0.03	0.02	<0.005	0.22	0.05	0.1	<0.005	0.01	1.5	5	20
Chromium (Cr)	11.47	33.79	23.16	31.56	30.21	66.9	6.54	5.42	14.94	31.56	31.25	19.27	10.71	44.64	32.76	2.42	12.25	10.58	10.87	9.23	13.91	30.28	16.21	15.96	21.1	14.24	14.68	20.47	27.98	19.69	18.42	20.69	36.6	42.21	17.78	15.82	31.78	52.03	19.31	29.94	30.3	32.17	30.12	12.78	20.51	100	250	800
Cobalt (Co)	7.79	5.62	6.61	9.08	10.05	10.45	0.47	0.3	4.07	3.64	3.49	3.85	0.92	5.63	3.34	0.08	0.8	2.17	1.13	0.46	0.46	2.43	1.2	1.86	3.2	1.27	1.8	1.89	4.26	5.88	4.58	3.97	4.59	6.61	7.28	3.69	11.13	14.34	54.28	8.55	9.59	3.1	8.62	1.26	3.94	25	50	300
Copper (Cu)	<5	8	21	40	40	16	8	5	10	<5	<5	9	<5	5	5	<5	<5	<5	<5	<5	<5	5	<5	<5	<5	<5	<5	6	12	23	18	11	9	8	28	9	42	73	92	56	37	6	29	<5	13	50	100	500
Tin (Sn)	<0.05	<0.05	<0.05	<0.05	<0.05	0.57	0.31	0.34	<0.05	0.11	0.25	<0.05	0.41	0.25	<0.05	<0.05	<0.05	<0.05	0.22	<0.05	<0.05	<0.05	0.3	<0.05	<0.05	0.13	<0.05	<0.05	2.64	<0.05	<0.05	<0.05	<0.05	0.31	0.85	<0.05	0.13	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	5	50	300
Manganese (Mn)	108.42	195.05	236.87	283.46	293.16	339.78	50.93	43.77	150.62	118.97	126.15	142.97	41.91	152.3	122.52	11.63	33.46	59.99	42.32	16.54	30.37	70.88	31.28	56.04	89.01	62.88	71.58	58.84	109.04	197.1	143.23	143.05	181.31	246.79	237.73	110.66	372.74	431.61	1217.2	276.89	313.74	96.46	264.1	84.75	151.89	1000	1000	2200
Mercury (Hg)	0.02	0.06	0.06	0.01	<0.01	0.03	0.03	0.02	<0.01	0.05	0.03	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	0.07	0.07	0.04	0.02	0.04	0.04	0.06	0.06	<0.01	<0.01	0.03	0.13	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.03	0.2	2	10
Molybdenum (Mo)	0.42	0.49	0.75	0.11	0.05	0.2	0.85	1.06	0.21	0.49	0.53	0.46	0.33	0.47	0.29	0.12	0.26	7.16	0.14	0.16	0.28	0.37	0.36	0.93	1.52	0.33	0.47	0.25	0.21	0.15	<0.05	0.1	1.32	0.35	0.8	0.11	1.26	1.57	6.16	0.13	0.14	0.43	0.19	0.42	0.34	2	10	40
Nickel (Ni)	3.67	15.04	14.81	21.73	23.1	31.18	1.51	1.92	9.4	9.6	8.42	8.4	2.41	13.94	4.1	<0.05	<0.05	2.51	0.08	<0.05	2.76	8.94	1.92	5.91	10.16	4.09	6.1	7.64	14.73	13.5	11.2	10.88	12.57	17.65	13.74	7.88	20.03	37.8	48.18	20.51	20.39	4.36	20.19	3.95	10.2	50	100	500
Lead (Pb)	5.92	5.59	5.55	3.75	2.69	10.44	8.86	8.17	24.76	6.41	6.31	17.03	6.29	5.97	3.15	1.49	3.62	2.8	3.57	3.37	5.42	2.75	7.8	3.05	2.49	5.23	9.05	9.84	2.82	5.88	3.36	5.39	10.59	7.47	7.98	1.11	18.15	9.71	75.59	2.69	3.19	2.71	2.65	5.75	5.53	50	500	1000
Selenium (Se)	1.98	<0.05	1.44	2.82	4.38	0.51	<0.05	<0.05	1.93	1.15	2.75	0.5	0.18	1.12	2.5	<0.05	<0.05	<0.05	<0.05	<0.05	1.05	2.47	<0.05	0.95	<0.05	<0.05	0.9	<0.05	<0.05	2.42	0.93	0.99	1.01	<0.05	1.71	0.69	3.01	2.82	6.48	3.84	<0.05	0.96	0.19	1.51	<0.05	1	3	10
Sulphur (%)	0.021	0.029	0.045	0.05	0.02	0.054	0.03	0.023	0.025	0.036	0.044	0.027	0.021	0.06	540	180	210	190	200	370	480	530	480	280	330	260	230	390	290	310	180	250	280	250	135	190	710	660	487	230	220	-	-	-	-	400	2000	2000
Total cyanides (CNt)	<0.1	-	-	<0.5	-	-	<0.5	-	-	<1.5	-	-	<0.5	-	-	<0.5	-	-	-	-	<0.5	-	-	<0.5	-	-	<0.5	-	-	<0.5	-	-	-	-	3.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-	-	-	2	50	500
Zinc (Zn)	1.87	21.9	32.46	26.05	26.62	43.4	<0.05	<0.05	18.92	20.2	20.86	25.29	8.4	36.87	18.13	0.65	4.43	13.8	6.89	3.9	<0.05	6.81	7.2	<0.05	2.46	<0.05	2.7	5.39	33.66	37.52	24.19	15.95	23.53	26.25	44.28	13.46	52.01	57.97	83.34	24.24	37.55	17.35	34.48	0.48	17.71	140	500	1500
Volatile organic compounds (VOCs)																																																
1,1,1-trichloroethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,1,2,2-tetrachloroethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,1,2-trichloroethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,1-dichloroethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,2-dichlorobenzene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	1	10
1,2-dichloroethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,2-dichloroethene (total)	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,2-dichloropropane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,3-dichlorobenzene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	1	10
1,3-dichloropropene (cie and trans)	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
1,4-dichlorobenzene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	1	10
Benzene	-	<0.1	-	-	-	-	-	-	-	-	-	-	-	<0.20	-	-	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-	-	-	<0.1	-	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	-	-	0.2	0.5	5
Chlorobenzene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	1	10
Chloroform	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
Vinyl chloride	-	<0.03	-	-	-	-	-	-	-	-	-	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	<0.03	-	-	-	-	-	-	-	-	-	<0.03	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	-	-	0.4	0.02	0.03
1,1-Dichloroethene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-			
Dichloromethane	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.3	5	50
Ethylbenzene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
Styrene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
Tetrachloroethene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.40	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.3	5	50
Carbon tetrachloride	-	<0.10	-	-	-	-	-	-	-	-	-	-	-	<0.20	-	-	-	-	-	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	-	-	0.1	5	50
Toluene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.4	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	3	30
Trichloroethene	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.4	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.2	5	50
Total xylenes	-	<0.2	-	-	-	-	-	-	-	-	-	-	-	<0.4	-	-	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-	-	-	-	<0.2	-	<0.20	<0.20	<0.20	<0.20	<0.20	-	<0.20	-	-	0.4	5	50

CHEMICAL ANALYSIS RESULTS FOR SOIL SAMPLES (continued)

Parameters	Results (mg/kg)																																													Criterion A	Criterio B	Criterio C
Polycyclic aromatic hydrocarbons (PAH)																																																
Benzo (a) pyrene-d12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene-d12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene-d10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7,12-Dimethylbenzoanthracene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Acenaphthylene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
Anthracene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
Benzo (a) anthracene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Benzo (a) pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Benzo (b, j, k) fluoranthene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Benzo (c) phenanthrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Benzo (g,h,i) perylene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Chrysene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Dibenzo (a,h) anthracene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Dibenzo (a,i) pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Acenaphthenes	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
Dibenzo (a,l) pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
2,3,5-Trimethylnaphthalene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	-	-	-
Fluoranthene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
Fluorene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
Indeno (1,2,3 cd) pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
3-Methylcholantrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Dibenzo (a,h) pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
Naphthalene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	5	50
Phenanthrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	5	50
Pyrene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	10	100
1-Methyl Naphthalene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
2-Methyl Naphthalene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	0.1	1	10
1,3-Dimethylnaphthalene	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	-	<0.10	-	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	-	-	-

Updated on 3 January 2022 - Stéphanie Marcha

5.0 CONCLUSION

At the end of the characterization of the soils performed as part of this study, it was noted that all samples taken in the observation trenches and the sampling stations for the soils are below criterion C of the *Guide d'intervention* and the limit value of appendix II of the RPRT, which is the acceptable limit for industrial grounds.

For petroleum hydrocarbons (C10-C50), PAH and VOCs, all collected samples were below the detection limit. No visual or olfactory signs of contamination were observed at the various sampling points.

Higher metal values may be associated with higher natural local background levels. With regard to selenium and sulphur, considering that both the surface and lower horizons have values exceeding criterion A, the assumption of a higher local natural content is preferred. This could be related to the geological context of the study area. It should be noted, however, that no sources of selenium or sulphur contamination from site activities were identified in the Phase I Environmental Site Assessment.

6.0 LIMITATIONS OF THE STUDY

It is expressly understood by the customer that the information contained in this report has been prepared for the specific purpose of the mandate granted. GCM Consultants can at no time be liable for the use of information contained in the report relative to third parties wishing to avail themselves of such information for similar or other purposes. Any third party relying on the information contained herein must understand its limitations and update the report at its own expense. GCM Consultants accepts no professional responsibility for any damages suffered by a third party as a result of a decision made or action taken on the basis of this report.

This soil characterization, conducted on behalf of Bonterra (hereafter referred to as the "Customer"), is strictly confidential. As such, GCM Consultants Inc. is not responsible for any third-party use of this report without its written authorization and that of the customer.

The reproduction of this report will not be allowed before and unless a written authorization has been obtained from the customer, a copy of which will be forwarded to GCM Consultants. This reproduction of the report must include all figures, illustrations and data recorded in the report in order to be considered complete.

GCM wishes to emphasize that these conclusions are based on the information contained in this report and are valid only for the period under review. It is understood that this assessment cannot take into consideration the outcome of activities not identified in the Phase I environmental assessment or field characterization.

The interpretation of the collected data and the issuance of comments and recommendations are based on our experience and according to the policies, criteria and regulations in force in the province of Quebec.

The environmental assessment paints a picture of the property at a specific point in time. The characterization results are therefore representative of the sampling undertaken in November 2021 on the basis of the risk areas identified in the Phase I ESA and the future locations of the proposed mining infrastructures.

GCM Consultants has no interest in the property that is the subject hereof. The visit to the property was conducted in a manner that ensured the health and safety of the GCM Consultants audit team. With this in mind, all safely accessible locations were visited.

This site soil characterization does not apply to environmental auditing and environmental management systems, which are covered by separate CSA standards.

The results and conclusions regarding soil contamination are based solely on the scope of the observations and information gathered during the Phase I ESA and the sampling conducted as part of the soil characterization of the site.

7.0 REFERENCES

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BONTERRA

Desmaraisville (Quebec)

Environmental site assessment – Phase I – BACHELOR MINE SITE, 200, CHEMIN DE LA MINE, DESMARAISVILLE (QUEBEC)

ESA REPORT - PHASE I

ENV0266-1503-01

GCM CONSULTANTS

GCM Reference N°:20-0696-0266

Stéphanie Marchand 2022.06.29

Prepared by: Stéphanie Marchand, Tech.
Environnement GCM
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Valérie Fortin 2022.06.29

Verified by: Valérie Fortin, Eng. OIQ N°:5016764
GCM Consultants

Revision	Issuance	Date
01	**FINAL**	**2022.06.29**

GCM
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29 June 2022

Mr. Steve Gaudreault
Ressources Bonterra Inc.
200, chemin de la Mine
Desmaraisville (QC) J0Y 1H0

Subject: **Environmental site assessment – Phase I – Bachelor Mine Site,**
200, CHEMIN DE LA MINE, DESMARAISVILLE (QUEBEC)
GCM ref. n°: **20-0696-0266**

Mr. Gaudreault,

I am enclosing the Phase I environmental assessment report for the property mentioned in the subject line.

I hope that you will find it compliant to your needs, and entirely satisfactory. Sincerely,

Valérie Fortin

Valérie Fortin, Eng., Project manager
GCM Consultants

SUMMARY

Customer	Bonterra Resources Inc. (Bonterra)	
Owner of the lots and property titles	• The mine site is formed by lots 6,096,775, 6,098,140, 6,098,141 and 6,098,128 of the Quebec land registry as well as by a portion of territory not listed in the land registry. The lots are the property of the Government of Quebec, Ministry of Energy and Natural Resources. • Bonterra holds a mining concession (CM-510) and a mining lease (BM-1025).	
Location	200, chemin de la mine, Desmaraisville (Québec) J0Y 1H0	
Coordinates	49°29'52.02 "N, 76°8'43.65 "W	
History of activities and infrastructures on the study site	• Discovery of the Bachelor deposit in 1946. • Construction of the infrastructures in 1980 and start of commercial production in 1982. • Exploitation of the Bachelor deposit from 1982 to 1989. A temporary stop in 1987 occurs in order to continue the sinking of the well. • Extraction of a small quantity of ore (not reported) in 1992, then flooding of the mine. • Dewatering of the mine in 2003 and 2004. • Resumption of operation from 2007 to 2018.	High risk potential due to the performance, on the property, of an activity described in appendix 3 of the Land Protection and Rehabilitation Regulation
Adjacent properties	The environment surrounding the Bachelor mine property is mostly wooded. A camp belonging to Bonterra is present at approximately 2 kilometres from the mine site. This camp is used to house and feed the mine employees. Also, to the north of the camp, is the former Coniagas polymetallic mine and tailings management area. This mine was operated from 1961 to 1967, but is now inactive.	No risk detected due to the distance between the camp site and the former Coniagas mine site.
Directory of Soil and Industrial Waste Deposits	The Bachelor Mine tailings management area is listed in the Directory of Soil and Industrial Waste Deposits. The nature of the contaminants in this listed management area is available cyanide (CN-) and various metals.	Potential high risk as the tailings management area is still active.
Directory of contaminated lots	According to the directory of contaminated lots, no contaminated land is present within a 1 km radius of the study site.	No risk detected.

Directory of petroleum equipment sites	Two oil tanks are listed in the directory of petroleum equipment sites for the site under study.	Medium potential risk due to the presence of petroleum hydrocarbon tanks.
Activities on the site	The Bachelor mine site includes galleries and underground worksites accessible by a mining shaft. The ore is brought to the surface and processed at the Bachelor or processing plant, while the tailings are routed to the tailings management area. The mine site also includes ore stockpiles, administrative offices, hoist room and headframe, various propane, diesel and hydrocarbon tanks, a parking lot, a core bank and a core deposit area.	Hi potential risk due to the type of activity performed, which is listed in Appendix 3 of the Land Protection and Rehabilitation Regulation
Stains on the floor or traces of contamination	A few oil stains were observed on the ground in the traffic and parking lanes. The Bonterra mining complex appears to be built on backfill from an unknown source.	Medium potential risk due to the unknown nature of the backfill.

CONCLUSION AND GENERAL RECOMMENDATIONS

In view of the obtained information, GCM Consultants inc. (GCM) concludes that the Bachelor mine site, designated by lots 6,096,775, 6,098,140, 6,098,141 and 6,098,128 of the Quebec land registry and by a portion of territory not listed in the land registry as well as by mining concession CM-150 and mining lease BM-1025 reveal, by the nature of the past and current mining activities, indications of potential contamination and recommends that a Phase II environmental site assessment be performed at the time of the closure and restoration of the site.

The objective of the Phase 1 ESA was to determine if there was a risk that the soils having to be excavated during construction, development and/or redevelopment of the installations for the project to increase the milling rate and ore processing of the Barry and Moroy deposits at the Bachelor site would be contaminated. In addition, the purpose of the Phase 1 ESA is to determine if there is a risk that new installations will be built on contaminated soils in excess of the regulatory limits applicable to the site.

Based on all of the collected information, there is a risk of airborne contamination throughout the mine site due to the presence of mining activities since the 1980s, including the operation of an ore processing plant and a tailings management area. In addition, the presence of backfill and ore stockpiles points to a risk of metal contamination. No other contamination risks have been identified in the areas targeted by the work planned for the project to increase the milling and ore processing rate of the Barry and Moroy deposits at the Bachelor site. Let us recall that the work will be limited to the expansion of the tailings management area, the construction of an overburden dump, two new ore stockpiles, the redevelopment of an existing ore stockpile and the construction of an access road linking the ore processing plant to the Barry-Bachelor road. There are also plans to add four outdoor tanks (one thickener and three leaching tanks) and to modify the ore receiving hopper.

However, it should be noted that activities likely to present a risk have been identified outside of the sectors targeted by the work. Indeed, as identified on previous development plans, the garage and the super dome that served as the former garage could represent a risk due to the type of activities performed, notably the maintenance and mechanical repair of heavy mining equipment. In addition, areas where waste oils, various petroleum tanks, hazardous waste and reagents used at the ore processing plant and mine water treatment unit are stored and/or have been stored in the past could also represent a risk. However, these were not subject to an exhaustive assessment since they are located outside of the area of the projected work.

GCM considers that a Phase II Environmental Site Assessment (ESA) is not mandatory prior to undertaking such work. The completion of a phase II would enable Bonterra to verify the overall condition of the site in the sectors targeted by the excavations, however the completion of a phase II does not eliminate the risk of discovering contaminated soils during the execution of the work. It must also be taken into consideration that an environmental characterization of the site will have to be performed during the site restoration work, as required by the Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec of the Ministry of Energy and Natural Resources (MERN).

As such, a full Phase II environmental characterization does not appear to be warranted at this time for the study site. However, as requested by COMEX in question 53, in the sectors of the industrial area affected by redevelopment work, it is recommended that a soil characterization be performed to ensure that the soil is managed in accordance with the Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés. Also recommended is a characterization of the initial state of the site according to the Guide d'intervention.

To ensure compliance with the Department's requirements, GCM recommends that a qualified environmental technician monitor the excavation and soil redevelopment work. In addition, it is recommended that the characterization plan be submitted to the Direction des évaluations environnementales for approval.

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1.0 INTRODUCTION

1.1 Background and mandate

An impact assessment for the increase of the milling rate and ore processing of the Barry and Moroy deposits at the Bachelor site was submitted to the Environmental and Social Impact Review Committee (ESIRC) in the autumn of 2019. Following the analysis of the file, the COMEX sent a series of questions and comments to Bonterra Resources Inc. (Bonterra) in May 2020.

Question QC-53 indicates that the proponent must provide an environmental characterization study for all of the sectors targeted by the proposed expansion, development, construction or repair work. The exact question that the characterization study must be carried out in accordance with the *Land Characterization Guide* and take the history of use into consideration (Environmental Site Assessment – ESA – Phase I). Bonterra mandated GCM to perform a Phase I Environmental Site Assessment (ESA) on the Bachelor mine site located at 200 chemin de la mine in Desmaraisville, Northern Quebec.

1.2 Objective

The objective of the Phase 1 ESA is to determine if there is a risk that the soils having to be excavated during construction, development and/or redevelopment of the installations for the project to increase the milling rate and ore processing of the Barry and Moroy deposits at the Bachelor site are contaminated. In addition, the purpose of the Phase 1 ESA is to determine if there is a risk that new installations will be built on contaminated soils in excess of the regulatory limits applicable to the site.

To allow for proper analysis, all of the collected information can be found in the following sections. They will also make it possible to formulate relevant conclusions and recommendations, by virtue of past and current activities as well as the presence of infrastructures on the study site and surrounding lands.

2.0 METHODDOLOGY

The methodology used to conduct this study is consistent with the principles of the Canadian Standards Association standard CSA Z768-01, Environmental Site Assessment, Phase I, July 2003 (confirmed in 2016).

The mandate consisted of the following steps:

- Study of files;
- Site visit;
- Evaluation of the information obtained;
- Drafting of a report.

2.1 Implementation steps

- Requests for access to information from the Ministère de l'Environnement et de la Lutte contre les changements climatiques (MELCC) du Québec, Environment Canada, the Centre de données sur le patrimoine naturel du Québec (CDPNQ) and the municipality concerned regarding the existence of records of any spills, sources of contamination, discharges of regulated materials, infractions or any other event having an environmental impact on the property.
- Consultation of the MELCC's directory of contaminated sites and the directory of soil and industrial waste deposits that could have an environmental impact on the study site.
- Consultation of the files of the Régie du bâtiment du Québec relative to petroleum tanks on the site under study.
- Review of available aerial photographs to trace chronological changes in occupancy of the study area and to identify areas of backfill or storage that may cause an environmental impact on soils or groundwater.
- Review of historical data, previous reports, land use plans and zoning plans to trace past land use.
- Title search to identify current and previous owners and activities that may cause environmental impacts.
- Consultation of topographic and land registry maps for the identification of sensitive natural environments.
- Consultation of the various plans and maps available from municipal and government authorities.
- Consultation of the municipal documentation and documentation on the region.
- Consultation of the Hydrogeological Information System (HIS) or the MELCC directory of wells and drillholes.
- General inspection of the site.
- Inspection of the surrounding area, through access roads, to detect any activity or facility that could affect the site through migration of products into the soil or groundwater, surface or subsurface runoff, or atmospheric release.
- A report containing all of the collected information and relevant findings that, if applicable, identify potential sources of contamination and recommendations for further work.

3.0 SITE DESCRIPTION

3.1 Identification of the study site

The Bachelor mine site is located at 200 chemin de la mine in the town of Desmaraisville in the Nord-du-Québec administrative region. The mining site is accessible from Route 113 from Lebel-sur-Quévillon or Chapais. The site is composed of lots 6,096,775, 6,098,140, 6,098,141 and 6,098,128 of the Quebec land registry as well as a portion of territory not listed in the Quebec land registry. Bonterra holds a mining concession (CM-510) with an area of 16.08 ha and a mining lease (BM-1025) with an area of 83.44 ha.

The central geographic coordinates (NAD83) of the Bachelor mine site are:

- Latitude: 49°29'52.02 "N
- Longitude: 76° 8'43.65”W

A general location map of the study site is presented in Appendix 1.

As previously stated, the objective of the Phase 1 ESA is to determine if there is a risk that the soils having to be excavated during construction, development and/or redevelopment of the installations for the project to increase the milling rate and ore processing of the Barry and Moroy deposits at the Bachelor site may be contaminated. As such, the areas of the Bachelor mine site that are targeted for redevelopment or new construction are the focus of this Phase 1 Environmental Site Assessment.

Plans CRQ0266-5502 and CRQ0266-5503 attached as Appendix 1 respectively provide a general view of the Bachelor site and a close-up view of the Bachelor mill installations and buildings on which are identified the proposed developments of the project to increase the milling rate and processing of or from the Barry and Moroy deposits.

Among other things, the expansion of the tailings management area to accommodate an additional 8 Mt of tailings is planned, as well as the installation of an overburden dump, two new ore stockpiles and the redevelopment of an existing ore stockpile. There are also plans to add four outdoor tanks (one thickener and three leaching tanks) and to modify the ore receiving hopper.

3.2 Topography and watershed

The topography of the study area includes plains, but also slopes on some hills. According to Google Earth, the average elevation of the area is 338 metres above sea level. The highest points are located at about 350 m. According to the topographic map of the study area of "The Atlas of Canada - Toporama", the water from the site flows first north towards Bachelor Lake, then southwest via the Bachelor River to join Waswanipi Lake. From there, the water drains northward through the Waswanipi River, Lake Matagami and reaches James Bay through the Nottaway River. The study site is part of the Nottaway River sub-watershed. The extract of the topographic map with the direction of the surface water flow is below.

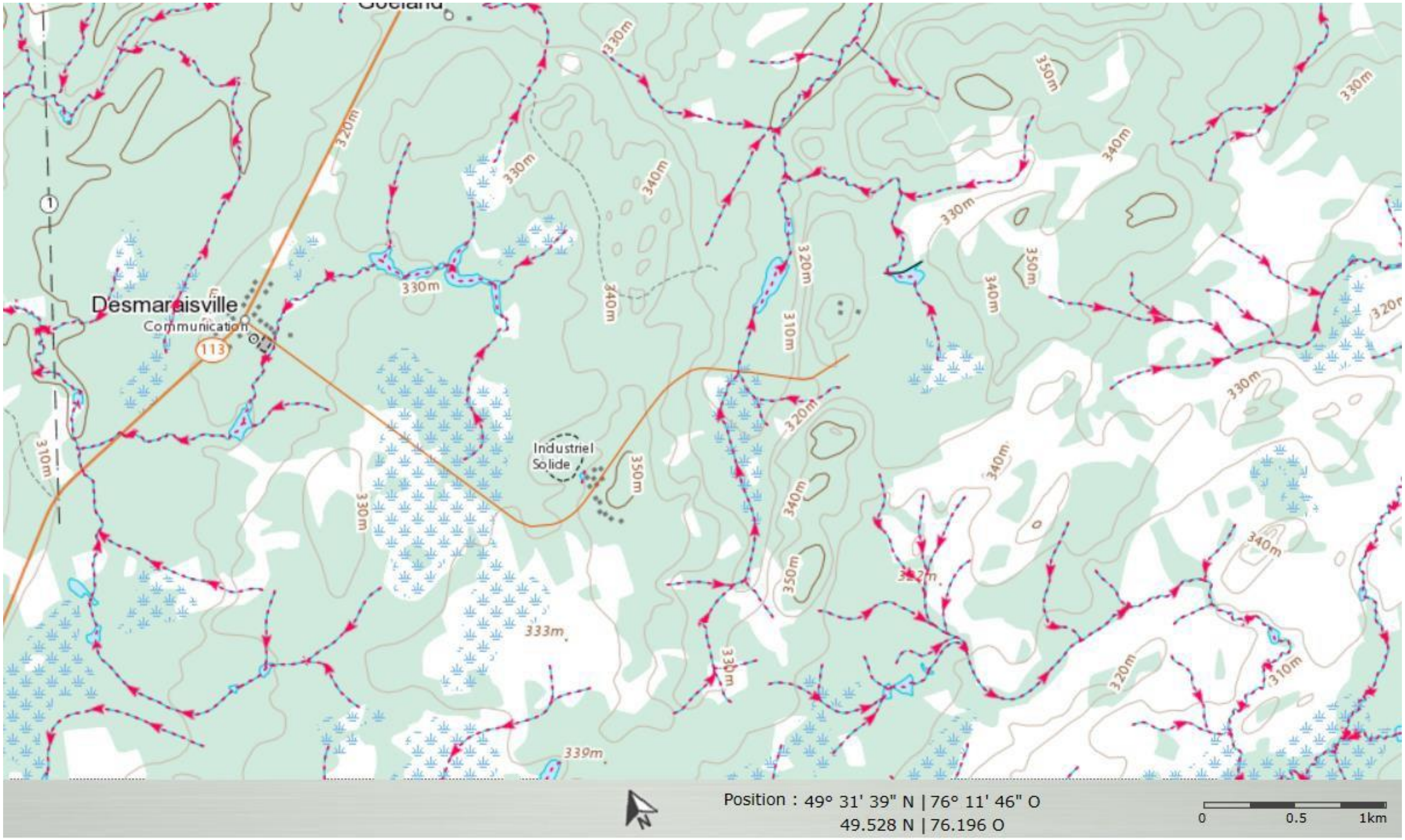

Figure 1. Topographic map of the area

3.3 Geological and hydrogeological context

According to the IMOIS interactive map, the study site is located in the Superior Province on the Obatogamau Formation Group and is composed of a geological system of Archean age. It is generally characterized by the presence of mafic and intermediate volcanic rocks.

According to the MELCC Hydrogeological Information System (HIS) database, no water supply wells are present on the study site. Although not listed in the system, it should be noted that a drinking water well is present.

3.4 Ecological description

The study area is located in the Matagami Lake Plain ecological region, Bachelor Lake Plain district. The site is located in the black spruce-moss bioclimatic domain. In areas where the relief is more pronounced, white birch fir stands are found.

A request relative to threatened, vulnerable or at-risk species (EMVS) was submitted on 29 July 2020 to the Centre de données sur le patrimoine naturel du Québec (CDPNQ) for fauna and flora for a 5 km radius. It appears that no EMVS have been identified in the study area, either in terms of flora or fauna. However, according to the letter from the MFFP, the presence of three avian species likely to be designated as threatened or vulnerable, namely the Common Nighthawk *(Chordeiles minor*), the Olive-sided flycatcher *(Contopus cooperi*) and the Rusty blackbird *(Euphagus carolinus*).

It should be noted that during the ecological inventories conducted by GCM last August, two species likely to be designated as threatened or vulnerable were identified, namely the Southern bog lemming *(Synaptomys cooperi*) and the Rock vole *(Microtus chrotorrhinus*).

The CDPNQ documents can be found in Appendix 2.

3.5 Municipal services

The Bachelor mine site is not connected to any municipal water and sewer system.

3.6 Current land use and zoning

Several works of various sizes have been performed on the site under study since the discovery of the Bachelor deposit in the late 1940s. Since the summer of 2018, the mine site has temporarily ceased these mining activities, only maintenance, exploration and monitoring activities are maintained by Bonterra. The Bachelor site zoning is located in the ER-1 zone area from which the exploitation of mining resources is permitted.

3.7 Future land use and zoning

Bonterra wishes to restart mining activities at the Bachelor site. As previously mentioned, Bonterra submitted an impact assessment in the fall of 2019, concerning the increase of the rate at the ore processing plant as well as the processing of gold ore from the Barry and Moroy projects at the Bachelor mine plant.

No change of use or zoning is anticipated for the study site.

3.8 Adjacent land uses and zoning

A mining camp owned by Bonterra is present less than 2 kilometres from the mine site. Also, located about 1.5 km west of the Bachelor mine is the old Coniagas mine which was operated between 1961 and 1967. Most of the land adjacent to the site is forested or subject to forestry operations.

4.0 HISTORICAL RESEARCH AND DOCUMENTARY REVIEW

4.1 Identification of lots

The mine site is located in the old land registry of the Township of Lesueur in the Abitibi land division. The site is composed of lots 6,096,775, 6,098,140, 6,098,141 and 6,098,128 of the Quebec land registry as well as a portion of territory not listed in the Quebec land registry.

4.2 Titles of Ownership

The information contained in this section was obtained from a search of the Quebec Online Land Registry, consulted on 2 July 2020, in order to trace the ownership history of the lots under study.

Table 1 below presents the lot numbering according to the consulted land registry plan, as well as the concordant lots according to the land registry.

Table 1. Matching of lots

Current Lot Quebec Land	Previous lot Township of
6,096,775	Lots 1, 2, 3 and part of lots 4, 21-1 and 22-1 row 4
6,098,140	Lots 4-3, 7, 8, 21-1-2 and 21-1-1
6,098,141	Part of Lot 22-1 row 4
6,098,128	Lots 4-1, 5, 6 and 21-1-1 row 4
Part of the territory not listed in the land registry	-

According to the online land registry, the lots are owned by the Government of Quebec, Ministry of Energy and Natural Resources. The information collected from the Land registry indicates no sales transactions over the previous years, suggesting that the lot has always been owned by the MERN. However, a first lease was apparently granted to the Bachelor Gold Mine in 1984.

The information obtained by consulting the deeds of sale and ownership titles enable us to conclude that the past and current tenants may have carried out activities with a risk of soil and groundwater contamination since they are companies working in the field of exploration and mining and this type of activity is listed in Schedule 3 of the Règlement sur la protection et la réhabilitation des terrains (Government of Quebec, 2018).

The documents examined in the land registry of the lots in question are found in Appendix 3.

4.3 Aerial photographs

A review of five aerial photographs (1965, 1970, 1985, 1995, and 2008) and a satellite image from 2019 provided an opportunity to observe the use of the study site at approximately 10-year intervals from the years 1965 to the present. Table 2 shows the main features observed in these photographs. The aerial photos consulted are found in Appendix 4.

Table 2: History of the land and infrastructures

Period	Observations/Changes
1965	• The path to the mine is already present. A few installations can be seen on the mine site. The bulk of the sector is wooded around the installations.
1970	• No change compared to 1965.
1985	• The Bachelor tailings management area is now present at the mine site. In addition, there are additional installations to the northeast of the mine. These installations are used as a camp to accommodate mine employees.
1995	• No change compared to 1985.
2008	• A new basin is present north of the tailings management area. A small portion was cleared near the installations that were already present on the mine site. A few gravel roads were designed from the southwest corner of the tailings management area.
2019	• New cells appear to have been added to the existing tailings management area. Tailings are visible in the western portion of the tailings management area.

4.4 History

The following paragraphs from the restoration plan (Metanor, 2017) summarize the history of the Bachelor site since the start of mining exploration activities at the site.

The exploration of the Bachelor property dates back to 1946 with the discovery of gold-bearing outcrops and the start of prospecting and sampling in the following years.

From 1946 to 1961, various companies performed work that confirmed the gold potential of the Bachelor property.

In 1961, Sturgeon River Mines drilled the first segment of the shaft, and in subsequent years proceeded with surface and underground exploration. This well was dug to a depth of 339 m and had seven levels. These various levels were separated at 46 m intervals, which was equivalent to approximately 3,350 m of development work. This work led to the first resource estimates in 1975. From 1972 to 1975, various surface and underground exploration programs delineated reserves. Work on the extraction of gold from the ore was also performed, resulting in the development of a direct cyanidation processing scheme.

The surface infrastructures at the Bachelor site were installed in 1980 and commercial production started in 1982. With the exception of downtime to deepen the shaft in 1987, the Bachelor mine operated until 1989. Reported ore production is 869,418 milled tonnes at a feed grade of 5.04 g/t and a mill recovery of 93%, for a total of 131,029 oz of refined gold (Wood, 2019).

In 1990, Acadia Mineral Venture carried out work including the sinking of 168 m of drifts and the completion of 4,807 m of diamond drilling. A small amount of ore (not reported) was reportedly extracted by a mining contractor in 1992, who then allowed the mine to flood following the early extended closure.

Between 1994 and 2004, there were several changes of ownership. From 1999 to 2004, Sabre Capital Partners, Ressources Campbell inc. and Corporation Wolfden Ressources conducted various surface and underground exploration programs. These exploration programs resulted in the estimation of new and very promising mineral resources. In the spring of 2004, the joint venture between Halo Resources Ltd. and Metanor began dewatering and redevelopment work. They secured the Bachelor mine infrastructures down to the bottom of the shaft at 562.7 m. Then, during the spring of 2005, an important underground exploration program was undertaken. This exploration program had a significant impact on the understanding of the geology of the deposit.

In September 2007, Metanor acquired 100% of the Bachelor site. Starting in 2008, Metanor carried out studies and works in order to put the Bachelor site back into operation after more than 16 years of interrupted operations. This re-opening involved the renovation of the ore processing plant to handle a 50,000 t bulk sample of ore from the Barry deposit. An impact assessment was submitted in 2007 for this purpose.

Following a 5,000 t bulk sample from the Bachelor underground mine in 2011, mining and processing of 900,000 t of ore from the underground mine was restarted in 2012 at a daily tonnage of 800 tpd.

In 2017, the authorities issued permits for the mining and processing of 600,000 t of ore from the Bachelor underground mine. With a limited capacity for the tailings management area, a new system to manage tailings was put forward in the permit applications leading to the 2017 authorizations. As such, since 2017, the piling of dry tailings has been implemented.

On 1 January 2020, Bonterra and Metanor merged. Exploration on the property has continued since the merger of these two companies. A surface and underground exploration campaign targeted the Moroy deposit in 2019. Bonterra submitted an impact assessment for the processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase of the milling rate.

Table 3 summarizes the key points of the work at the Bachelor site.

Table 3. History of exploration and exploitation at the Bachelor site

Period	Proponent	Work
1946	Various prospectors	Prospecting and sampling work on the Bachelor property.
1946-1961	Various companies	Continued work to confirm the gold potential of the Bachelor and Hewfran properties.
1961	Sturgeon River Mines	Sinking of a first well segment on the property Bachelor; surface and underground exploration works.
1975	Sturgeon River Mines	First estimate of resources.
1980	Bachelor Lake Gold Mines	Construction of surface infrastructures.
1982	Bachelor Lake Gold Mines	Beginning of commercial production in July 1982.
1987	Bachelor Lake Gold Mines	Temporary cessation of operations for additional development of the underground infrastructure.

Period	Proponent	Work
1989	Bachelor Lake Gold Mines	Discontinuation of production.
1990	Acadia Mineral Venture	Sinking of new galleries and diamond drilling.
1992	Ross-Finlay	Recovery of skipped ore before letting the mine fill with water.
1999-2004	Sabre Capital Partners, Resources Campbell and Wolfden Ressources	Conducting exploration programs to estimate new resources.
2003-2004	Wolfden Ressource	Dewatering of the mine.
2005	Halo Resources and Ressources Métanor.	Exploration program to better characterize the geology of the deposit.
2008–today	Ressources Métanor and Bonterra Resources Inc.	Exploration work. Renovation of the ore processing plant. Upgrade of the BTMA to comply with environmental standards. Renovation of the compressed air installations. Renovation of the well hoisting installation. Addition of emergency generators. Construction of a workers' camp for 160 people. Construction of service buildings on the mine site. Deepening of the well. Development of new levels in the mine. Installation of a cyanide treatment unit.
2019	Bonterra Resources Inc.	Preparation of an impact assessment for the processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase of the milling rate.

4.5 Previous studies

Over the years, the Bachelor mine site has been the subject of several studies in the context of obtaining various authorizations and permits. Bonterra has provided GCM with several documents such as applications for authorization, certification of remediation and impact assessments. According to the information gathered during the research, among the information of environmental interest, a Phase I ESA was carried out in November 2009 as part of an authorization request to install a drinking water pipeline and sanitary water treatment. GCM was unable to obtain a copy of the Phase 1 ESA conducted by Genivar in November 2009. A soil and groundwater status report was also completed in 2018 as part of the remediation certification. The objective of this study was, based on the available information, to delimit the sectors potentially contaminated or, with proven contamination, by current or past activities. This report is attached as Appendix 5 and the potential sources of contamination identified in this study are listed below.

1. The ore processing plant, the laboratory and the refinery: in addition to the various chemicals used in the plant, it accommodates tanks of cyanides, lime and caustic soda.
2. The garage: all maintenance and repair activities are performed in this building. There is a diesel generator and fuel tanks. Used oils and propane are stored in tanks near the garage.

3. Storage of blasting agents: even if most of the explosives and detonators are stored underground as soon as they are received, in exceptional cases these products are stored in designated depots.
4. Electrical transformers.
5. Compressor room.
6. Winch room.
7. Propane tank to the west of the crushing building.
8. Storage tanks and silos for Magnafloc, Borax, sodium nitrate, as well as hydrocarbon tanks (22,700 litres of diesel and 4,560 litres of gasoline).
9. Waste rock stockpiles 1 and 2; (there appears to be a typographical error; GMC believes that Wood meant to refer to the two ore stockpiles).
10. Tailings management area.
11. Settling and sedimentation basins.

In addition, the consultation of the documents provided by the customer enabled us to identify different development plans for the site. The consulted plans make it possible to visualize and follow the evolution of the various developments at the Bachelor site. These are attached in Appendix 6 and described below:

- 1997 development plans:

  In this plan, it is possible to note that the ore processing plant, the conveyors, the crusher, the headframe, the hoist and compressor room, the electrical station, the water tank, as well as the building used as a warehouse and workshop (currently represented as the garage), are present. According to the plans, the location of these buildings appears to have remained unchanged over the years since 1997.

  The dry house at the current office location appears to be smaller. We note that a pipe appears to be present between the water tank and the ore processing plant as well as between the water tank and the dry house. A pipe also appears to be present from the dry house to a garage located in the current storage backyard. A wood yard is located behind this garage. An ore stockpile is located to the northwest of the processing plant.

  Access to the site is through the entrance located southwest of the existing garage and the offices are located near the gate. A fuel oil tank is identified southwest of the water tank. In addition, used oil storage is also identified in this area northwest of the electrical station. A septic tank is identified at the southeast corner of the ore processing plant.

- 2007 development plan:

  The 2007 development plan indicates that site access is through the existing entrance located to the southeast of the plant. The administrative offices are still located near the old gatehouse to the northwest of the garage. The garage identified in the 1997 plan is identified as storage. A gas tank is now identified in the plan in the area where the wood yard was identified in the 1997 plan. Two 50 m x 50 m ore stockpiles are identified in the plan to the north of the processing plant. A second septic tank is identified at the southeast corner of the ore processing plant.

- 2011 development plan:

  The 2011 development plan indicates that the administrative offices have been relocated with the former dry house to the northwest of the headframe. The old dry house seems to have been converted into a storeroom and a new dry house has been built with the offices. A super dome is now identified at the location designated as a garage in the 1997 plan and designated as a storage site in the 2007 plan. To the northwest of this super dome are identified two hydrocarbon tanks as well as two other super domes. The rear storage yard is now identified in the plan to the northwest of the offices.

  The hazardous materials storage facility and a hazardous materials collector are identified to the north of the storage backyard to the west of the ore stockpile. The septic tanks located in the southeast corner of the plant in the 2007 plan appear to have been relocated to the southwest corner of the parking lot and a septic field appears to have been added. A second septic field is identified to the southwest of the super dome located at the garage identified in the 1997 plan. A crushing area is identified around the crusher. A proposed waste rock dump is also identified within the footprint of the tailings management area east of the mill.

  A summary of the authorizations obtained over time at the Bachelor mine site is taken from the restoration plan and presented in Table 4. This table provides a picture of the previous activities that have been undertaken at the Bachelor mine site.

Table 4. History of authorizations issued by the authorities

Activity	Reference n°:	Document	Authority	Issue date
Certificate of Authorization for the storage of five used oil containers for the storage of waste oils produced by the mine.	-	Certificate of authorization	MDDEP	1997
Development of the mine site and dewatering of the underground mine.	3214-14-27	Certificate of non-taxation	COMEX	2004-05-13
	7610-10-01-70018-26 / 200085249	CA application Sec. 22	MDDEP	2004-06-28
Increase of the milling to 800 tpd to process 500,000 t of ore from the Barry site using the Bachelor site infrastructures and the addition of a portable crusher.	3214-14-27	Request for modification (sec. 122.2) of CA sec. 22 EQA	COMEX	30 July 2008
	7610-10-01-70018-27 / 200207917		MDDEP	2008-08-12
Installation of a system for the destruction of cyanides using hydrogen peroxide instead of a SO^2/air system.	3214-14-27	Request for modification (sec. 122.2) CA sec. 22 EQA	COMEX	27 March 2009
	7610-10-01-70018-28 / 200230114		MDDEP	3 April 2009
Expansion of the camp including the installation of a domestic wastewater treatment system.	7610-10-01-70018-30 / 200233805	Authorization request under sec. 32 EQA	MDDEP	18 June 2009
Expansion of the camp including the installation of a system to treat drinking water.	7610-10-01-70018-31	Authorization request under sec. 32 EQA	MDDEP	22 July 2009
Increase of the milling rate from 800 to 1,200 tpd	3214-14-27	Modification (sec. 122.2) of the CA application sec. 22 EQA	COMEX	27 July 2009
	7610-10-01-70018-29 / 200242770	Authorization request under sec. 22 EQA	MDDEP	
Development of a new dry house and related offices including the installation of a system to treat domestic wastewater.	7610-10-01-70018-32 / 200246365	Authorization request under sec. 32 EQA	MDDEP	8 January 2010
Installation of a drinking water treatment system.	7610-10-01-70018-33 / 200272593	Authorization request under sec. 32 EQA	MDDEP	9 August 2010
Development of an underground water catchment installation.	7610-10-01-70018-33 / 200272598	Authorization request under sec. 31 EQA		11 August 2010

Activity	Reference n°:	Document	Authority	Issue date
Bulk sampling of 5,000 t.	3214-14-27	Certificate of non-taxation	COMEX	21 December 2010
	7610-10-01-70018-34 / 400789708	Authorization request under sec. 22 EQA	MDDEP	28 February 2011
Installation of a cyanide destruction system by ozonation.	3214-14-027	Authorization request under sec. 32 EQA	COMEX	20 June 2011
	7610-10-01-70018-34 / 400808865		MDDEP	15 July 2011
Installation of equipment at the ore processing plant.	7610-10-01-70018-36-400849127	Authorization request under the EQA	MDDEP	23 August 2011
Modification of the CA - System for the destruction of cyanides.	3214-14-027	Authorization request under the EQA	COMEX	22 November 2012
Construction of a new groundwater well at the camp.	7610-10-01-70018-37 / 400921268	Authorization request under sec. 31 EQA	MDDEP	31 May 2012
Mining and processing of 900,000 t of ore at a rate of 800 tpd.	3214-14-027	Impact Assessment and authorization request under EQA	COMEX	4 July 2012
	7610-10-01-70018-38 / 400952125		MDDEP	16 August 2012
Raising of the retention structures of the BTMA.	7610-10-01-70018-39 / 401008019	Authorization request under the EQA	MDDEP	25 March 2013
Modification of the AC – Follow-up program to identify actual impacts and verify the effectiveness of mitigation measures and adjustments to the contents of the annual monitoring report.	3214-14-027	Authorization request under the EQA	COMEX	19 July 2013
Sewage treatment for three new dormitories at the camp.	7610-10-01-70018-40 / 401120815	Authorization request under sec. 32 EQA	MDDELCC	4 July 2014
Increase of the capacity of the drinking water treatment system at the camp.	7610-10-01-70018-41 / 401175058	Authorization request under sec. 32 EQA	MDDELCC	7 October 2014
Sampling of water for drinking water supply at the camp.	7610-10-01-70018-42 / 401242006	Authorization request under sec. 31 EQA	MDDELCC	2015-06-03

Activity	Reference n°:	Document	Authority	Issue date
Follow-up activities for certification of the sanitation.	7610-10-01-70018-07 / 401365042	Authorization request under sec. 32 EQA	MDDELCC	June 2016
Changes in turnover - Mining and processing of 600,000 tonnes of additional ore.	3214-14-027	Authorization request under the EQA	COMEX	10 February 2017
	7610-10-01-70018-38 / 401582703		MDDELCC	26 May 2017
Stacking of tailings.	3214-14-027	Authorization request under the EQA	COMEX	19 May 2017
	7610-10-01-70018-38 / 401582703		MDDELCC	26 May 2017
Impact assessment – Processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase of the milling rate		Impact assessment under the Regulation on the assessment and review of impacts on the environment	COMEX	Under analysis since the end of September 2019

4.6 Consultations with authorities

4.6.1 Consultation with the Eeyou Istchee James Bay Regional Government (EIJBRG)

On 29 July 2020, a request for access was sent to the EIJBRG. According to the obtained information, no document refers to an activity that could lead to a contamination potential for this study. The documents provided by the City are available in Appendix 7.

4.6.2 Consultation with the MELCC

A Freedom of Information request was sent on 29 July 2020 to the MELCC Regional Branch. In addition, two e-mail reminders to receive access to information were sent to the MELCC on 8 October 2020 and 3 November 2020. At the time of writing this report, responses to the request were still pending. An addendum will be issued if any responses obtained modify the findings and recommendations of this report. The correspondence sent to MELCC can be found in Appendix 8.

4.6.3 Directory of contaminated sites, soil deposits and industrial waste

A search was conducted on the MELCC website as of 24 August 2020. The Ministry maintains two directories, one for the list of contaminated lands and the other for soil and industrial waste deposits.

The Bachelor mine site tailings management area is listed in the MELCC's directory of soil and industrial waste deposits. In fact, the tailings management area is still active and, according to the register, contains contaminants such as available cyanide (CN-) and metals.

According to the directory of contaminated lands, no other contaminated land would be present within one metre of the study site.

The lists in the directories are available in Appendix 9.

4.6.4 Emergency-Environment Interventions

The Emergency-Environment response register was consulted on 24 August 2020. This register lists all events of an environmental nature involving a field Emergency-Event intervention since 5 May 2008. This research enabled us to confirm that no intervention took place within a radius of 1 kilometre. The registry can be found in Appendix 10.

4.6.5 Files on petroleum equipment inventoried by the Régie du bâtiment du Québec

The register of petroleum equipment installations and the list of holders of a usage permit for high-risk petroleum equipment were consulted on the website of the Régie du bâtiment du Québec (RBQ). On the study site, there is only one petroleum equipment installation (#1-5212270977). This installation is owned by Metanor Resources Inc. (now Bonterra) with two tanks with a licensed capacity of 19,046 litres at their site.

Considering their location on the site, these petroleum equipment components represent a medium risk for the site under study. However, since the areas targeted by the redevelopment work are located at a distance of more than 100 metres, the presence of the tanks does not represent a risk.

In addition, according to the RBQ, a petroleum equipment installation belonging to Petronor is located on the site. During the search, no mention of this installation was found in the RBQ listings. Five propane tanks and two hydrocarbon tanks appear to be present on the site and these do not appear to have been identified on the list of petroleum equipment.

No other installations were identified within 1 km of the study site. The results of searches on the RBQ website are presented in Appendix 11.

4.6.6 Directory of federal contaminated sites

The Secretariat of the Treasury Board of Canada maintains an inventory of contaminated sites currently under the responsibility of various federal departments.

A review of the said directory on 30 July 2020 revealed that there are no federally contaminated properties within one kilometre of the study site and therefore no risk of contamination. The map and list of federal contaminated sites can be found in Appendix 12.

4.6.7 Consultation with Environment Canada

A freedom of information request was sent to Environment Canada on 29 July 2020.

At the time of writing this report, responses to the request were still pending. An addendum will be issued if any responses obtained modify the findings and recommendations of this report.

4.6.8 Fire insurance plan

A search of the Bibliothèque et Archives nationales du Québec (BAnQ) was conducted on 25 August 2020 to see if fire insurance plans were present for this area of Desmaraiville. According to the BAnQ, no documents are available.

5.0 SITE VISIT AND INTERVIEW

A field visit was conducted on 26 August 2020 by Mrs. Valérie Fortin of GCM in the company of Mr. Steve Gaudreault, environmental superintendent at Bonterra. During this visit, a general inspection of the site was carried out. The various recorded observations are described in the following section.

The site under study is located at the end of the chemin de la Mine, thus forming the civic address 200 chemin de la Mine.

The infrastructures present on the site are a headframe, an ore processing plant (crushing workshop, conveyors, chemical product tanks, a laboratory, a compressor room), two ore stockpiles, a hazardous materials warehouse, a waste oil container, a core storage area, a garage for mechanical maintenance, several storage areas and domes for various mining materials, administrative offices, a parking area, access roads and a tailings management facility.

There are also six propane tanks, one waste oil tank, one 14,496 litre diesel tank and one 4,550 litre gasoline tank on the study site.

Some hydrocarbon stains on the ground were observed near the final effluent under stored machinery. These were observed during the complementary characterization of the final effluent sector on 20-24 September 2020, by Christine Beaumier and Amélie Trottier-Picard. In addition, paint stains on the cement slab located next to the hazardous materials were observed by Mrs. Fortin during her visit. An odour of paint was detected at this location.

During Mrs. Fortin's visit, particular attention was paid to areas where redevelopment or new structures are planned. It should be noted that the interior of the Bachelor mine site buildings was not visited as it is outside the scope and objectives of this Phase 1 ESA.

For example, the material storage yard located to the northeast of the offices was inspected, since a redevelopment of the space and of the current ore shed is planned with the installation of the two new ore stockpiles. The proposed site of the new ore stockpiles and access road is located in an area that is currently forested. The target location for the four new tanks to the southeast of the plant was also verified and tarp-covered equipment was currently stored at this location (photos 16 and 17). Both the proposed overburden dump site and the tailings management area expansion are forested.

At the northwestern end of the site, it is possible to see that the storage backyard as well as the majority of the mining complex is resting on backfill. Drill cores and wood chips are visible in the slope at the northwestern end of the site (photos 13 and 14).

A photographic report of the site and surrounding area is available in Appendix 13. With the exception of a few stains on the ground, no other signs that an environmental impact has occurred on the site were observed during the inspection.

A mining camp owned by Bonterra is present less than 2 kilometres from the mine site. Furthermore, the old Coniagas mine that was exploited between 1961 and 1967 is located at about 2 km west of the Bachelor mine.

The majority of the area surrounding the mine site is forested.

6.0 SUMMARY OF RELEVANT INFORMATION

Table 5 below provides a summary of the relevant information required for the Phase 1 ESA. The risk zones identifying the location of equipment, buildings, infrastructure and mining developments likely to contaminate the site's soils and groundwater are presented on plans CRQ0266-5502 and CRQ0266-5503 in Appendix 1.

Table 5: Summary of relevant information

Identified risks	Sources	Potential contaminants
*Airborne contamination resulting from past and present mining operations (including ore processing plant and tailings management area)	Activity listed in Appendix 3 of the Land Protection and Rehabilitation Regulation	Metals
*Backfill	2020 site visit	Metals
*Presence of ore stockpiles	Old development plan and 2020 Site visit	Metals
Garages	Old development plan	C10C50 hydrocarbons, PAH, VOC, metals, BTEX
Petroleum tanks (existing and old)	2020 site visit, RBQ, old development plan	C10C50 hydrocarbons, PAH, VOC, metals, BTEX
Presence of a hazardous residual materials storehouse (paints, used oils, etc.)	Old development plan, 2020 site visit	C10C50 hydrocarbons, PAH, VOC, metals, BTEX
Presence of a cyanide tailings management area	Aerial photos from 1985 to present and old development plan	Metals and cyanides
Spill of chemicals used for ore processing and water treatment	Previous studies	Reagents (cyanides, lime and caustic soda, anhydrous borax, sodium nitrate, Magnafloc, Rydlyme, etc.)

*The items in Table 5 identified with an * are the risks identified in the area where the redevelopment work will be carried out.

7.0 CONCLUSION AND RECOMMENDATIONS

GCM Consultants conducted a Phase I ESA at the Bachelor mine site located at 200, chemin de la mine in Desmaraisville. The objective of the Phase 1 ESA was to determine if there was a risk that the soils having to be excavated during construction, development and/or redevelopment of the installations for the project to increase the milling rate and ore processing of the Barry and Moroy deposits at the Bachelor site would be contaminated. In addition, the purpose of the Phase 1 ESA was to determine if there was a risk that new installations would be built on contaminated soils in excess of the regulatory limits applicable to the site.

The environmental site assessment work consisted of a file review and a site visit to assess the potential for contamination of the study site. Based on all of the collected information, there is a risk of airborne contamination throughout the mine site due to the presence of mining activities since the 1980s, including the operation of an ore processing plant and a tailings management area. In addition, the presence of backfill and ore stockpiles points to a risk of metal contamination. No other contamination risks have been identified in the areas targeted by the work planned for the project to increase the milling and ore processing rate of the Barry and Moroy deposits at the Bachelor site. Let us recall that the work will be limited to the expansion of the tailings management area, the construction of an overburden dump, two new ore stockpiles, the redevelopment of an existing ore stockpile and the construction of an access road linking the ore processing plant to the Barry-Bachelor road. There are also plans to add four outdoor tanks (one thickener and three leaching tanks) and to modify the ore receiving hopper.

However, it should be noted that activities likely to present a risk have been identified outside of the sectors targeted by the work. Indeed, the garage and the super dome that served as the former garage could represent a risk due to the type of activities performed, notably the maintenance and mechanical repair of heavy mining equipment. In addition, areas where waste oils, various petroleum tanks, hazardous waste and reagents used at the ore processing plant and mine water treatment unit are stored and/or have been stored in the past could also represent a risk. However, these were not subject to an exhaustive assessment since they are located outside of the area of the projected work.

GCM considers that a Phase II Environmental Site Assessment (ESA) is not mandatory prior to undertaking such work. The completion of a phase II would enable Bonterra to verify the overall condition of the site in the sectors targeted by the excavations, however the completion of a phase II does not eliminate the risk of discovering contaminated soils during the execution of the work. It must also be taken into consideration that an environmental characterization of the site will have to be performed during the site restoration work, as required by the Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec of the Ministry of Energy and Natural Resources (MERN).

As such, a full Phase II environmental characterization does not appear to be warranted at this time for the study site. However, as requested by COMEX in question 53, in the sectors of the industrial area affected by redevelopment work, it is recommended that a soil characterization be performed to ensure that the soil is managed in accordance with the *Guide d'intervention – Protection des sols et réhabilitation des terrains contaminés.* Also recommended is a characterization of the initial state of the site according to the *Guide d'intervention*. To ensure compliance with the Department's requirements, GCM recommends that a qualified environmental technician monitor the excavation and soil redevelopment work. In addition, it is recommended that the characterization plan be submitted to the Direction des évaluations environnementales for approval.

8.0 LIMITATIONS OF THE STUDY

This environmental site assessment is limited to an opinion regarding signs of contamination, considering the available information and the timeframe of the mandate. This study does not constitute a legal opinion.

The assessment results described in this document consist primarily of historical land use research (aerial photographs, previous ESA reports, title and assessment roll searches, regulatory information and land use records), a site visit and interviews.

It is assumed that the information provided to us by the various stakeholders is accurate and well founded. GCM Consultants cannot assume any responsibility for the accuracy or reliability thereof.

This report is the exclusive property of Bonterra Resources Inc. and was prepared on behalf of the customer. As such, GCM Consultants declines any responsibility for the use of this document by a third party without its authorization and subject to that of Bonterra Resources Inc. To preserve the integrity of this report and to allow for its proper interpretation, we ask that no data, value or result be partially or completely removed.

8.1 Limitations and general conditions

It is expressly understood by the customer that the information contained in this report has been prepared for the specific purpose of the mandate granted. GCM Consultants can at no time be liable for the use of information contained in the report relative to third parties wishing to avail themselves of such information for similar or other purposes. Any third party relying on the information contained herein must understand its limitations and update the report at its own expense. GCM Consultants accepts no professional responsibility for any damages suffered by a third party as a result of a decision made or action taken on the basis of this report.

This assessment was conducted in accordance with the Canadian standard CSA Z768-01 – entitled "Environmental site assessment, Phase I". Any deviation from this standard is noted in this section. This assessment, conducted on behalf of Bonterra Resources Inc. (hereinafter referred to as the "Customer"), is strictly confidential. As such, GCM Consultants Inc. is not responsible for any third-party use of this report without its written authorization and that of the customer.

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It should be noted that these conclusions are based on the information contained in this report and are valid only for the period under review. It is understood that this assessment cannot take into consideration the outcome of activities not identified in this study.

The interpretation of the collected data and the issuance of comments and recommendations are based on our experience and according to the policies, criteria and regulations in force in the province of Quebec.

The environmental assessment paints a picture of the property at a specific point in time. The observations made during the visit to the property are limited to the conditions that existed on the days on which GCM Consultants representatives were present on the site. The observations, opinions and interpretation of the information relate to the presence of actual or potential pollution on the property and do not constitute a qualitative assessment of the property with respect to the geotechnical aspects of the site.

GCM Consultants has no interest in the property that is the subject hereof. The visit to the property was conducted in a manner that ensured the health and safety of the GCM Consultants audit team. With this in mind, all safely accessible locations were visited.

No testing or sampling of soil, surface water, groundwater, air or building materials was conducted in the context of this assessment, subject to the specific requests documented in this report.

This phase I site environmental characterization does not apply to environmental auditing and environmental management systems, which are covered by separate CSA standards. This report does not address the selection or conduct of measurement, sampling, analysis or remediation activities; these activities may be included in a Phase II, unless otherwise noted in the introduction to this report.

Although this phase i environmental site assessment was conducted in accordance with the CSA standard, there are limitations to the work performed. The results and conclusions regarding land contamination are based solely on the scope of the observations and information gathered during the Phase I ESA (extracted from CSA Z768-01).

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QC2-25: SPILL REPORTS 2018 TO 2021 – BONTERRA

Zalewski, Josée

From: Steve Gaudreault
Sent: 8 novembre 2018 10:07
To: Liette Gauthier (liette.gauthier@mddelcc.gouv.qc.ca)
Cc: 'Vicky.Gagnon2@mddelcc.gouv.qc.ca'; Norm Parker
Subject: Raport d'évènement déversement d'environs 100 L de diesel au parc à résidus Bachelor
Attachments: Incident 100 L diesel mine Bachelor.pdf

Bonjour Liette et Vicky,
Voici le rapport d'évènement du 100 litres de diésel, tel que demandé par téléphone lors de la déclaration du déversement, hier.

Notez que le déversement a été ramasser. Les absorbant ont été placé dans des bacs de MDR de Terrapure et le sol contaminé a aussi été ramassé et mis dans des bacs de MDR de Terrapure. Le tout sera expédier chez Terrapure lors de la collecte des MDR régulière.

Prendre aussi note que nous allons limiter les heures de travail du lever au coucher du soleil afin de limiter ce type d'incident.

En espérant le tout conformes à vos attentes, veuillez accepter mes salutations cordiales,

METANOR

Une filiale en propriété exclusive de :
BONTERRA

Mine Bachelor & Mine Barry
200, chemin de la mine
Desmaraisville (Québec)
J0Y 1H0

Steve Gaudreault
Coordonnateur Environnement
Bureau **819-753-2043 poste 2016**
Cellulaire **819 290-3327**

sgaudreault@metanor.ca

RESSOURCES METANOR INC.

SGI : FO-47

DÉCLARATION D'ACCIDENT/INCIDENT

Ce document constitue l'inscription de l'événement au registre officiel des accidents. contractuel

Nom : Maxime Dumoulin Icebound Fonction : Opérateur Machinerie lourde

No. matricule : Ø Département : Environnement Superviseur : Jean Drapeau

Lieu de l'événement : Cellule 1 au parc à résidus

Date de l'événement : 08 / 11 / 2018 (jour / mois / année) Heure de l'événement : ~ 17 h 00 (heure / minute)

Noms des témoins s'il y a lieu : Ø

Description des faits : (Comment l'accident/incident s'est-il produit? Travail effectué au moment de l'événement : rédiger étape par étape ce qui s'est passé)

Max conduisait le camion 10 roues de la mine pour aller décharger son voyage de résidus sur la cellule 1 du parc. Il ne voyais pas très bien, mais avais vu un petit tas de résidus. ~~à~~ essayer d'éviter mais pas vu Roche et passer sur roche qui a percer le réservoir de diesel.

Signature de l'employé : Date rapportée : 08 / 11 / 2018 (jr / ms / an) Heure : 17 h 00 (Hr / min)

Mesures correctives immédiates (action prise) : Appeler aide et mécanique à la radio immédiatement + mis Absorbant pour récupérer déversement (Fuite) du réservoir

Encercler la lettre :

Gravité :	Réelle	Potentielle
A = Faible	A	[✓ A]
B = Modéré	[✓ B]	B
C = Élevé	C	C

Enquête : oui ☒ non ☐

Superviseur et/ou chef d'équipe : Steve Gaudreault Date : 08 / 11 /2018 (jr / ms / an)

Nature de la blessure et/ou perte :

Camion de la mine a le réservoir de diesel persé et possiblement d'autre dommage mécanique à Faire évaluer par mécanique

Nature des premiers soins :

Ø Requis.

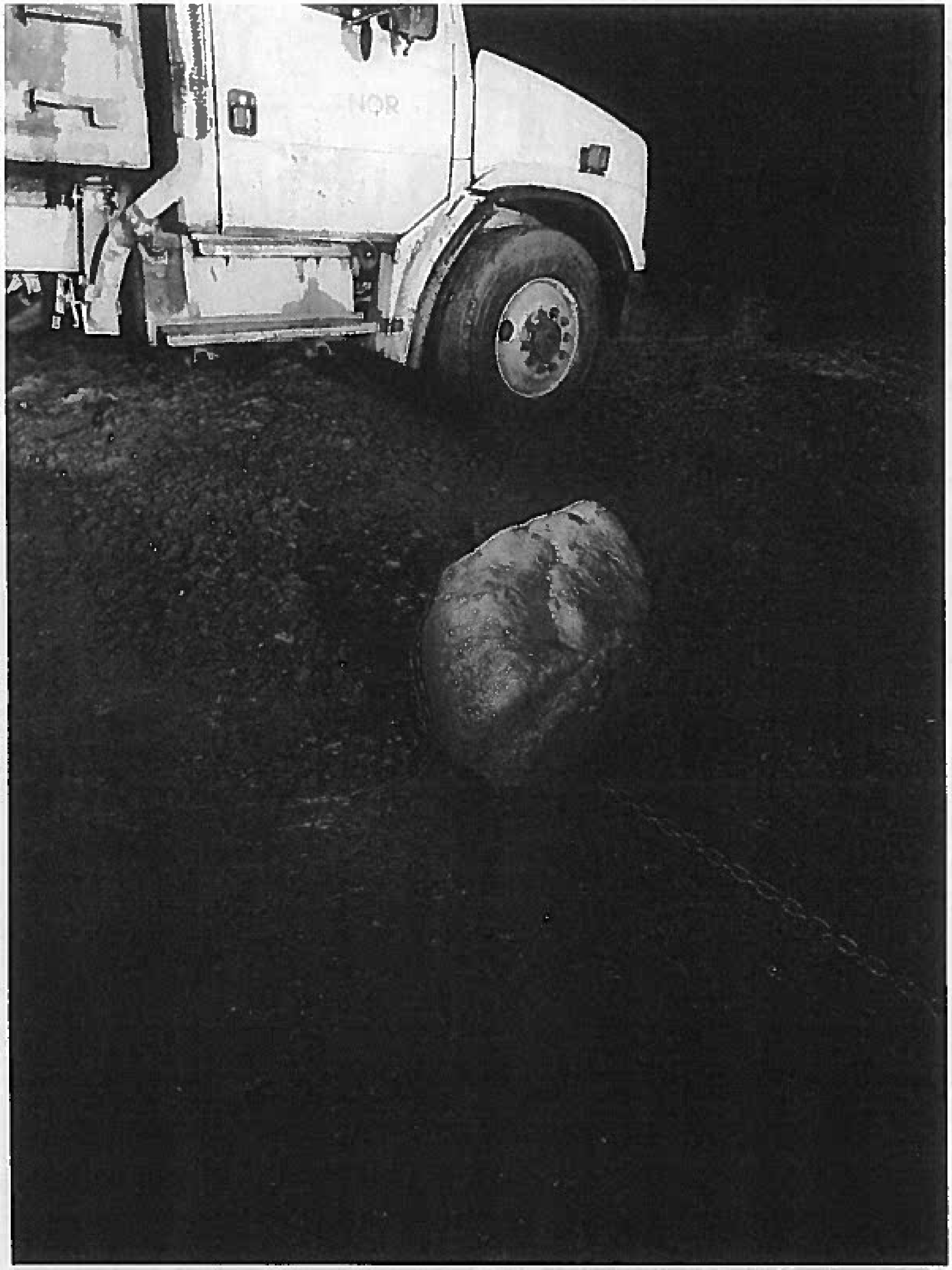
Un formulaire d'assignation temporaire a-t-il été remis au travailleur? : oui ☐ non ☒

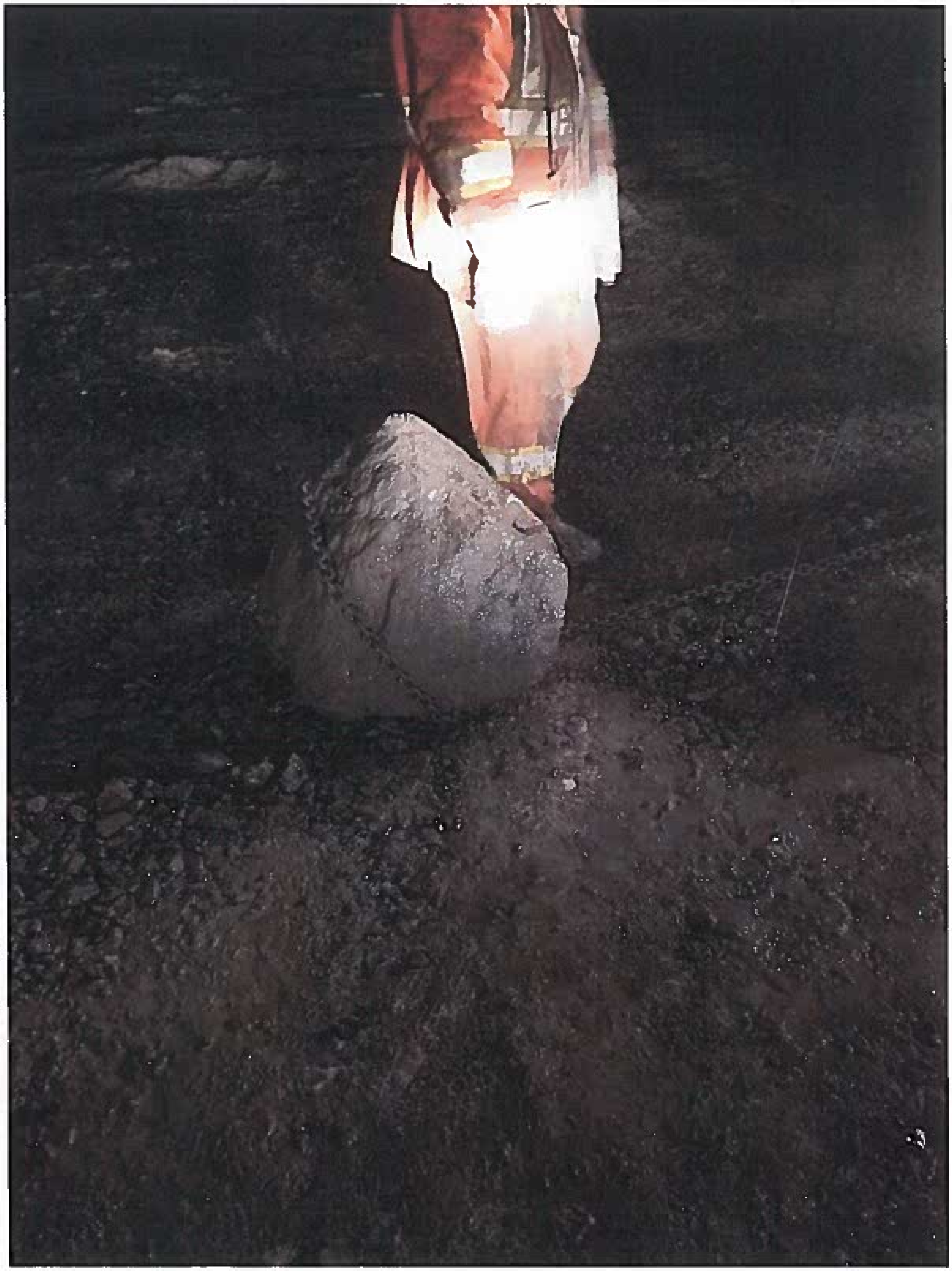
Date : 2018/11/08 Heure : 9h34 Infirmière/secouriste : Vu et tester par Janie.

Rapporté ☐ Premier soin ☐ Soin médical ☐ Assignation temporaire ☐ Compensable ☐

Domage matériel ☒


METANOR


NOR



Déclaration de déversement

Nom du site minier Mine Bachelor	Nom du déclarant Charles Lalancette
Témoin Denise Morin	N° de téléphone 819-753-2043
Date et heure de l'accident 01/05/18 10:00	Lieu de l'accident Chemin d'accès Gérik-mine
Produit impliqué et no CANUTEC Huile Hydraulique	Quantité déversée ≈ 20L
Nom du transporteur, compagnie Moreau	Est-ce une fuite? Source? Fuite, Fardier

Description de l'accident

Hose de l'hydraulique du panneau arrière a brisé. Le Conducteur à vite réagit en mettant des cauches absorbante.

Météo

Ensoleillé ☒ Pluie ☐ Venteux ☐ (direction) ______

Nuageux ☒ Neige ☐ Calme ☐

Pente du terrain

Faible (<2%) ☒ Moyenne (2-10%) ☐ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d'eau : 500m   Puits eau potable : 1 Km

Qui a été informé de l'urgence?

Police ☐   Pompier ☐   Expéditeur ☐   MRNF ☐
Canutec ☐   MDDEP ☒   EC-REMM ☐   EC-UE ☐

Responsable sur le site : Francis Lefebvre
Autres : ______

Actions correctives entreprises :

Mettre des couches absorbantes pour enlever les surplus liquide, et excavé sur environ 3po pour enlever le sable/Gravel contaminé. Environ 0,6 m³

Signature Coord. Env.   Date : 01/05/19   Heure : 13h00

Autres commentaires

Melcc /Nicky Gagnon à été informé
Urgence environnement /Samuel l'italien à été informé

Déclaration de déversement

Nom du site minier Bachelor	Nom du déclarant Charles Lalancette / Steve Gaudreault
Témoin Contremaître Machine Roger	N° de téléphone 819-290-3327
Date et heure de l'accident 2019-08-09 14h	Lieu de l'accident En bordure du parc à résidus : Lat : 49.492789° Long : -76.145787°
Produit impliqué et no CANUTEC Diesel coloré	Quantité déversée ~ 150 L
Nom du transporteur, compagnie Machine Roger International	Est-ce une fuite? Source? Mauvaise manipulation de l'opérateur

Description de l'accident :

Le 9 août 2019 vers 14h, l'opérateur de la foreuse à installer le pistolet de diesel dans l'embout du réservoir de la foreuse. Il est allé démarrer la pompe. Puis, il est allé voir si tout se déroulais comme il le faut, mais l'embout du pistolet avait tomber par terre due à un coup de bélier de la pompe. Le diesel coulait sur le sol directement. L'opérateur c'est empresser d'aller fermer la pompe. Résultant en ~150 L de diesel coloré déversé sur le sol.

L'opérateur a mis immédiatement des couches absorbantes sur le diesel liquide en surface et à appeler un responsable BonTerra pour rapporter la situation.

Charles Lalancette a téléphoner la ligne d'urgence environnement du MELCC pour rapporter la situation. Le tout a été ramasser le jour même et disposé avec Terrapure. 3 poches de couches absorbante ont été récupéré et mise dans des bac de matière contaminé ramasser par Terrapure et ~ 3 mêtres cube de sol contaminé a été récupérer et disposé via Terrapure.

Météo
Ensoleillé ☐ Pluie ☐ Venteux ☐ (direction) _____
Nuageux ☑ Neige ☐ Calme ☐

Pente du terrain
Vers le parc à résidu
Faible (<2%) ☑ Moyenne (2-10%) ☐ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d’eau : Lac Bachelor 3.5 km   Puits eau potable : pas le même bassin versant

Qui a été informé de l’urgence?
Police ☐   Pompier ☐   Expéditeur ☐   MRNF ☐
Canutec ☐   MELCC ☑   EC-REMMMD ☐   EC-UE ☐

Responsable sur le site : Géologie/Francis Lefebvre
Autres : ________________________

Actions correctives entreprises :

L’opérateur a été rencontré pour le rafraichir sur la procédure de remplissage d’une foreuse (2 personnes).

3 poches de couches absorbante ont été récupéré et mise dans des bac de matière contaminé ramasser par Terrapure et ~ 3 mètres cube de sol contaminé a été récupérer mis en pile et quelques semaine plus tard disposé via Terrapure (le temps que Terrapure nous amène les mètres cube et qu’on dispose la pile)

________________________________   __2019-04-23 __   ____15h30 __
Signature Coord. Env.   Date   Heure

Autres commentaires


SYNEE
DRILLING

Récupération des couches absorbante contaminé

Nettoyage pratiquement terminé

Mise en pile en attendant les contenant de Terrapure

Poches mise dans des bac Terrapure pour disposition.

PROCÉDURE ENVIRONNEMENTALE

Classification: ENV-015-F1-V2

Date d'émission: 2019-12-05

Suivi de Déclaration de déversement

Nom du site minier Bachelor/Moroy	Nom du déclarant Steve Gaudreault
Témoin Jeff Couture	N° de téléphone 819-290-3327
Date et heure de l'accident _2019/_12_/_09_ au courant de la nuit	Lieu de l'accident Derrière la salle des compresseurs
Produit impliqué et no CANUTEC Recofreeze PG 50/50 premixed 1, 2-Propylene glycol / CAS : 57-55-6	Quantité déversée Entre 500 et < 908 L < 908L = ~20% du réservoir de 4540 L)
Nom du transporteur, compagnie Bonetrra	Est-ce une fuite? Source? Bris d'une braquette de la fan qui a tombé sur le radiateur et l'a percé

Description de l'accident :

Le treuil dispose de compresseur à l'air et les compresseurs à l'air sont refroidis par du glycol qui est refroidi par un système de fan et radiateur. Le système de radiateur sont des radiateurs à l'horizontal surmonter d'une série de fans pour ventiler et refroidir.

L'une des braquette d'un des ventilateurs a brisé/lâcher et le fan avec le moteur est tomber sur le radiateur perçant celui-ci.

La quantité déversé (surestimé à cause que normalement le volume de glycol est chaud et là il est à ~ 20°C ce qui réduit la dilatation thermique du niveau habituel) est d'environ 20% du réservoir. Le réservoir est d'une capacité totale de 4540L donc on parle entre 500L et 908L maximum (908 L correspondant à 20% de la capacité du réservoir).

Urgence environnement QC a été téléphoner à 7h42 et un retour d'appel de Mme Isabelle Labrecque c'est fait à 7h52 le 2019-12-09

Météo

Ensoleillé ☐ Pluie ☐ Venteux ☑ (direction) _NO_

Nuageux ☑ Neige ☑ Calme ☐

Pente du terrain

Faible (<2%) ☑ Moyenne (2-10%) ☐ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d'eau : _460 m_ Puits eau potable : _400 m_

Qui a été informé de l'urgence?

Police	☐	Pompier	☐	Expéditeur	☐	MRNF	☐
Canutec	☐	MELCC	☑	EC-REMM	☐	EC-UE	☐

Responsable sur le site : _Francis Lefebvre directeur adjoint_
Autres : _Gille Landry surintendant surface et usine_

Actions correctives entreprises :

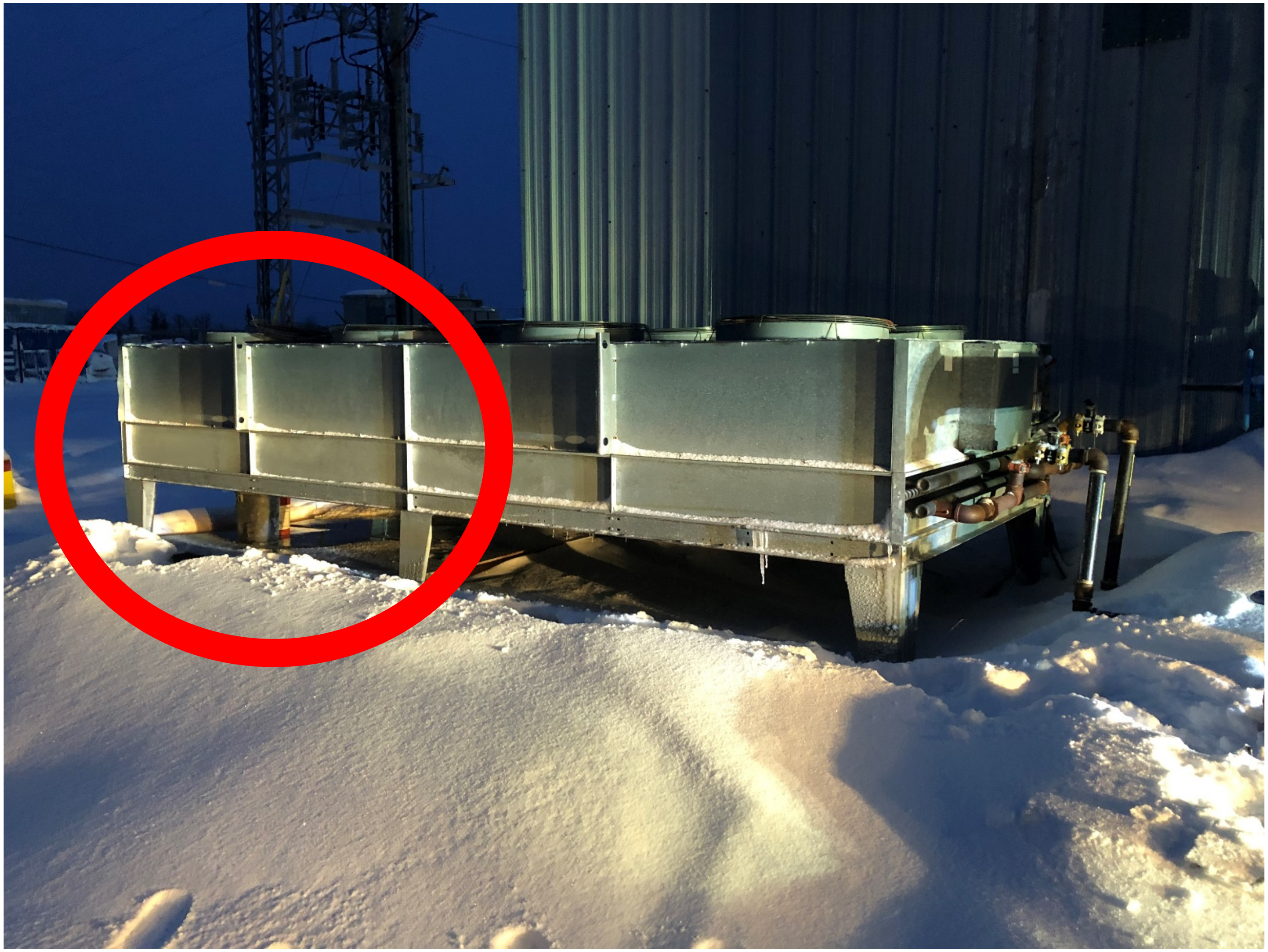
Isolation de la partie brisé pour repartir les opérations. Réparation/remplacement du radiateur et de la fan brisé + nettoyage de ce qui est possible de retirer sans nuire à la stabilité de l'équipement.

____________________	__2019-12-09__	___08h30 am__
Signature Coord. Env.	Date	Heure

Autres commentaires

Le nettoyage a été complété et 1 m3 de neige souillé avec un peu de gravier a été retirer

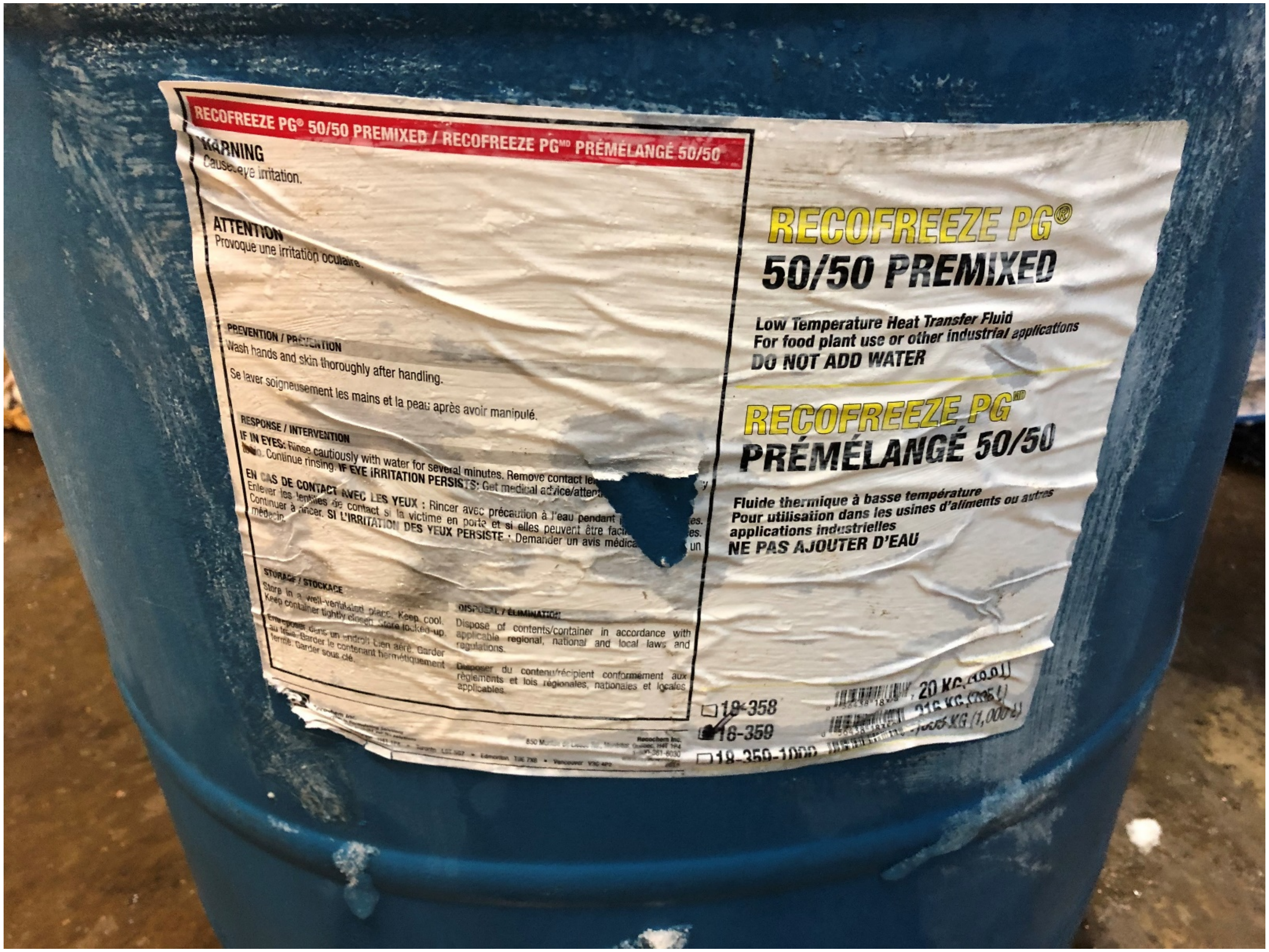
Vue d'une partie du système de refroidissement et d'un réservoir d'air comprimé pour le treuil



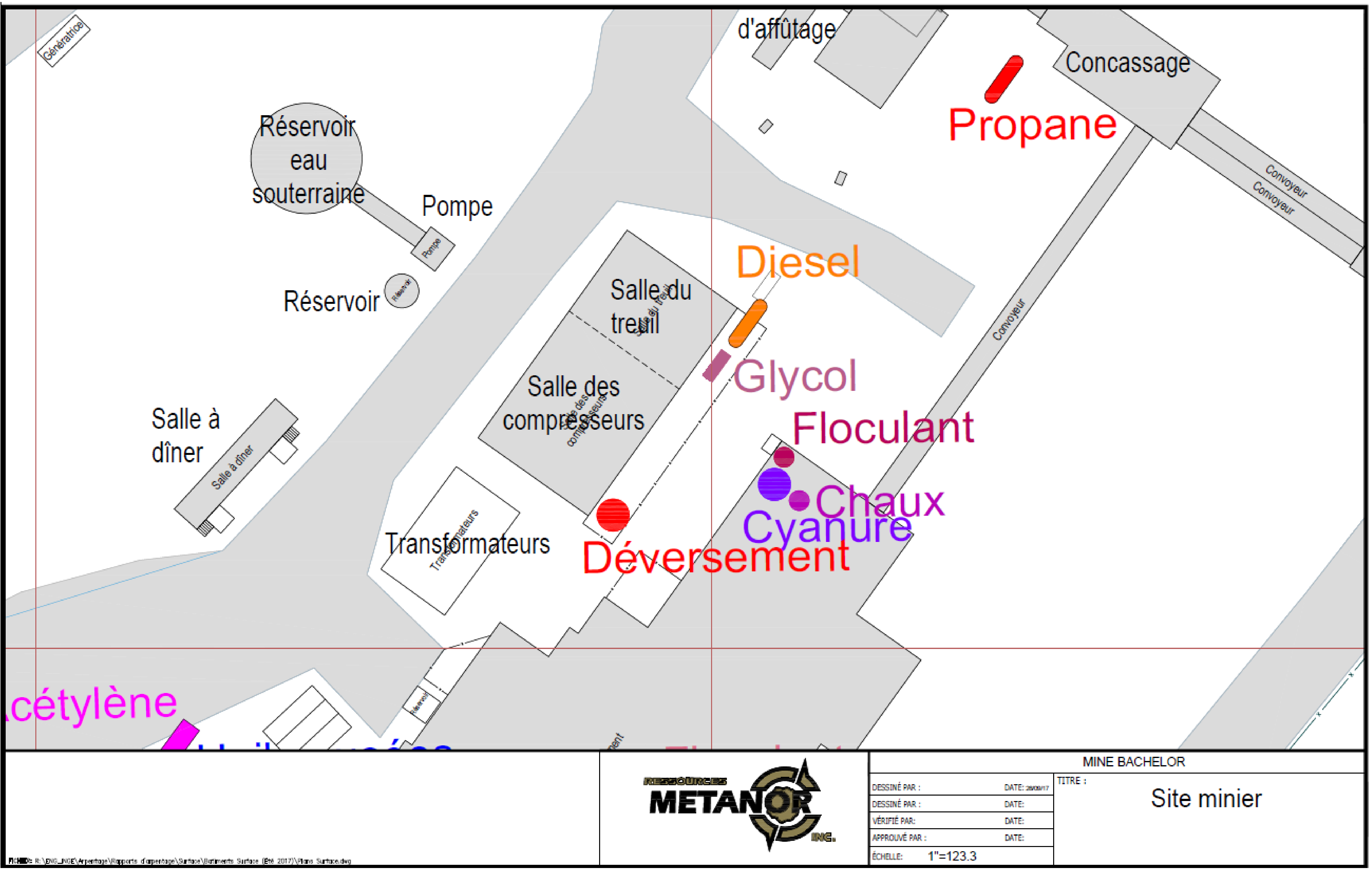
Système de refroidissement complet

Zone impacté

Zone de déversement



Produit déversé



MINE BACHELOR

DESSINÉ PAR : DATE: 28/09/17
DESSINÉ PAR : DATE:
VÉRIFIÉ PAR: DATE:
APPROUVÉ PAR : DATE:
ÉCHELLE: 1"=123.3

TITRE :
Site minier

FICHIER: R:\ENG_INGE\Arpentage\Rapports d'arpentage\Surface\Batiments Surface (Été 2017)\Plans Surface.dwg

Après nettoyage photo 1

PROCÉDURE ENVIRONNEMENTALE

Classification: ENV-015-F1-V2

Date d’émission: 2019-12-05

Après nettoyage photo 2

Après nettoyage photo 3

Quantité récupérer 1 m3

BONTERRA

PROCÉDURE ENVIRONNEMENTALE

Déclaration de déversement

Nom du site minier Bachelor/Moroy	Nom du déclarant Steve Gaudreault
Témoin Fredéric Géo	N° de téléphone 819-290-3327
Date et heure de l'accident _2019/_12_/_09_ au courant de la nuit	Lieu de l'accident En bordure du parc à résidu (près de la pompe)
Produit impliqué et no CANUTEC Propane, diesel, résidus de combustion	Quantité déversée À être déterminer
Nom du transporteur, compagnie Bonetrra / Machine Roger	Est-ce une fuite? Source? Feu de la foreuse

Description de l'accident :

Entre 2h et 3h du matin

L'opérateur de la foreuse était en train de déglacer des tiges puis a déposé la torche toujours allumer pour aller chercher un item dans le pickup. La torche au propane a alors enflammer le siège dans la foreuse enflammant aussi des papiers à proximité.

Aucun dommage environnemental a l'exception du fumé. Le feu a été éteint rapidement par les opérateurs.

Urgence environnement QC a été téléphoner a 7h00 am et Alexandre Huot a répondu. Un retour d'appel de Mme Francine Chagnon c'est fait à 7h10 le 2019-12-12 poste 250 et ce rapport a été transmis à Francine par courriel aux alentours de 10h15

Météo

Ensoleillé ☐ Pluie ☐ Venteux ☐ (direction) _____

Nuageux ☑ Neige ☑ Calme ☐

Pente du terrain

Vers le parc à résidu qui est fermer (pas d'effluent)

Faible (<2%) ☐ Moyenne (2-10%) ☑ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d'eau : _300 m_ Puits eau potable : _800 m_

Qui a été informé de l'urgence?

Police ☐ Pompier ☐ Expéditeur ☐ MRNF ☐

Canutec ☐ MELCC ☑ EC-REMM ☐ EC-UE ☐

Responsable sur le site : Francis Lefebvre directeur adjoint

Autres : ________________________

Actions correctives entreprises :

Nous démobiliserons la drill et Machine Roger nettoierons la place

_________________________________ __2019-12-12__ ___10h15 am__

Signature Coord. Env. Date Heure

Autres commentaires

Aucune action environnement nécessaire

Vue générale de l'installation de la drill

Entré de la foreuse

Siège de l’opérateur bruler et arrière aussi

Résidus du feu

Déclaration de déversement

Nom du site minier Bachelor	Nom du déclarant Hugues Bordeleau
Témoin Jeff Couture	N° de téléphone 819-290-3327
Date et heure de l'accident 2021-02-15 10 h 00	Lieu de l'accident : Mine Bachelor sous-terre Niveau #14
Produit impliqué et no CANUTEC Huile hydraulique	Quantité déversée Environ 10 litres
Nom du transporteur, compagnie Orbit Garant	Est-ce une fuite? Source? Provient d'une foreuse

Description de l'accident/incident :

Lors de réparations sur la foreuse à diamant au niveau #14, une quantité d'environ 10 litres d'huile s'est déversée par terre, l'opérateur n'a pu la contenir et l'huile s'est retrouvé dans le puisard du niveau #14.

Lors de sa tournée de vérification des pompes, le mécanicien a vu l'huile en surface dans le puisard et a immédiatement installé des couches absorbantes pour récupérer l'huile surnageante. Après avoir récupéré l'huile, il a placé les couches absorbantes dans un sac de plastique qui a été remonté à la surface dans le conteneur des matières dangereuses.

Météo

Ensoleillé ☒ Pluie ☐ Venteux ☐ (direction) ____

Nuageux ☐ Neige ☐ Calme ☒

Pente du terrain :

Sous-terre

Faible (<2%) ☒ Moyenne (2-10%) ☐ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d'eau : Aucun, sous-terre

Qui a été informé de l'urgence?

Police ☐ Pompier ☐ Expéditeur ☐ MRNF ☐

Canutec ☐ MELCC ☒ EC-REMM ☐ EC-UE ☐

Responsable sur le site : Francis Lefebvre

Autres :

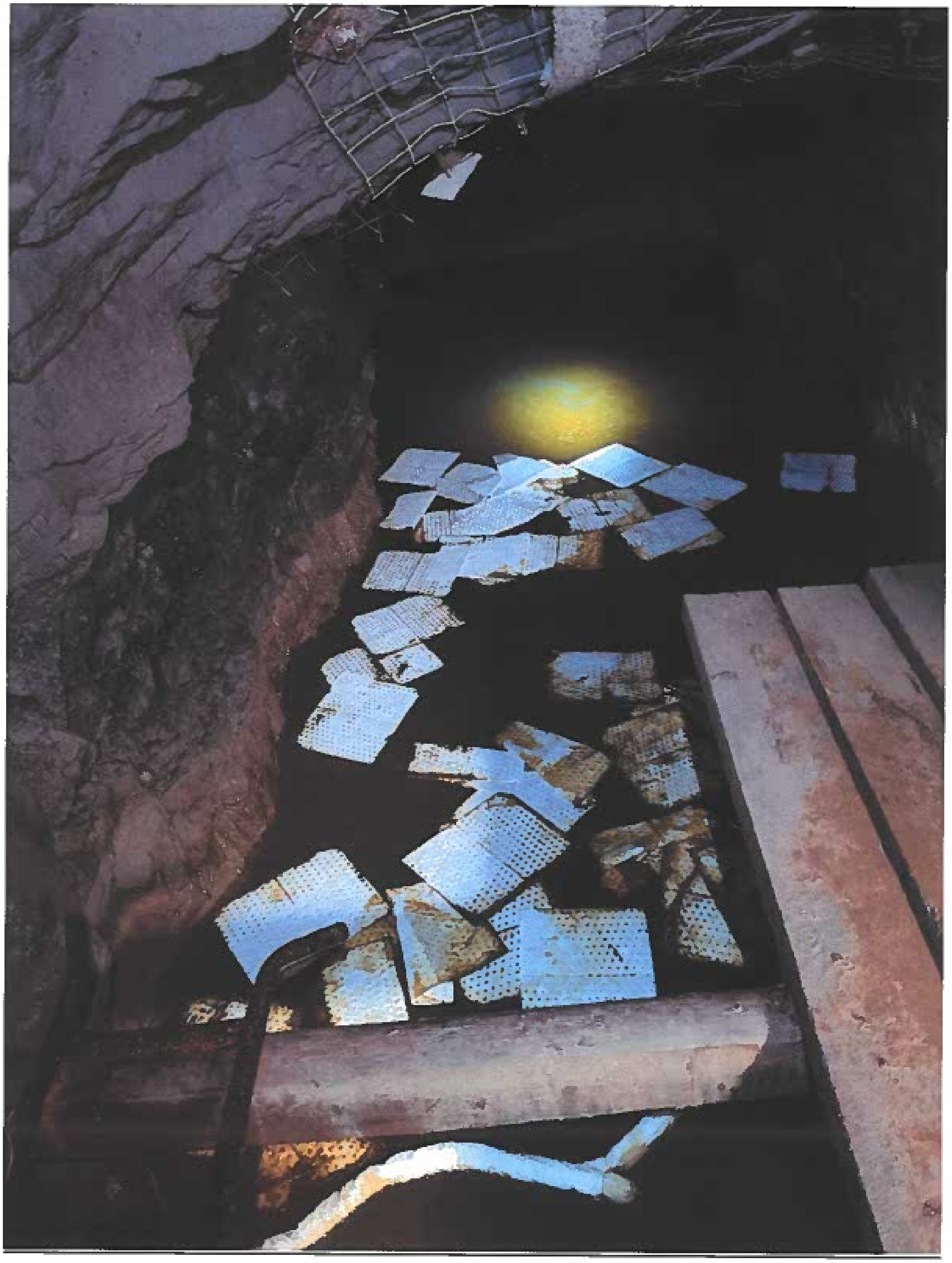
Actions correctives entreprises :

Installation en aval du lieu de travail de boudins dans le canal menant au puisard dans le but de récupérer tout contaminant éventuel pouvant s'y trouver.

	2021-02-15	11h45
Signature Tech. Env.	Date	Heure

Autres commentaires

Photos du déversement



Déclaration de déversement

Nom du site minier Bachelor	Nom du déclarant Steve Gaudreault
Témoin Oussama Affane	N° de téléphone 819-290-3327
Date et heure de l'accident 2021-05-19 7 h 45	Lieu de l'accident Site minier Bachelor; entrepôt huile neuve
Produit impliqué et no CANUTEC Huile/huile hydraulique	Quantité déversée Environ ~165 L (environ 40 litres dans le fond du conteneur et le reste au sol)
Nom du transporteur, compagnie Ressources Bonterra	Est-ce une fuite? Source? Le baril a été percé par le bout des fourches sur la palette lors de l'entreposage

Description de l'accident/incident :

Pendant une inspection surface, le technicien environnement a découvert que le fond du conteneur avait une flaque d'huile d'environ 40 L qui provenais d'un baril percé par le bout des fourches sur la palette lors de l'entreposage. Le baril était plein lors de son entreposage. Ce qui veux dire qu'une quantité d'environ 165 L a été déversé au sol hors du conteneur. Le sol est du sable et gravier.

Contrairement à la déclaration, suite à une investigation plus poussé, il apparait évident que le baril a été percé par le bout des fourches sur la palette lors de l'entreposage pendant sa mise en place dans le conteneur.

Météo
Ensoleillé ☑ Pluie ☐ Venteux ☐ (direction) _____
Nuageux ☐ Neige ☐ Calme ☐

Pente du terrain :

Faible (<2%) ☑ Moyenne (2-10%) ☐ Forte (>10%) ☐

Distance par rapport aux éléments sensibles (mètres)

Cours d'eau : 375 m (effluent final)

Qui a été informé de l'urgence?

Police ☐ Pompier ☐ Expéditeur ☐ MRNF ☐

Canutec ☐ MELCC ☑ EC-REMM ☐ EC-UE ☑ par transparence

Responsable sur le site : Laurian Marcotte

Autres :

Actions correctives entreprises :

Le baril percé vide a été retiré et envoyer à la ferraille. Le sol contaminé a été excavé entreposé sur une toile et recouvert. Les résultats d'analyse montrent 47 000 mg/kg pour l'échantillon 1; 29 000 mg/kg pour l'échantillon 2 (qui correspond au sols contaminé) et de < 100 mg/kg et de <100 mg/kg pour les échantillons 2 et 3 après nettoyage. Étant donné les quantité élevé d'hydrocarbures dans les échantillons de sols contaminé, nous disposerons du sol contaminé chez Terrapure à l'aide de « tôte » (mètre cube ouvert sur le dessus). Vous trouverez annexer à ce document, les résultats d'analyses.

Un bac de rétention sera fabriqué et mis en place pour éviter toute récidive de déversement au sol.

40 L ont été récupéré par des absorbants et mis dans des bacs de débris huileux qui sera envoyé chez Terrapure

	2021-05-20	9 h 30
Signature Surint. Env.	Date	Heure

Autres commentaires

Parlé à : Valérie Pedneault du MELCC 8h 05 am

Parlé à urgence environnement Canada à 8h15 am

Parlé à Liette Gaultier MELCC vers 8h20 am

Photos du déversement

Photo #1

Photo #2

Photos du déversement

Photo #3

Photo #4

Photos du déversement

Photo #5

Photo #6

Photos du déversement

Photo après décontamination des sols

Photo #7

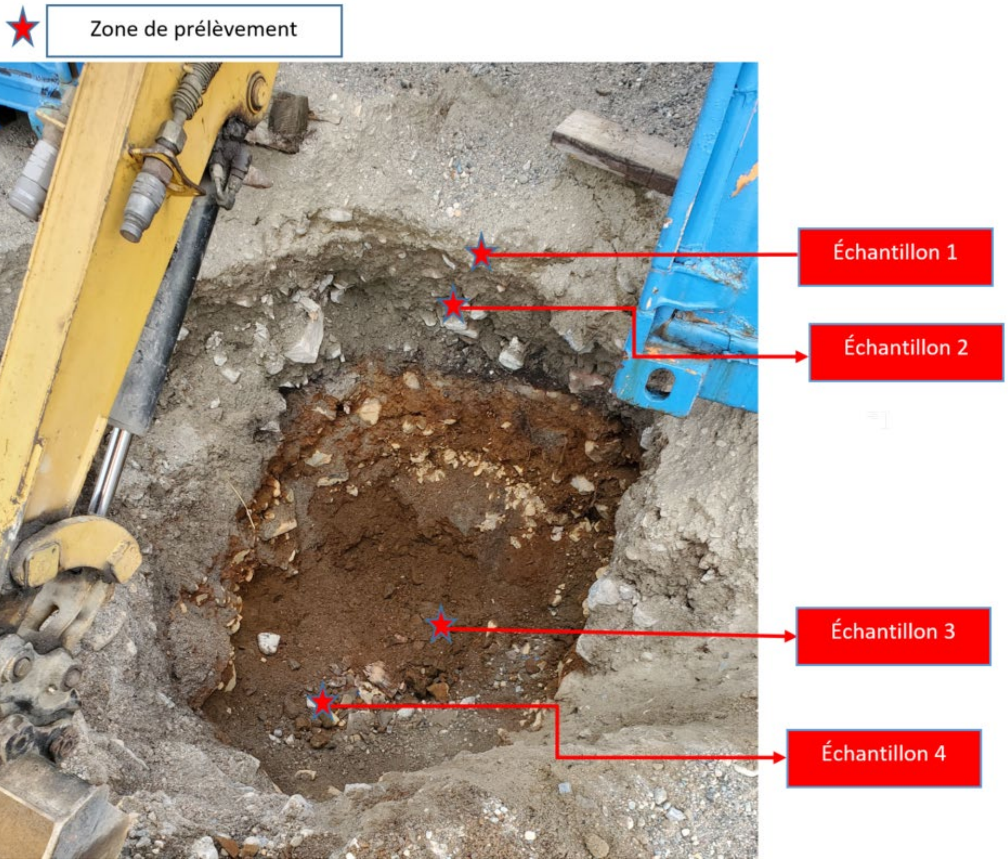
Photos du déversement

Photo #8

Photos du déversement

Photo #9

Photos du déversement



L’échantillon 1 a été pris sur le dessus du déversement

L’échantillon 2 a été pris au milieu de l’excavation du déversement

L’échantillon 3 a été pris au fond de l’excavation après nettoyage

L’échantillon 4 a été pris sur le bord du fond de l’excavation après nettoyage

Votre # du projet: BACHELOR SOLIDS
Adresse du site: 90458738
Votre # Bordereau: N-A

Attention: Steve Gaudreault

Ressources Bonterra
Mines Bachelor
200, chemin de la mine
Desmaraisville, QC
Canada J0Y 1H0

Date du rapport: 2021/06/07
\# Rapport: R2662578
Version: 1 - Finale

CERTIFICAT D'ANALYSES

 # DE DOSSIER LAB BV: C125002
Reçu: 2021/05/28, 10:00

Matrice: Sol
Nombre d'échantillons reçus: 4

Analyses	Quantité	Date de l' extraction	Date Analysé	Méthode de laboratoire	Méthode d'analyse
Hydrocarbures pétroliers (C10-C50)	1	2021/06/01	2021/06/01	QUE SOP-00210	MA400–HYD 1.1 R3 m
Hydrocarbures pétroliers (C10-C50)	2	2021/06/01	2021/06/02	QUE SOP-00210	MA400–HYD 1.1 R3 m
Hydrocarbures pétroliers (C10-C50)	1	2021/06/01	2021/06/03	QUE SOP-00210	MA400–HYD 1.1 R3 m

Remarques:

Bureau Veritas est certifié ISO/IEC 17025 pour certains paramètres précis des portées d’accréditation. Sauf indication contraire, les méthodes d’analyses utilisées par Bureau Veritas s’inspirent des méthodes de référence d’organismes provinciaux, fédéraux et américains, tels que le CCME, le MELCC, l’EPA et l’APHA.

Toutes les analyses présentées ont été réalisées conformément aux procédures et aux pratiques relatives à la méthodologie, à l’assurance qualité et au contrôle de la qualité généralement appliqués par les employés de Bureau Veritas (sauf s’il en a été convenu autrement par écrit entre le client et Bureau Veritas). Toutes les données de laboratoire rencontrent les contrôles statistiques et respectent tous les critères de CQ et les critères de performance des méthodes, sauf s’il en a été signalé autrement. Tous les blancs de méthode sont rapportés, toutefois, les données des échantillons correspondants ne sont pas corrigées pour la valeur du blanc, sauf indication contraire. Le cas échéant, sauf indication contraire, l’incertitude de mesure n’a pas été prise en considération lors de la déclaration de la conformité à la norme de référence.

Les responsabilités de Bureau Veritas sont restreintes au coût réel de l’analyse, sauf s’il en a été convenu autrement par écrit. Il n’existe aucune autre garantie, explicite ou implicite. Le client a fait appel à Bureau Veritas pour l’analyse de ses échantillons conformément aux méthodes de référence mentionnées dans ce rapport. L’interprétation et l’utilisation des résultats sont sous l’entière responsabilité du client et ne font pas partie des services offerts par Bureau Veritas, sauf si convenu autrement par écrit. Bureau Veritas ne peut pas garantir l’exactitude des résultats qui dépendent des renseignements fournis par le client ou son représentant.

Les résultats des échantillons solides, sauf les biotes, sont rapportés en fonction de la masse sèche, sauf indication contraire. Les analyses organiques ne sont pas corrigées en fonction de la récupération, sauf pour les méthodes de dilution isotopique.
Les résultats s’appliquent seulement aux échantillons analysés. Si l’échantillonnage n’est pas effectué par Bureau Veritas, les résultats se rapportent aux échantillons fournis pour analyse.
Le présent rapport ne doit pas être reproduit, sinon dans son intégralité, sans le consentement écrit du laboratoire.
Lorsque la méthode de référence comprend un suffixe « m », cela signifie que la méthode d’analyse du laboratoire contient des modifications validées et appliquées afin d’améliorer la performance de la méthode de référence.
Notez: Les données brutes sont utilisées pour le calcul du RPD (% d'écart relatif). L'arrondissement des résultats finaux peut expliquer la variation apparente.

Note : Les paramètres inclus dans le présent certificat sont accrédités par le MELCC, à moins d’indication contraire.

Votre # du projet: BACHELOR SOLIDS
Adresse du site: 90458738
Votre # Bordereau: N-A

Attention: Steve Gaudreault

Ressources Bonterra
Mines Bachelor
200, chemin de la mine
Desmaraisville, QC
Canada J0Y 1H0

Date du rapport: 2021/06/07
Rapport: R2662578
Version: 1 - Finale

CERTIFICAT D'ANALYSES

 # DE DOSSIER LAB BV: C125002
Reçu: 2021/05/28, 10:00

clé de cryptage

Veuillez adresser toute question concernant ce certificat d'analyse à votre chargé(e) de projets
Alexe Martineau, Chargée de projets
Courriel: Alexe.MARTINEAU@bureauveritas.com
Téléphone (418) 658-5784
==
Ce rapport a été produit et distribué en utilisant une procédure automatisée sécuritaire.
Lab BV a mis en place des procédures qui protègent contre l’utilisation non autorisée de la signature électronique et emploie les «signataires» requis, conformément à l’ISO/CEI 17025. Veuillez vous référer à la page des signatures de validation pour obtenir les détails des validations pour chaque division.

HYDROCARBURES PAR GCFID (SOL)

ID Lab BV		JE2942		JE2943		JE2944	JE2945		
Date d'échantillonnage		2021/05/19		2021/05/19		2021/05/27	2021/05/27		
# Bordereau		N-A		N-A		N-A	N-A		
	Unités	**DEV-HN-01**	**Lot CQ**	**DEV-HN-02**	**LDR**	**DEV-HN-03**	**DEV-HN-04**	**LDR**	**Lot CQ**
% HUMIDITÉ	%	2.6	N/A	3.4	N/A	8.4	9.6	N/A	N/A
HYDROCARBURES PÉTROLIERS									
Hydrocarbures pétroliers (C10-C50)	mg/kg	47000	2192167	29000	1000	<100	<100	100	2191997
Récupération des Surrogates (%)									
1-Chlorooctadécane	%	84	2192167	78	N/A	87	89	N/A	2191997

LDR = Limite de détection rapportée
Lot CQ = Lot contrôle qualité
N/A = Non Applicable

REMARQUES GÉNÉRALES

HYDROCARBURES PAR GCFID (SOL)

Les limites de détections indiquées sont multipliées par les facteurs de dilution utilisés pour l'analyse des échantillons.

Les résultats ne se rapportent qu’aux échantillons soumis pour analyse

RAPPORT ASSURANCE QUALITÉ

Lot AQ/CQ	Init	Type CQ	Groupe	Date Analysé	Valeur	Réc	Unités
2191997	DES	Blanc fortifié	1-Chlorooctadécane	2021/06/01		88	%
			Hydrocarbures pétroliers (C10-C50)	2021/06/01		82	%
2191997	DES	Blanc de méthode	1-Chlorooctadécane	2021/06/01		89	%
			Hydrocarbures pétroliers (C10-C50)	2021/06/01	<100		mg/kg
2192167	DES	Blanc fortifié	1-Chlorooctadécane	2021/06/02		94	%
			Hydrocarbures pétroliers (C10-C50)	2021/06/02		87	%
2192167	DES	Blanc de méthode	1-Chlorooctadécane	2021/06/02		89	%
			Hydrocarbures pétroliers (C10-C50)	2021/06/02	<100		mg/kg

Blanc fortifié: Un blanc, d’une matrice exempte de contaminants, auquel a été ajouté une quantité connue d'analyte provenant généralement d'une deuxième source. Utilisé pour évaluer la précision de la méthode.

Blanc de méthode: Une partie aliquote de matrice pure soumise au même processus analytique que les échantillons, du prétraitement au dosage. Sert à évaluer toutes contaminations du laboratoire.

Surrogate: Composé se comportant de façon similaire aux composés analysés et ajouté à l’échantillon avant l’analyse. Sert à évaluer la qualité de l’extraction.

Réc = Récupération

GRILLE D'OBSERVATIONS ET D'ACCEPTABILITÉ DES ÉCHANTILLONS

Adresse de facturation:
Bonterra Resources
ATTN: Comptes Payables
2872, ch. Sullivan, Bureau 2
Val-d’Or, QC
Canada J9P 0B9
Contact du client:
Steve Gaudreault

Adresse du rapport :
Ressources Bonterra
Mines Bachelor
Steve Gaudreault
200, chemin de la mine
Desmaraisville, QC
Canada J0Y 1H0

Dossier Lab BV:	C125002
Date de réception:	2021/05/28
Votre # Bordereau:	N-A
Votre # du projet:	BACHELOR SOLIDS
Chargé du projet Lab BV:	Alexe Martineau
# de soumission:	B90395

Aucune anomalie notée.

Commentaires

Date de réception: **2021/05/28** **Heure:** **10:00** **Par:** ____________

Date d'inspection: ____________ **Heure:** ____________ **Par:** ____________

Date d'impression du GOAE: ____________ **Heure:** ____________ **Par:** ____________

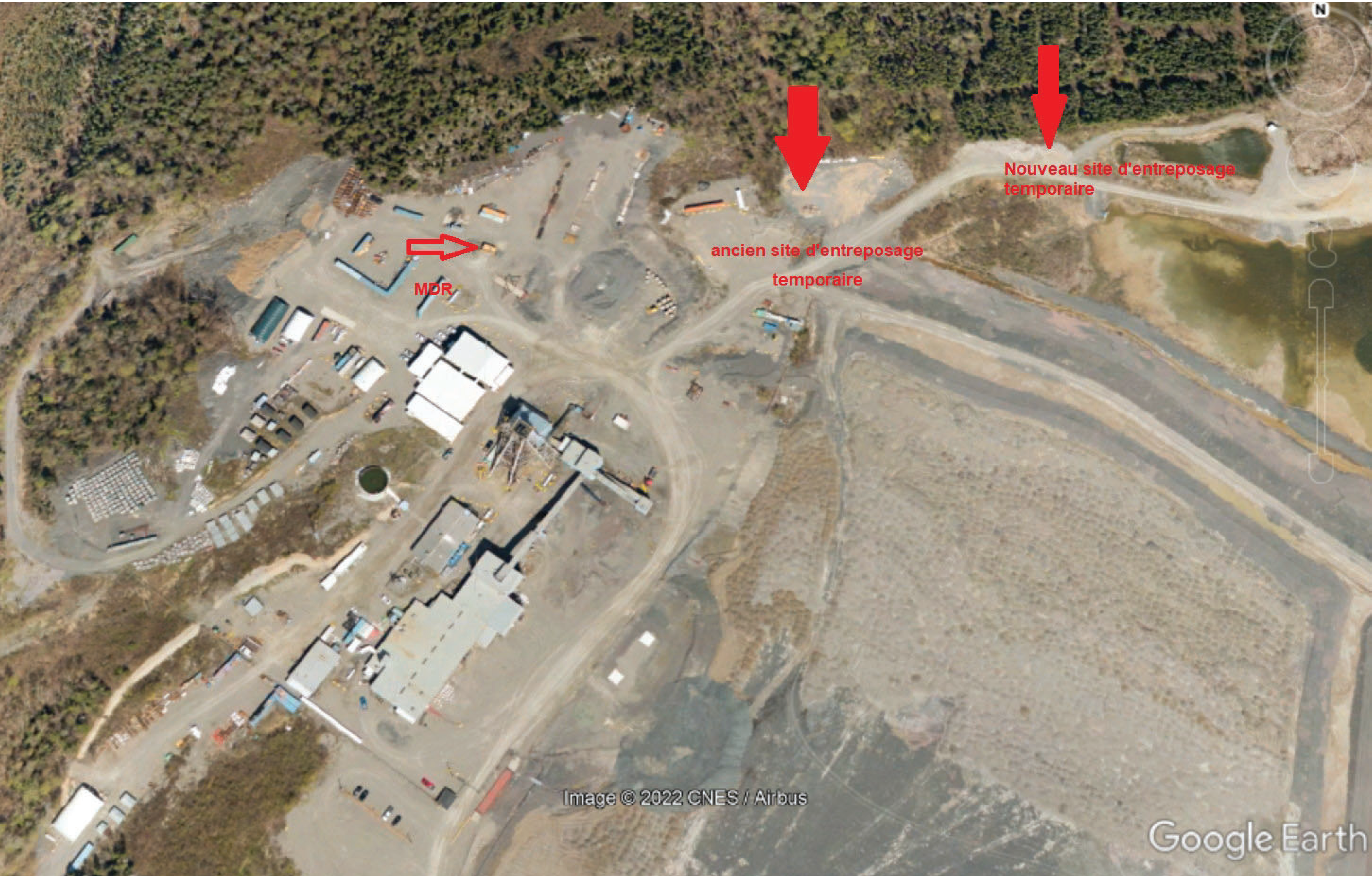
PAGE DES SIGNATURES DE VALIDATION

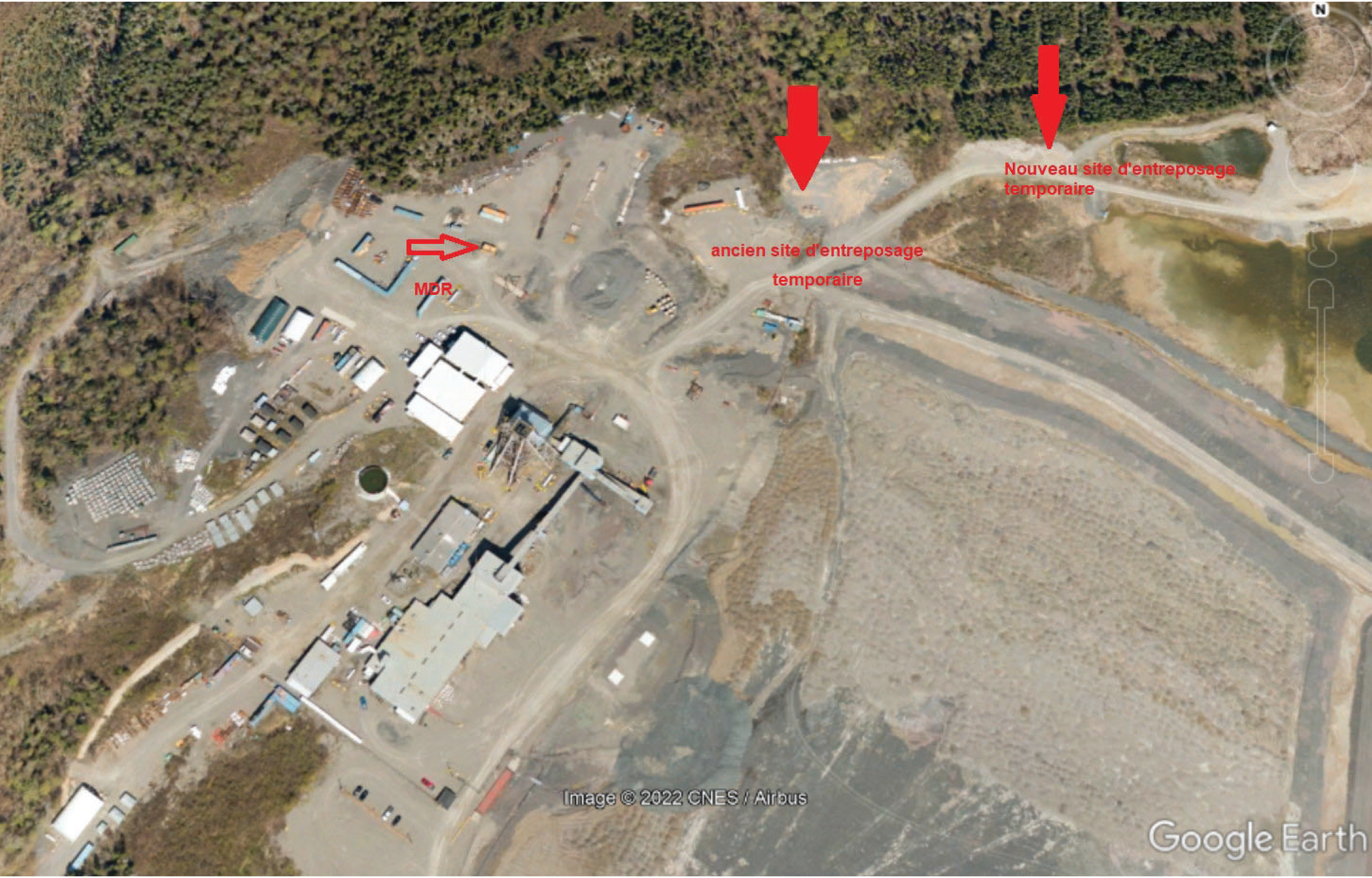
Les résultats analytiques ainsi que les données de contrôle-qualité contenus dans ce rapport ont été vérifiés et validés par:

Frédéric Arnau
2000-102

Frederic Arnau, B.Sc., Chimiste, Montréal, Spécialiste Scientifique

QC2-31: WOODY MATERIALS STORAGE LAYOUT


Nouveau site d'entreposage temporaire
ancien site d'entreposage temporaire
MDR
Image © 2022 CNES / Airbus
Google Earth
N


Nouveau site d'entreposage temporaire
ancien site d'entreposage temporaire
MDR
Image © 2022 CNES / Airbus
Google Earth
N

QC2-32: TABLE 7-2. HAZARDOUS MATERIALS (MODIFIED)

Table 7-2. Chemicals used at the Bachelor site

Chemicals	Product concentration	Appearance	Hazard	Flammability limits	Stored Quantity[1]	Storage method	Previously authorised quantities of stored hazardous materials[2]	Additional quantities of hazardous materials stored as part of this application for authorisation (in metric tons);	Quantity of hazardous materials projected situation 1800 tpd	Quantity of hazardous materials projected situation 2400 tpd
Acetylene	100%	Colourless gas with ether odour	Extremely flammable gas	2.5 to 85%	3,420 L	Pressurized bottle of 91 L	N/A	--	1 200 L	3420 L
Sodium cyanides	23-32%	Brownish liquid characterized by an almond smell	Toxic and corrosive material with aluminium metal. Reacts with acids, thus forming an explosive mixture with air.	5.6% to 40%	45,400 L	Double-walled tanks	45 000 L	--	45 000 L	45,400 L
Lime	90-100%	Solid, white powder and odourless	Corrosive and toxic material. Reacts violently with acids.	n/a	43 t.	Silo	43 t	--	43 t.	43 t.
Flomin 905	0,0073 kg/t	Solid, white powder and odourless	Stable, non-flammable material incompatible with oxidants	n/a	1,250 kg	25 kg bag	N/A	1250 kg	1 250 Kg	1,250 kg
Caustic soda	50%	Clear or greyish liquid	Toxic, corrosive and non-flammable. Reacts violently with water.	n/a	4000 L	1000 L portable tank	4 tanks of 1,100 L each	2,000 L	4 000 L	6,000 L
Anhydrous borax	0,00164 kg/t	Solid, white powder and odourless	Stable, non-flammable and non-explosive substance. Reacts violently with water.	n/a	1,250 kg	25 kg bag	N/A	--	1000 Kg	1,250 kg
Sodium nitrate	95-100%	Solid, white powder and odourless	Unstable and flammable material. Incompatibility with organic matter and reducing agents.	n/a	1,250 kg	25 kg bag	N/A	--	1000 Kg	1,250 kg
Propane	Propane 90% - 99% Ethanethiol <0.1%	Colourless gas with artificial smell of rotten egg	Extremely flammable	2.1 to 9.5 %	25,420 gallons	Single-walled tank and double-walled tank	N/A	Reduction of 6,420 gallons associated with the conversion of heating installations in some buildings to electricity as well as the conversion of the furnace to gas for an induction furnace.	1 000 Gallons	19000
AmexTM (mixture of ammonium nitrate and diesel)	Ammonium nitrate 90-95% Diesel oil 5-10%	Solid, orange granules with a slight kerosene odour	Stable, explosive and water-soluble substance. Risk of fire in contact with ignition sources.	0,07%	37,500 kg	25 kg bag	N/A	Storage reduction proportional to the consumption reduction of explosives. The quantity of stories explosives will be reduced from 37,500 kg to 28,125 kg, for a reduction of 9,375 kg.	0	9375
Emulsion - Ammonium nitrate	Ammonium nitrate 60-70% and sodium nitrate 5-10%, aluminium 1-5%	White, viscous liquid	Oxidizing material, explosive.	Not available	2,000 kg	25 kg box	N/A	Storage reduction proportional to the consumption reduction of explosives. The quantity of stories explosives will be reduced from 2000 kg to 1500 kg, for a reduction of 500 kg.	0	1500

Note(s)

Source: Bachelor site environmental emergency response plan (Metanor, 2018); Impact study - Processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase of machining rate (Wood, 2019); Data transmitted by Bonterra (2022); Personal communication with Gilles Landry (General Manager) (2022).

GENIVAR. 2012. Project to mine and process 900,000 tonnes of gold ore from the Bachelor mine site. Application for a Certificate of Authorisation under Directive 019 of the Environmental Quality Act. Report from GENIVAR to Ressources Métanor inc. 178 p. and appendices.

QC2-33: TECHNOLOGICAL RISK REPORT (FOREST, 2022)

Technological risk study as part of the environmental impact assessment

Processing of gold ore from the Barry and Moroy projects at the Bachelor site and increase of the milling rate
Desmaraisville, Quebec

Bonterra Resources Inc.

Y/Ref --------------
Ref. GCM--------------

26 July 2022

Signatures

Michel Forest

Report prepared by: On 26-07-2022

Michel Forest, Eng.
Technological risk expert

Nicolina D'Agosto

Report verified by: On 26-07-2022

Nicolina D’Agosto, Eng.
Quality control

Note: Nicolina D'Agosto, Eng. verified the report to ensure that the technical data were accurate and that Michel Forest's expertise corresponded to the project's needs. She has no expertise in the discipline of technological risks.

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Appendix A. Compilation of materials present on site and material safety data sheets for key products

Appendix B. ALOHA model results Standard scenarios

Appendix C. ALOHA model results Alternative scenarios

1 Introduction

Bonterra has retained the services of Michel Forest, Eng. of MF Environnement, Expert in technological risk, to perform all of the necessary studies and analyses under the supervision of Nicolina D'Agosto, Eng. It should be noted that Mrs. D'Agosto is acting as supervisor for this part of the project. Indeed, she does not have the expertise to verify the aspects of technological risks included in this environmental impact assessment, but will ensure that Mr. Forest's conclusions are consistent with Bonterra's needs.

1.1 Contextualization of the technological accident risk analysis

This technological risk assessment constitutes the answer to the 2nd series of questions from the COMEX received on 26 November 2021 sent to the proponent Metanor/Bonterra Resources Inc, hereafter represented as "Bonterra", in the context of the analysis of the gold ore processing project of the Barry and Moroy projects and the increase of the milling rate at the Bachelor mine site, and more particularly to questions QC2-33 and QC2-37 sent to Bonterra by the Direction de l'évaluation environnementale des projets industriels, miniers, énergétiques et nordiques of the Direction adjointe des projets industriels et miniers of the Ministère de l'Environnement et de la Lutte contre les changements climatiques MELCC as part of the eligibility analysis of the project's environmental impact assessment.

Question QC2-33 reads as follows:

QC - *Present and provide details on whether there are possible risks to human health (injury, mortality, etc.) for the population near the project site in the event of a risk of a major technological accident caused by the hazardous materials, provided for in this project, having a high level of danger such as, but not limited to, acetylene, cyanide and propane. In the event that such risks cannot be ruled out, the proponent must present and provide quantitative details on the possible impacts envisaged concerning major technological risk accidents for these hazardous materials.*

- Following the previous point, present the additional emergency measures necessary for these accident risks.

Question QC2-37 reads as follows:

QC2- *In section 7-4 of the document "Addendum – Answers to questions and comments by COMEX" (Bonterra, 2021), the proponent mentions that the quantity of explosives stored and used will be increased.*

The proponent must:

- *mention the maximum total quantities provided;*
- *confirm that the instructions of Natural Resources Canada for the storage of explosives, in particular with regard to the quantity/distance principle, remain respected with the increase in the quantity of stored explosives; In this regard, it should be noted that there will be a decrease of the quantity of explosives, not increase;*
- *specify whether the increased storage and use of explosives affects the risk incurred by the surrounding population and if so, to what extent.*

This report was developed with particular consideration to:

- the requirements prescribed in question QC2-33; from the MELCC, contained in the "Questions et commentaires pour le projet de Traitement de minerai aurifère des projets Barry et Moroy au site Bachelor et augmentation du taux d'usinage – Dossier - - . 20 novembre 2021";
- of the "Guide de gestion des risques d'accident industriels majeurs" (2017 edition) from the Conseil pour la réduction des accidents industriels majeurs (CRAIM);
- the Guide d'analyse de risques d'accident technologiques majeurs (2002 edition) of the Quebec Ministry of the Environment;
- the "Risk Management Program Rule", 40 CFR 68.25 of the United States Environmental Protection Agency (USEPA).

1.2 Project description

Although most of the ore is sourced from the Barry site, located some 110 km from the Bachelor site, Bonterra has chosen to increase the ore processing rate at the Bachelor mill rather than build a new ore processing plant at the Barry site. In this sense, Bonterra has favoured the reuse of existing infrastructures, including the Bachelor tailings management area (BTMA), which contains 1.0 M m^3 (1.3 Mt) of tailings and covers an area of approximately 700,000 m^2. The BTMA is designed to receive the pulp from the ore processing plant's discharges. With the increase of resources, the capacity of the BTMA must necessarily be increased in order to support the projected production. The BTMA must be able to accommodate an additional 5.6 M (8 Mt) of tailings. The expansion will be to the south and the additional area is estimated at just over 1,000,000 m^2. These silty tailings, produced at variable rates, are potentially acid generating (PAG) only to a slight degree, but are contaminated with cyanides from the ore processing plant.

The mining method used at the Bachelor mine is the non-backfilled long-hole site method. This method consists of excavating the ore using long-hole drills inserted into sub-levels. It allows for better exploitation of the Bachelor site, because the deposits are composed of several narrow, non-directional zones, with a dip greater than 50°. This allows the ore to fall by gravity into the racking zone.

The Bachelor mine remains one of the few mines in Quebec that uses "conventional" machinery. This machinery allows the excavation of small drifts and is recommended for low-powered vein-type deposits (medium thickness). The average thickness of the deposits at the Bachelor site is between 1 and 2 m. On the other hand, mechanized machinery requires larger excavations, which results in an increase of the planned dilution. In addition, conventional machinery runs on compressed air or batteries, and therefore essentially on Hydro-Quebec electricity. In this way, the use of non-renewable energy is minimized. In the Main Zone of the Bachelor mine, the operation goes below the level of the mine access shaft. Below the last level, a ramp is excavated and mechanized machinery is used to haul the ore. This is the mining method with mechanized long-hole drilling. The principle remains the same, but machinery is used to run the operation from the upper level to the lower level. The mining method used at the Bachelor mine will also be used for the Moroy deposit. The Moroy deposit will be mined by continuing the existing underground network of drifts.

The anticipated ore to waste rock ratio will be 3 mt of ore to 1 mt of waste rock, as is the case for the Bachelor mine.

The main explosives used at the Bachelor mine/Moroy are AmexTM and emulsion (cartridge explosives). AmexTM is a standard blend of ammonium nitrate and diesel fuel that is used for development (ore access).

Cartridge explosives, composed of a mixture of ammonium nitrate and sodium nitrate, are used for ore production sites. The proportion of encapsulated explosives to bulk explosives *(Ammonium Nitrate and Fuel Oil* or ANFO) is about 50%. The explosives are not manufactured on site. The latter as well as the detonators are supplied by Orica of Val-d'Or and transported to the mine by the same supplier in trucks identified for this purpose, in compliance with regulatory requirements. Most of the explosives and detonators are stored underground as soon as they are received. If necessary, depending on the circumstances (unavailability of the cage for descent into the shaft), the existing explosive depot on the surface is temporarily used. These storage facilities, built to all current standards, are located at the end of a dead-end road, which originates along the main access road from the camp to the mine.

Since 2013, the average consumption of these detonators at the Bachelor mine is close to 1 kg of explosives per 9 t of ore, a ratio of 0.11 kg/t. With respect to the main residual chemicals, the reaction theoretically forms only nitrogen, carbon dioxide and water. In practice, these conditions are impossible to achieve and explosions produce moderate amounts of toxic gases, such as carbon monoxide (CO) and nitrogen oxides (NOx). It should be noted that, as an explosive, AmexTM is known to produce minimal post-detonation smoke (Orica, 2008). No change in the use and quantity of explosives is planned as the Moroy deposit is part of the Bachelor site. As the average consumption is close to a ratio of 0.11 kg/t, it is estimated that 25,000 kg of explosives will be required annually.

The presence of waste rock in the ore is a constant challenge at the Bachelor/Moroy mine. The vein-type deposit offers good grades when the ore is assayed; however, the vein walls are completely waste rock. This waste rock is deposited in the waste rock dump located to the south of the site.

The ore from the Bachelor site will continue to be stockpiled on the two existing ore stockpiles, which are called temporary because they are only used to accumulate a certain volume while waiting to be processed. Each one has a maximum dimension of 70 m by 40 m and can reach a height of 15 m with slopes of 2:1. Storage time can vary from 7 to 45 days. At present, Bonterra has never used both stockpiles at the same time.

In addition, they have never been filled to capacity. The ore stockpiles are located south of the mill within the BTMA drainage area. Preferentially, the ore from the Barry site will not be stored outside before processing, by unloading it from the truck directly into a hopper feeding the crusher, which will in turn feed it by conveyor to the plant. In order to deal with operational hazards (e.g. machinery breakdowns), three new temporary Barry ore stockpiles will be set up. Of imperfect rectangular shape, each one will have a dimension of approximately 40 m by 25 m for an average height of 6 m. They will also be located within the BTMA enclosure.

Ores from the Barry and Bachelor sites can be considered conventional for the Abitibi region; in the sense that after a physical release of the gold grains from the crushing and grinding circuit, the gold contained in the ore is easily dissolved in a cyanide solution. In addition, the gold grains are relatively coarse, which facilitates the use of gravity centrifugal concentrators to reduce the amount of gold going to the chemical recovery process. The Bachelor mill formerly used the Merrill-Crowe process, but underwent a major conversion to the carbon in pulp (CIP) process in 2011. Therefore, the proposed modifications do not involve any change to the recovery process, but only an expansion of the plant to process the ore from the Barry site. In other words, some equipment will be replaced with more efficient equipment, and since the process is sensitive to leaching time, tanks similar to those in operation will be added. The coal processing circuit and the refinery have sufficient capacity and do not require any modifications. The ores from the Barry and Bachelor sites will not be processed simultaneously, meaning that both ores will have to be stored at their respective sites and processed alternately over periods of several days.

The efficient handling of ore is essential for ensuring the Project's profitability. As such, several modifications will be made to the ore storage silos at the Bachelor site, along with the addition of a receiving and handling circuit for the ore from the Barry site. The machining criteria are based on the parameters presented in Table 1.1.

Table. - Machining criteria

Parameter	**Current process**	**Proposed process**
Nominal production	750 tpd	Barry and Bachelor: 2,400 tpd
Production	34.5 tph	Barry and Bachelor: 108.7 tph
Availability	90.5	92 %
Crushing circuit product	80% exceeding 10 mm	80% exceeding 150 mm
Grinding circuit product	80% exceeding 75 µm	80% exceeding

The density of the cyanide pulp is controlled to about 55% solids. For this purpose, a high performance thickener is used. The overflow (liquid) is recirculated as process water, while the densified underflow is directed to the first cyanidation tank. The gold is put into a sodium cyanide solution by means of mixing in mechanically stirred tanks. An initial set of four tanks in series is used with cyanide solution added to the first tank. The discharge from the fourth tank goes to the CIP tanks. Carbon has the property of adsorbing gold in solution. The carbon, which is much coarser in size than the crushed ore, is added to the last tank. A typical carbon particle size is 1 to 2 mm
1,000 to 2,000 µm), whereas the ore is normally ground to less than 75-100 µm.

Sieves retain the carbon at the outlet of the tanks. They are coarse enough to allow the ore to pass through, but retain the carbon which is taken up by a pump and directed to the tank immediately upstream. The carbon in the first tank, which has been circulating against the flow of the pulp and has become loaded with adsorbed gold, is pumped to a sieve to recover the carbon and deliver it to the carbon processing circuit, while the pulp is returned to the first tank. The pulp at the outlet of the last tank constitutes the process discharge (residue). It passes over a safety sieve to recover any carbon grain that might have followed the pulp. This carbon is accumulated and processed separately. The expansion and increase of the tonnage will cause a decrease of the retention time of the pulp through the circuit. As a result, the thickener will have to be replaced by a larger one, which will be installed outside. Also, two new carbon in pulp tanks will have to be installed inside. The inter-tank sieves will also have to be changed. Three new cyanidation tanks could be installed outside if needed. The safety sieve (at the end of the CIP circuit) will also be changed to a larger capacity model. The modifications to existing installations are:

- Replacement of the thickener for one with a larger capacity.
- Possible addition of new cyanidation tanks.
- The addition of two new CIP tanks, with their inter-tank sieves and carbon transfer pumps.
- The change of the inter-tank sieves for a model with a greater capacity.
- Change of the flocking sieve for a larger capacity model.

The carbon recovered from the first tank is accumulated in the washing tank. The purpose of this step is to remove impurities from the carbon, especially carbonates that have been adsorbed while the carbon was in the CIP circuit. The washing is performed by circulating a solution containing caustic soda, which serves to remove the impurities (the washing has never been performed with HCl and HNO_3). Caustic soda is often (but not necessarily) added at the end of the cycle to neutralize the carbon before its transfer to the elution tank. This step takes a few hours, adjusted according to the level of impurities and the desired degree of cleaning.

The carbon is transferred to the elution tank, which is an operation in which the gold adsorbed on the activated carbon is put back into solution (desorption). Desorption is performed by circulating a heated solution (100-120°C) under moderate pressure to prevent boiling. The solution is a mixture of sodium cyanide and caustic soda (NaOH), each at a concentration of 0.1 to 0.2. The gold adsorption reaction is then reversed and the gold returns to solution, which becomes loaded with soluble gold, resulting in a small volume of solution with a high concentration of gold, called rich solution.

The rich solution is pumped to the electrolysis cells, where the gold is deposited on stainless steel cathodes by forced reverse polarity. The gold-free solution (barren solution) is heated and recycled to the elution tank. The cycle is stopped when all of the gold has been desorbed from the carbon. The elution and electrolysis operation lasts several hours, normally from 6 to 12 hours.

Activated carbon has a dendritic structure, with a lot of active surfaces, which makes it a good choice for the gold adsorption process. On the other hand, the carbon particles were fairly passivated by their passage through the CIP circuit, the acid wash and the elution. The adsorption properties of the carbon can be reactivated by heating in the presence of steam, which also prevents the oxidation of the carbon at high temperatures.

The desorbed carbon is transferred from the elution tank and passed over a sieve to remove excess water before passing into the reactivation furnace. This furnace is operated at a temperature of 550 to 700°C and the water contained in the carbon creates the steam necessary for reactivation and protection against oxidation. The carbon at the exit of the furnace is immediately put into contact with water to reduce its temperature. The passage of carbon through the furnace causes marked attrition of the carbon. Thus, the carbon with the soaking water is pumped to a sizing screen, where excessively fine carbon particles can be removed and recovered in bags to be sold to third parties for gold recovery. Typically, 2-5% of the carbon is removed in this manner. The good quality carbon, fully washed, which is gold content removed, reactivated and graded is then returned to the CIP circuit.

The gold is deposited as a metallic sludge with a high gold content on the cathodes during electrolysis. This sludge is accumulated until the efficiency of the electrolysis is diminished, normally a few days. Each cathode is then pressure washed and the metal sludge is accumulated in a buffer tank before being pumped through a plate filter. The filtered cake is then dried in an oven. Alternatively, the sludge is decanted from its excess water and put into the drying oven directly in trays used for this purpose. The dried cake is then mixed with fluxing agents (borax and sodium nitrate) and melted in a furnace. The molten metal, containing a high gold content, is cast into gold bars directly from the furnace.

These are cleaned, polished, stamped and sent by secure transport to the external refinery. The excess fluxing agent is then recirculated for the next melt or returned to the plant feed. This process does not generate any losses.

The maintenance and use of the ore transport trucks from the Barry site will be outsourced to a contractor. The latter will also ensure the refuelling of the trucks. At a maximum production rate of 2,400 tpd, a fleet of eight trucks in service and one or two spare trucks will be required. It is anticipated that a fleet of approximately five in-service trucks and one spare truck will suffice for an average production rate of 1,500 tpd. The exact location of the garage and fuelling station will be determined by the successful subcontractor, but this location will not be on the study site. It is assumed that a team of four full-time mechanics will be required.

These installations will comply with current standards, including those governing the management of residual materials. The existing hydrocarbon supply installations at the Bachelor site are currently underutilized and will meet the additional needs of the Project at the Bachelor site without being modified.

Cyanides and petroleum products are the main hazardous materials used at the Bachelor site. Reagents for the ore processing plant are described in Table 2.3, as well as in the cyanide management plan to minimize the risks associated with the use of this substance. For cyanide management, Bonterra follows the guidelines of the International Cyanide Management Code, which addresses transportation, handling, storage, operation, decommissioning, safety, emergency response, training, and employee and public dialogue (ICMI, 2016).

The main petroleum products used at the Bachelor site are divided into two categories, fuels on the one hand and oils and greases on the other. Diesel and gasoline fuels are stored in tanks belonging to Petronord that comply with regulations; they are installed above-ground and are double-walled or equipped with a retention basin. New and used oils are also stored in compliant tanks; hydraulic and motor oils represent the main quantities stored, while smaller quantities include lubricating greases, thinners, brake oils, gear oils and antifreeze, among others.

All maintenance and repair activities are performed inside the garage. It is equipped with materials and equipment suitable for the recovery of spilled products. In addition, all heavy machinery is equipped with an emergency kit for the recovery of products spilled outside the garage. These kits include sufficient absorbent rolls to contain the spill within the operating range of the machinery used. All solid (e.g.: soil drags) and liquid (e.g. oils) residual hazardous materials resulting from maintenance or repair activities are recovered and stored in special garbage cans or containers that comply with the standards and regulations in effect. Residual hazardous materials are collected by a company that is known in this field, such as Terrapure from Rouyn-Noranda or Les Serres coopératives de Guyenne. Table 2.3 lists the hazardous material tanks, their capacities, and the capacities of their retention basins, if any.

Worn tires resulting from trucks transporting ore are also generated. However, the retreading of ore truck tires will preserve the tire tread, so that only worn treads will be sent for recycling or recovery. It should be noted that trailer tires generally wear much more slowly due to load distribution and that continuous maintenance of the haul road surface will increase the durability of the treads.

The supplier responsible for the trucking will be responsible for managing the retread. The used treads will be treated in a centre authorized for this purpose.

2 Presentation of the project components

2.1 The project and its environment

2.1.1 Location of the project

The Project's main location is the Bachelor site which is located approximately 225 km northeast of Val-d'Or, 95 km northeast of the town of Lebel-sur-Quévillon (VLSQ), 30 km southwest of the Cree First Nation of Waswanipi (CFNW) community and 3.5 km east of the hamlet of Desmaraisville. The Bachelor site is located within the municipal territory of Eeyou Istchee Baie-James. The Barry site is located in the northwestern part of Barry Township, approximately 90 km east of VLSQ and 65 km southeast of Desmaraisville. It is connected to the Bachelor site by an existing transportation route totalling approximately 110 km (see Figure 2.1).

2.1.2 Presentation of the study area and of the property line (fictitious)

The property line (fictitious) considered in this study is delimited to the north and west by mining lease BM-1025 (Lot 6,096,775) and mining concession CM-510, to the east by the future Bachelor BTMA tailings dam and to the south by lot 6098128. The selected study area is shown in Figure 2.2. The study area extends within a 5 km radius in all four cardinal directions from the treatment plant.

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2.1.3 Identification of sensitive environmental factors

Various sensitive elements, also known as receptors, surrounding the project site were considered for the analysis of impacts to sensitive receptors. These include:

- Population (density).
- Public institutions.
- Businesses and industries.
- Other sensitive elements (pipelines, high voltage power lines and transportation routes).

Population and population density

The population data is based on information contained in the Bonterra-Wood Environmental Impact Statement, 26 September 2019), that indicates the number of residents counted on either side of the study area. Table 2.1 shows the number of inhabitants by populated places.

Public institutions

Public institutions, such as schools, senior residences, CLSCs, hospitals, sports centres and government buildings, were also identified in the Bonterra-Wood Environmental Impact Assessment, 26 September 2019) and are presented in Table 2.2.

Table. - Population and population density within a radius of 5 km

Inhabited places	Population	Population density (inhab./km)
Hamlet of Desmaraisville (3.5 km northwest)	30	<1
Bachelor Lake Cree Camp[2] (non-permanent and random 3.0 km northeast)	1-2	<1
Bachelor Lake Non-Cree Camp[2] (non-permanent 3.0 km northeast)	1-2	<1
Bachelor Lake Cree Camp[2] (non-permanent) 2.0 km west	1-2	<1
Bachelor Lake Cree Camp[2] (permanent 1.5 km southwest)	N/A	<1
Bonterra workers' camp	100-160	<1
TOTAL	**-**	<1

(1) Reference: Bonterra-Wood Environmental Impact Assessment, 26 September 2019).
(2) There is no infrastructure on the site.

Table. - Number of public institutions/businesses within 5 km

Public institutions	Number
School and CEGEP	0
Senior residences	0
CLSC, Hospital	0
Sports centre/pools	0
Bar/Convenience store	2
Government, community building	0
TOTAL	

(1) Reference: Bonterra-Wood Environmental Impact Assessment, 26 September 2019).

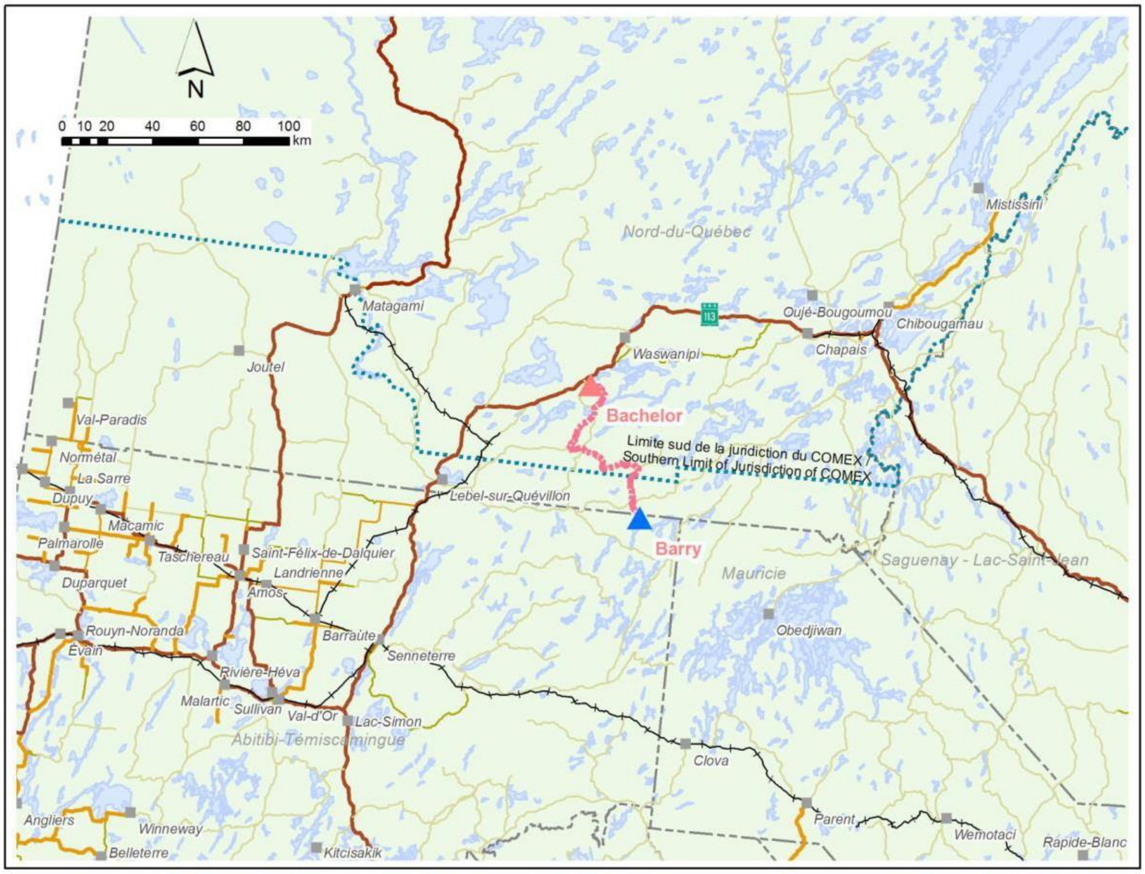

Figure. – Location of the project

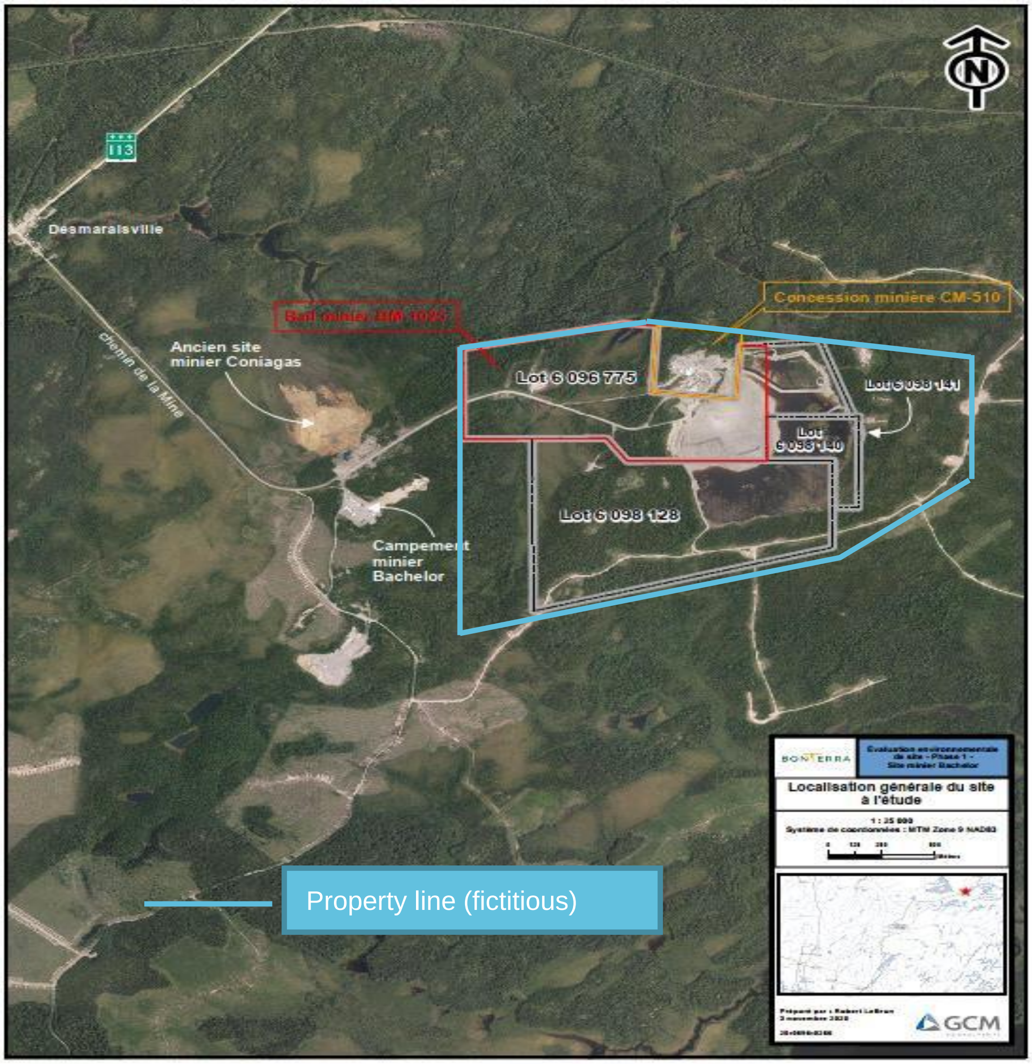

Figure. - Property line (fictitious)

2.2 Description of the installations

The most important installations where the main hazardous materials are found with the maximum quantities in storage are presented in Table 2.3. The hazardous materials are taken from the inventory in Appendix A. The selected substances are those present in quantities of more than 1 tonne and which are classified as hazardous. These installations are shown in Figures 2.3 and 2.4 (by tank/container numbers), for the substances selected in the hazard analysis (see section 4.1.4).

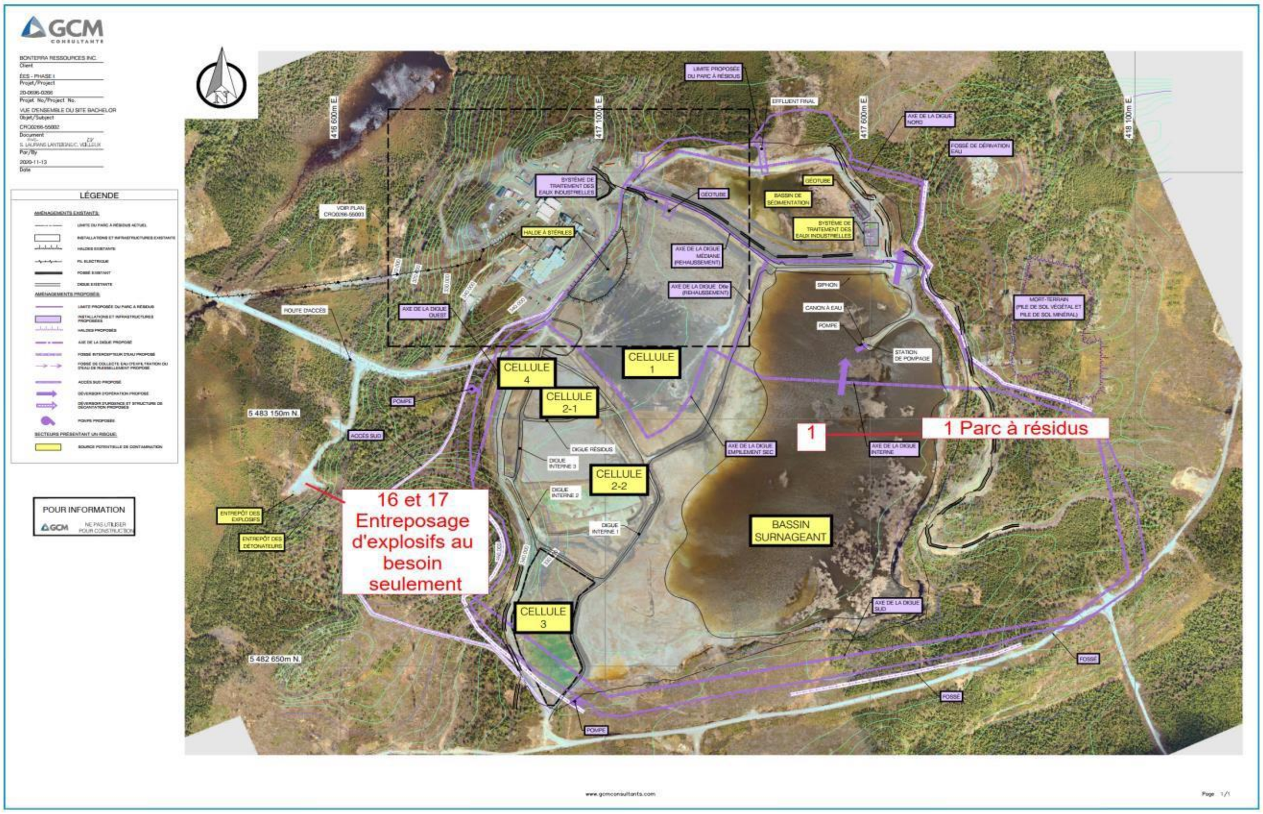

Table. - Tanks/containers of the main hazardous materials

Tanks/containers of hazardous materials		Use	Location	Number	Capacity	Capacity of retention basin
Tailings management area						
1	Cyanide sludge	Treatment residues	Bachelor tailings management area (BTMA)	1	Volume 6,600,000 m^3	n/a
Materials at the ore processing plant						
2	Lime (solid)	Adding ore to the grinding circuit	Door #8 inside the plant	1	Total: 43 t Silo: 43 t	n/a
3	Sodium cyanide	High-efficiency thickener	Ore processing plant	2	Total: 380 kg Thickener: 190 kg	n/a

Tanks/containers of hazardous materials		Use	Location	Number	Capacity	Capacity of retention basin
4	Activated carbon (solid)	Leaching and CIP circuit	Ore processing plant	12	Total: 6000 kg Bag : 500 kg	n/a
5	Sodium cyanides	Leaching and CIP circuit	Door #8 inside the processing plant	1	Volume: 45,400 Litres	Inside the building forming a retention area of 800 m2
6	Caustic soda 50	Processing of activated carbon	Ore processing plant	4	Volume: 275 Litres	None
7	Magnaflox - Flomin 905 (solid)	Flocculant	Ore processing plant	100	Total: 2,500 kg Bag : 25 kg	n/a
8	Anhydrous borax (solid)	Gold refining circuit	Ore processing plant	50	Total: 1,250 kg Bag: 25 kg	n/a
9	Sodium nitrate (solid)	Gold refining circuit	Ore processing plant	40	Total: 1000 kg Bag: 25 kg	n/a
Flammable materials						
10	Acetylene	Welding/cutting	Garage	34	Volume: 3,420 Litres	None
11	Propane	Heating or operating equipment	Underground heating	1	Volume: 68,400 Litres (18,000 gallons)	None
12			Kitchen (food preparation)	1	Volume: 3,800 Litres (1,000 gallons)	None
13	Diesel	Operation of vehicles or generators	Backyard	1	Volume: 22,700 litres (double wall)	None
			Backyard (office generator)	1	Volume: 2,275 litres (double wall)	None
			Rear of the compressors	1	Volume: 4,450 litres (double wall)	None
			Kitchen generator	1	Volume: 700 Litres	70 Litres
14	Used oil	Garage	Garage	1	Volume: 2,000 Litres	3,000 Litres
15	Gasoline	Garage	Backyard	1	Volume: 4,500 litres (double wall)	None
Explosive materials						
16	AmexTM (mixture of ammonium nitrate and diesel)	Explosive	Mine sites (underground storage)	6 explosives storehouse	Total: 28,125 kg (over six locations) 6,250 kg (250 bags of 25 kg per explosives storehouse)	n/a
			Mining sites (temporary above-ground storage)	1 building	Total: 3,000 kg 3,000 kg (120 bags of 25 kg)	n/a
17	Emulsion - Nitrate + Fuel Ammonium Oils	Explosive	Mining sites (underground storage)	6 explosives storehouse	Total: 1,500 kg Bag: 25 kg box	n/a
Other – Water treatment plant						
18	Caustic soda (NaOH)	Water treatment	Processing plant for water	5	Volume: 1,000 Litres	None
19	Ferric sulphate (Fe2(SO4)3)	Water treatment	Processing plant for water	5	Volume: 1,000 Litres	None
20	CHEMFLOC solid flocculant CMX 123	Water treatment	Water Treatment Plant	40	Total: 1,000 kg Bag : 25 kg	n/a

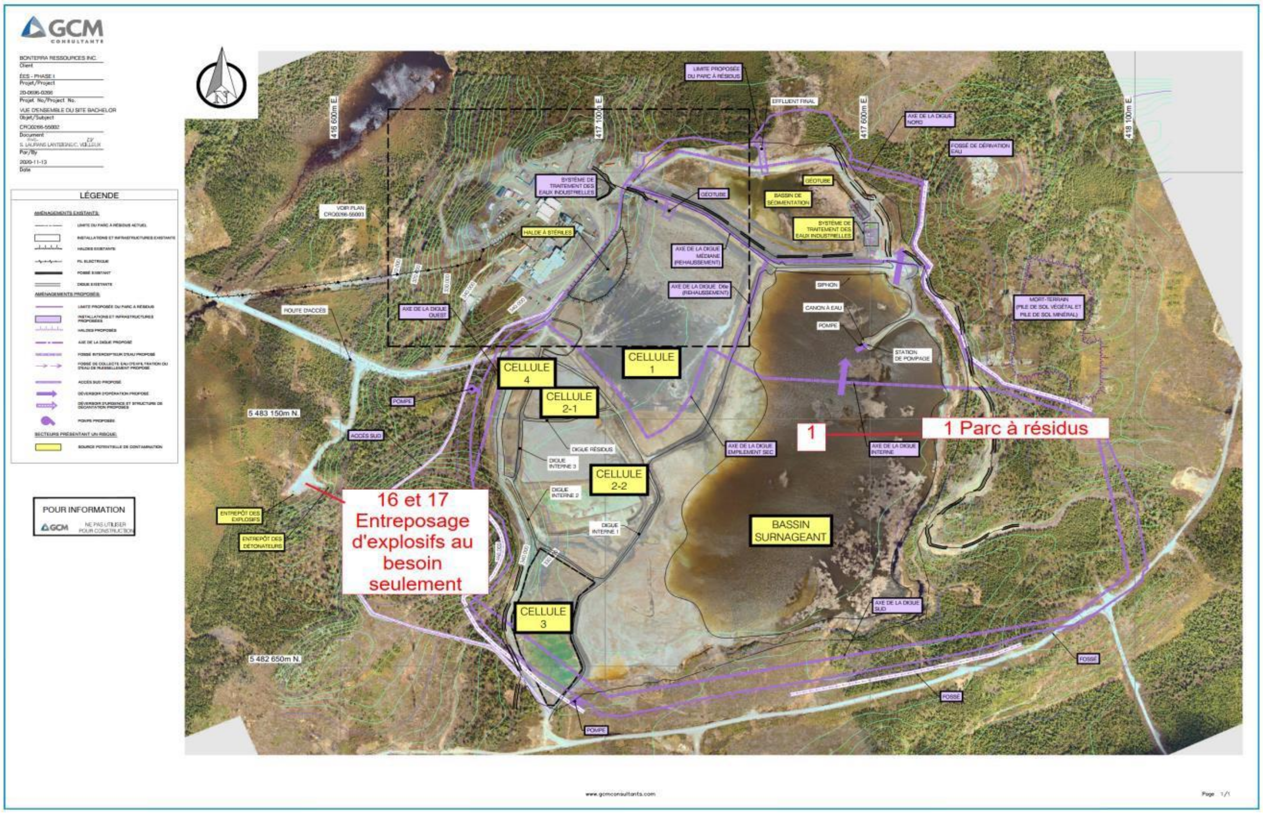

Figure. - Location of the installations (with tailings dam)

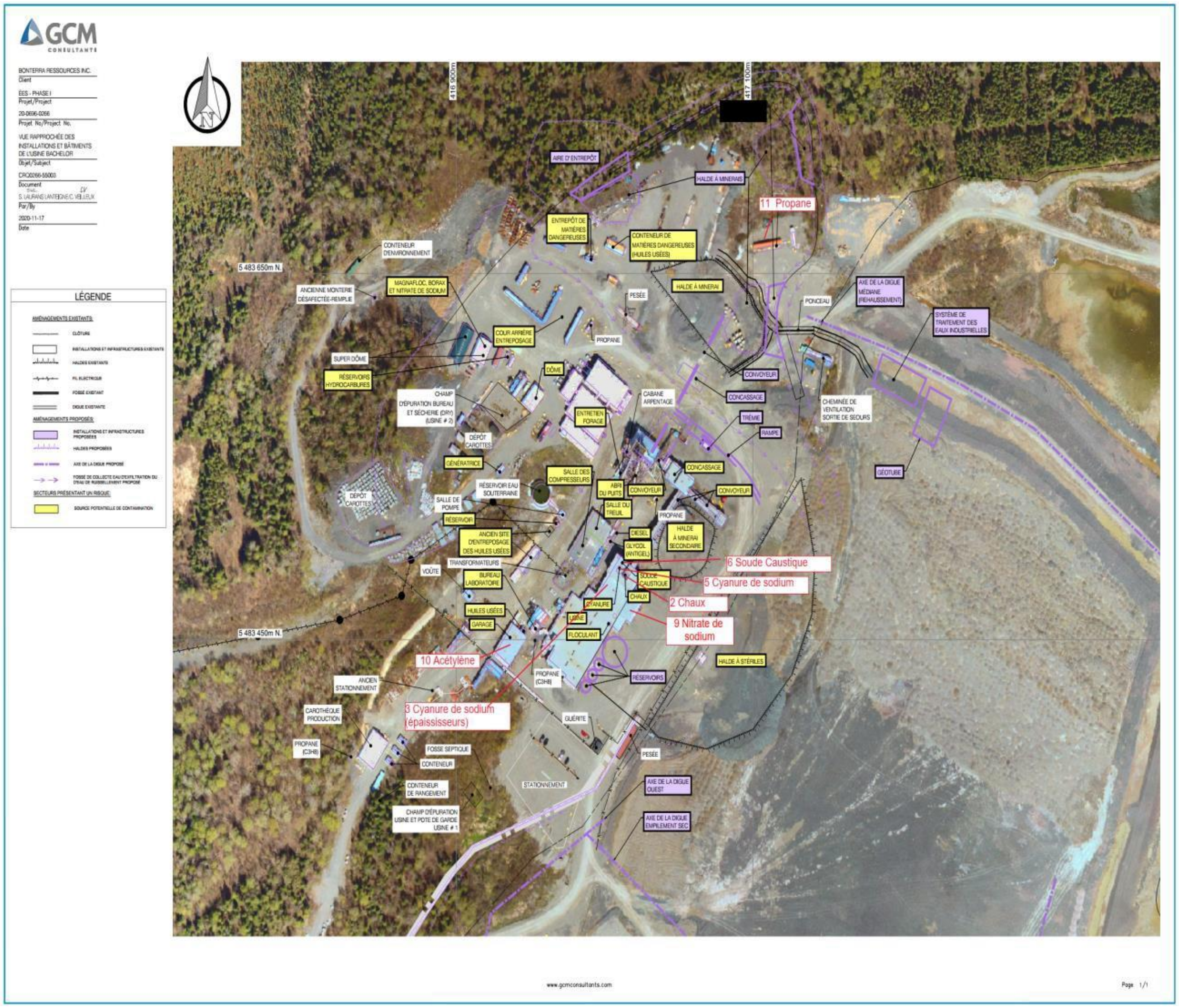

Figure. – Location of the installations (ore processing plant)

3 Methodology

The ultimate goal of the technological accident risk analysis is to assess the individual risks to the population due to the dangers of fire, explosion and toxic effects related to mining activities. The employed risk assessment methodology (See Figure 3.1) is consistent with MELCC guidelines and refers to the Major Industrial Accident Risk Management Guide (2017 edition) of the Conseil pour la réduction des accidents industriels majeurs (CRAIM) and to the Guide d'analyse de risques d'accident technologiques majeurs (June 2002) of the MENV. The employed assessment method involves four main steps:

1. Identification of hazards and development of accident scenarios.
2. Analysis of potential consequences (by modelling with ALOHA).
3. Frequency analysis.
4. Individual risk assessment and comparison to risk acceptability thresholds (CCAIM).

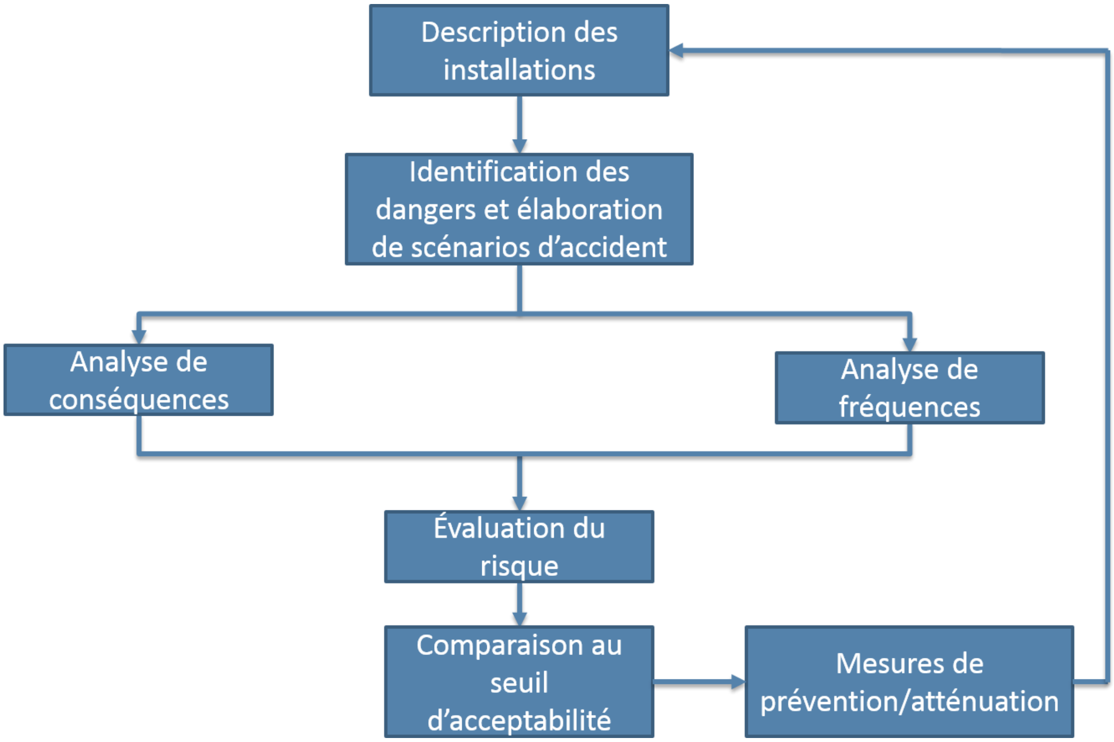

Figure. – Flow chart representing the employed analysis methodology for technological

This approach ensures that we have the highest possible level of confidence in the results obtained by overestimating the risk. Indeed, the operating conditions were chosen to represent the highest maximum consequences that could be obtained on the basis of the available data.

The identification of hazards, both internal and external, is the first step in the analysis of technological accidents (refer to section 4). These are notably assessed on the basis of a historical review of accidents in comparable gold mining operations, identification of risks related to the transported products and failure analysis.

Accident scenarios (see section 5) are developed and defined from the various identified hazards. For gold mining activities involving hazardous materials, these are essentially fire, explosion and toxicity scenarios related to breaches of various sizes that can occur in the event of a tank and/or equipment leak. The methodology used for this analysis is based on that recommended in the CRAIM "Guide de gestion des accidents industriels majeurs" (2017 version) and the U.S. Environmental Protection Agency U.S. E.P.A. "Risk Management Program Guidance for Offsite Consequence Analysis" document. . It is a risk assessment method based on the evaluation of standard "Worst Case Scenario" and alternative accident scenarios.

A standard accident scenario for gaseous and liquid materials is defined as the loss of containment of the largest quantity of a hazardous material that would result from the rupture of a container or piping system over a 10-minute period under worst-case weather conditions. These scenarios consider passive protection systems (e.g. dikes, buildings, etc.), but not active protection systems such as detectors. The standard accident scenario is a preliminary diagnostic tool that is very unlikely to occur. These scenarios are used to determine the worst-case consequences during emergency planning.

As for the alternative scenarios, they have been developed from various breach dimensions, as found in the literature on this subject. These represent more plausible situations. These standard and alternative scenarios are then subjected to consequence analysis (refer to Section 6) with ALOHA software (version 5.4.7 from the EPA Office of Emergency Management and NOAA (Emergency Response Division).

Fire scenarios are evaluated in terms of thermal radiation effects while explosion scenarios are evaluated in terms of overpressure effects. Toxicity scenarios are evaluated based on the threshold concentrations of toxic substances in the air.

Accident frequency analysis and individual risk are not considered further in this study because the consequence analysis demonstrates that the impact radii of the alternative scenarios do not reach sensitive receptors.

In the event that a risk is identified that is not considered acceptable, the hazard mitigation measures are reviewed on the basis of the risk levels obtained, in order to reduce it to an acceptable level.

4 Identification of hazards

4.1 Identification of internal hazards

4.1.1 Historical review of accidents

A review of major mine accident data was conducted. In addition, the data compiled in the MELCC's Environmental Emergency Response Registry was used to identify the probable risks and consequences associated with accidents at mine sites. Between 2010 and 2022, some twenty (20) accidents that were considered major, and that had a significant impact on the communities due to the magnitude of the impacts, were compiled(Table 4.1). These are mainly failures of tailings dams and accidents related to gasoline and diesel oil spills.

Table. - Mine site accidents

Location	Type of accident	Year	Material involved	Volume spilled
Brazil(Brumadinho)	Dike breach of the iron mine with a large amount of mud and mining waste spilled into the environment. This event affected an entire village and caused a hundred deaths and nearly 300 missing.	1 January 2019	Tailings sludge	N/A
Canada (Mount Polley, British Columbia)	Dike breach at the gold and copper mine that resulted in the release of contaminated water into the environment.	4 August 2014	Tailings-laden water	24,000,000 m^3
Canada (Aurizon Mine - Casa Berardi)	Dike breach at the gold mine with release of contaminated water and tailings into the environment.	1 May 2013	Tailings-laden water	62,000 m^3
Canada (Monique Mine - Richmond)	Leakage of dewatering water from the gold mine basin into the environment.	18 April 2013	Tailings-laden water	15 m^3
Canada (Anne Opémisca mine - Chapais - Obatogamau River)	Breakage of the entire sedimentation basin of the copper mine which emptied into the environment.	23 June 2008	Tailings-laden water	Area of 42 hectares
Near the Sigma 1 waste rock dump	Release of tailings into the environment	28 July 2020	Tailings	160 tonnes
100 chemin du lac Mourier	Release of tailings into the environment	21 August 2014	Tailings	50 m^3
500 route du Lithium	Release of tailings into the environment	15 June 2014	Tailings	490m^3
Louvicourt mine	Discharge of processing sludge and water into the environment	8 February 2014	Tailings-laden water	100m^3
500, route du Lithium	Mine tailings in the environment	2 April 2013	Tailings	<200m^3
500, route du Lithium	Mine tailings (mainly water and quartz) in the environment	18 March 2013	Tailings	<50,000m^3
Rouyn-Noranda	Spillage of copper concentrate into the environment	6 January 2020	Copper	34 tonnes
Val d'Or	Gasoline spill into the environment	1 November 2019	Gasoline	16,000 litres
Val d'Or	Diesel spill into the environment	22 October 2019	Diesel	150 Litres
Rouyn-Noranda	Release of calcium chloride solution into the environment	10 January 2019	Calcium chloride	100 Litres

Location	Type of accident	Year	Material involved	Volume spilled
Val d'Or	Spillage of heating oil into the environment	23 October 2018	Oil	200 Litres
Senneterre	Diesel spill into the environment	21 May 2015	Diesel	2,000 litres
Chapais	Sulphuric acid spill into the environment	26 January 2018	Sulphuric acid	1,200 litres
Eeyou Istchee James Bay Regional Government	Ferric sulphate spill on surface infrastructures	19 August 2019	Ferric sulphate	28,400 litres
Eeyou Istchee James Bay	Diesel spill into the environment	20 July 2015	Diesel	5,000 litres
Chibougamau substation, on route 113 between Chibougamau and Chapais	Spillage of BCP-free insulating oil into the environment	28 March 2012	Oil	1,650 litres

4.1.2 Identification of product-related hazards

Below, all of the hazardous materials identified in the previous sections are described in terms of their main hazard characteristics.

A) Acetylene

Pure acetylene is an extremely flammable gas which can also explode spontaneously when subjected to high pressure (above two atmospheres) or a sudden temperature increase. It is usually found in pressurized bottles of about 91 litres 42 kg), dissolved in acetone impregnated in a porous material. It has no odour when pure. The risk of fire is very high. A mixture with air containing 30% acetylene can ignite at 305°C. The risk of explosion is very high. Acetylene forms explosive mixtures with air between concentrations of 2.5% and 82%. It can explode in contact with chlorine and fluorine. The following Table 4.2 presents the characteristics of this compound that are most relevant to this study. Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

Table Characteristics of acetylene

Parameters	Hydrogen cyanide
Flash point 1)	<-17.8°C
Auto-ignition temperature 1)	305°C
Steam density 1	0.91 kg/l
Vapour pressure 1	101.3 kPa
Lower flammability limit 1	2.5
Upper flammability limit 1	82%

(1) Reference: CNESST Toxicological Directory.

B) Tailings sludge

The sludge from the gold ore processing plant is sent to the tailings management area. This sludge is treated at the water treatment plant so as to limit the amount of cyanides. This liquid sludge still contains metals and cyanides. However, at the level of the dikes, these sludges are stable. Due to its dangerousness, in the event of dike breakage, this substance is considered in greater detail further in this consequence study.

C) Anhydrous borax

Anhydrous borax is mainly used in the gold refining circuit. At room temperature, it is a white crystalline solid with no odour. This product is a non-volatile and non-flammable solid material. This product absorbs moisture from the air (hygroscopic) and becomes opaque. It is incompatible with strong acids. Considering the low dangerousness of the Borax present on the site, this substance will not be considered in the hazard analysis.

D) Activated carbon

Activated carbon is mainly used in the gold refining circuit. At room temperature, it is a black solid with no odour. This product is a non-volatile material and is flammable if heated strongly. It is unstable in sufficient concentration in the air and in the presence of a flame, the dust can explode. This product is incompatible with strong oxidizing agents (e.g. perchlorates, chlorates, nitrates, etc.). Considering the low dangerousness of the activated carbon present on the site, this substance will not be considered in the hazard analysis.

E) Quicklime

Calcium oxide, commonly known as quicklime ($CaCO_3$) is added to the ore at the beginning of the process in the grinding circuit. Quicklime is used to keep the pH basic in order to avoid the production of hydrogen cyanide in the various process steps. At room temperature, it is a white powdery solid with no odour. This product is non-volatile and non-flammable. However, contact of calcium oxide with water or moisture can generate enough heat to ignite surrounding flammable or combustible materials. Bulk calcium oxide powder may spontaneously heat up when moistened with water. Considering the low dangerousness of the quicklime present on the site, this substance will not be considered in the hazard analysis.

F) Sodium cyanide

Sodium cyanide is a product commonly used in the extraction of gold from ore. In its diluted form to 23-32, it is used to dissolve and separate gold from the ore by a process called leaching, the main method used by gold mines in Quebec. Sodium cyanide in aqueous solution is corrosive and deadly.

Sodium cyanide solutions are highly toxic by inhalation and release hydrogen cyanide when in contact with acids. Hydrogen cyanide is very harmful to aquatic life because of its acidity. Exposure to vapours and mists causes skin, eye and respiratory tract irritation. It is extremely irritating to the skin. Therefore, it can cause severe burns to the skin, eyelids and eyes, and causes blindness in humans. In and of itself, this product is non-flammable. The following Table 4.3 presents the characteristics of this compound that are most relevant to this study.

Table. – Characteristics of sodium cyanide

Parameters	Hydrogen cyanide
Boiling point [1]	105°C
Melting point [1] r	-5 to 15 °C
Density of the liquid [1] 1) n	1.15 kg/l
pH c	12
Partial vapour pressure at 25°C	<0.1 kPa

(1) Reference: CNESST Toxicological Directory.

Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

G) Hydrogen cyanide

Hydrogen cyanide is not stored on the mine site per se. However, it can come from the decomposition of sodium cyanide if it is not kept at a very basic pH 12-13. Hydrogen cyanide is an irritant and highly flammable. It evaporates easily, thereby releasing extremely toxic vapours. In case of leakage or evaporation, the concentration of hydrogen cyanide in air could easily exceed the ceiling value due to its high volatility (vapour pressure of 83 kPa).

It can be ignited by heat, flames or certain substances such as oxidants. This product can polymerize when pure (without inhibiting agent), when heated to 50°C or in contact with certain substances such as bases. In some cases, the polymerization can become explosive. Vapours may spread to a source of ignition and cause flashback. This product may form explosive mixtures with air. The following Table 4.4 presents the characteristics of this compound.

Table. – Characteristics of hydrogen cyanide

Parameters	Hydrogen cyanide
Boiling point [1]	25.7°C
Melting point [1]	-13.2°C
Steam density [1]	0.93 kg/l
pH 1)e n	<7
Vapour pressure	83 kPa
Lower flammability limit	5.6
Olfactory detection limit 1)	0.58 ppm

☹

(1) Reference: CNESST Toxicological Directory.

Hydrogen cyanide takes the form of a highly volatile bluish-white liquid or a colourless gas with a bitter almond odour. The odour of hydrogen cyanide can be detected from 0.58 ppm. This value is below the ceiling value (10 ppm) and the lower explosive limit (LEL of 5.6% or 56,000 ppm). In toxicological terms, exposure to high concentrations of hydrogen cyanide immediately causes intense irritation of the ocular and respiratory mucosa. Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

H) Diesel

Diesel is mainly used to start combustion sources (boilers, dryers, etc.) and to power generators in case of power failure and vehicles. It is stored in various tanks ranging from 0.7 m^3 to 23 m^3 and is transported to the site by trucks. Table 4.5 shows the characteristics of a typical diesel. Diesel is a compound derived from the distillation of crude oil. It is made up, among other things, of a mixture of kerosenes, naphthenes and aromatic compounds. The number of carbon atoms contained in each of these molecules varies mainly between 10 and 20.

Diesel represents little danger of explosion because of its low volatility. Diesel is also incompatible with strong oxidizing agents. Considering the small quantity of diesel present on the site, as well as its low volatility, this substance will not be considered in more detail in the hazard analysis.

Table. – Diesel characteristics

Parameters	Gas oil
Boiling point 1)	Between 176-370°C
Flash point 1)	≥ 50°C
Self-ignition temperature 1) e 1)	257°C
Lower flammability limit	0.6 %
Upper flammability limit 1)	4.7 %
Density 1e)	0.84 kg/m^3
Vapour pressure 1)	0.4 kPa 40ºC
Composition:	
Paraffins 2) Naphthenes 2) Aromatics 2) Olefines 2) Residual 2) o	55% (volume) 12% (volume) 24% (volume) 5% (volume) 4% (volume)

(
(1 Reference's Diesel, www.library.cbest.chevron.com.
(2) Reference: The Origin and Chemistry of Petroleum, www.zymaxforensics.com.

I) Gasoline

Gasoline at room temperature is a highly flammable liquid that will ignite and burn on contact with an ignition source. At room temperature, it is partially volatile. It tends to accumulate at ground level since it is heavier than air. At concentrations above the recommended exposure level, gasoline may cause eye and respiratory tract irritation, headaches, dizziness, other nervous system effects and aspiration pneumonia. At concentrations between the lower and upper flammability limits, gasoline may explode on contact with a spark or open flame. Table 4.6 summarizes the main physical and chemical characteristics of a typical commercial gasoline, Shell Bronze gasoline. In this study, only deflagration and fire scenarios are developed.

Table. – Characteristics of gasoline

(Parameters	Gasoline
Boiling point 1)	Between 35-220 °C
Ignition temperature[1]	280 °C
Flash point	-30°C
Lower flammability limit [1]	1.4 %
Upper flammability limit [1]	7.6 %
Liquid density (water = 1)	0.74
Vapour density (air = 1) [1]	3.5
Vapour pressure 1)	< 107 kPa 38°C

1 Reference: Shell Bronze gasoline material safety data sheet (MSDS).

J) Magnalox flocculant

Magnalox (Flomin 905) is used as a flocculant in the ore processing plant. No hazardous materials are listed in the manufacturer's MSDS. Considering the low dangerousness of this product, it will not be considered further in the hazard analysis.

K) Ammonium nitrate

Ammonium nitrate is used as an explosive at the mine and is stored underground upon receipt. If necessary, depending on the circumstances (unavailability of the cage for descent into the shaft), the existing explosive depots on the surface are temporarily used.

At room temperature, it is a white deliquescent material with no odour. This product is flammable and explosive. It becomes spontaneously combustible when in contact with moisture or water vapour. This product reacts violently or explodes when in contact with acids, reducing agents, organic materials, powdered metals, sulphur, phosphorus, chlorides, sodium perchlorate. If heated to 210°C, it decomposes, emitting toxic nitrogen oxide gases. Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

L) Sodium nitrate

Sodium nitrate is mainly used in the gold refining circuit. At room temperature, it is a white crystalline solid, odourless, non-volatile and flammable. When heated strongly, it begins to decompose at over 300°C and can explode when heated to 540°C or if subjected to impact/friction. It can then produce nitrogen oxides.

This product is incompatible with reducing materials, certain metals (barium, antimony, etc.) and cyanides. Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

M) Propane

Commercial propane is sold as a liquefied compressed gas. When a compressed propane container leaks, the propane returns to its natural state as a gas at room temperature and atmospheric pressure. It tends to accumulate on the ground since it is heavier than air. Propane is an asphyxiating gas that causes suffocation if present at levels that make oxygen insufficient for breathing.

At concentrations between the lower and upper flammability limits, it may explode on contact with a spark or open flame. Table 4.7 summarizes the main physicochemical characteristics of commercial propane sold by Shell. Due to its dangerousness, this substance is considered in greater detail further in this consequence study.

Table. – Propane characteristics

Parameters	Propane
Boiling point [1]	-42 °C
Flash point [1]	-104 °C
Ignition temperature [1]	432 °C
Lower flammability limit [1]	2.1 %
Upper flammability limit [1]	9.5 %
Liquid density (water = 1) [1]	0.58
Vapour density (air = 1) [1]	1.5

(1) Reference: Shell commercial propane MSDS.

N) Caustic soda

Caustic soda (NaOH) is also known as sodium hydroxide. At room temperature, this white solid substance is odourless and deliquescent. It comes in flakes, powder, pellets or blisters. When sodium hydroxide is put into an aqueous solution, this strong base forms solutions with a basic pH well above 11.5, making it a corrosive substance. This substance is not volatile. It is non-flammable and non-explosive. Considering the low dangerousness of the caustic soda present on the site, this substance will not be considered in the hazard analysis.

O) Ferric sulphate

Ferric sulphate is mainly used in water treatment to transform cyanides into insoluble and solid compounds. At room temperature, it is an odourless, non-volatile and non-flammable solid. When it absorbs moisture from the air (hygroscopic), it oxidizes to ferric sulphate. At over 400°C, it decomposes into sulphur dioxide. It is incompatible with alkalis such as sodium hydroxide. Considering the low dangerousness of this product, it will not be considered further in the hazard analysis.

P) Summary of identified hazards

Table 4.8 summarizes the study sites for each of the selected substances and their associated hazards as defined by WHMIS.

Table. - Summary of hazardous properties of selected substances according to WHMIS classification

WHMIS category		Acetylene	Sodium cyanide	Hydrogen cyanide	Gasoline	Ammonium nitrate	Sodium nitrate	Propane
E	Compressed gas	X						X
B1	Flammable gas	X		X				X
B2	Flammable liquid				X			
B3	Combustible liquid							
B4	Flammable solid							
B5	Flammable aerosol							
B6	Flammable reactive material					X	X	
C	Oxidizing material							
D1A	Very toxic material with immediate and severe effects		X	X		X		
D1B	Toxic material with immediate and severe effects							
D2A	Very toxic material with other effects				X			
D2B	Toxic material with other effects							
D3	Infectious material							
O	Corrosive material		X	X				
F	Dangerously reactive material						X	

Q) Identification of the characteristics of the tanks and their contents

Table 4.9 presents, for each of the selected hazardous materials, the characteristics of the main tanks/containers on the Bachelor site and of the transport vehicles circulating on the road network in order to transport these materials to the mine.

Table Characteristics of the vehicles and tanks/containers of the selected hazardous materials scheduled under

Selected substance	Characteristics of the largest tanks/containers on site			
	Capacity		Property of the transported substance	
	Litres	Tonnes	Physical state	Pressure at 25 °C
Acetylene	91	0.042	Liquid	16.0 bar (G)
Sodium cyanide	45,400	52.2	Liquid	Atm
Hydrogen cyanide [3]	--	0.2	Gas	Atm
Gasoline	4,500	3.6	Liquid	Atm
Ammonium nitrate	--	1.3	Solid	N/A
Sodium nitrate	--	1.0	Solid	N/A
Propane	420-68400	0.2-33.7	Liquid (compressed gas)	10.2 bar (G)
Selected substance	**Characteristics of the largest truck/container circulating on the road network**			
	Capacity)		**Property of the transported substance**	
	Litres	**Tonnes**	**Physical state**	**Pressure at 25 °C**
Sodium cyanide	30,000	34.5	Liquid	Atm
Gasoline	4,500	3.6	Liquid	Atm
Ammonium nitrate	--	1.3	Solid	N/A
Sodium nitrate	--	1.0	Solid	N/A
Propane	55,000	32.0	Liquid (compressed gas)	10.2 bar (G)

(1) Data obtained from Bonterra.
(2) Data obtained from carriers, users and manufacturers.
(3) The maximum quantity is established for one of the two thickeners with a volume of 375 m^3. It is assumed that all of the sodium cyanide at a concentration of 500 ppm is transformed into hydrogen cyanide 200 kg).

4.1.3 Failure analysis

The main causes of failures in gold mines are primarily associated with dam failures or spills of hazardous materials. In addition, there are natural hazards and terrorism. These causes are summarized as follows:

Breakage in connection with the dam in the tailings management area

The rupture of pipes or the BTMA dike can likely lead to a spill of hazardous materials. According to the accident history, there have been several dam failures in the last 10 years in Canada and in the world. These failures are often related to deficiencies in maintenance and monitoring.

Malfunction of the ore processing plant

In the ore processing plant, a problem could lead to the release of hydrogen cyanide, especially if there is a complication in terms of the injection of quicklime in the grinding circuit. This would cause the pH to become slightly more acidic in the thickener, thereby creating the conditions to generate hydrogen cyanide.

Equipment breakdown

Whether man-made, natural or due to wear and tear, equipment breakdowns can lead to leaks of hazardous materials (e.g., truck trans-shipments, tank leaks, etc.). In Canada, there have been several oil spills from hazardous material leaks over a 10-year period.

Natural hazards

At present, it is believed that no natural hazard could cause a loss of tank/container containment that would be more severe than the events already mentioned.

Lightning is a natural hazard that is considered a plausible event, but it is taken into account in equipment design and operational rules.

Terrorism

A number of potential terrorism-related events are possible. The consequences of what is considered to be the maximum impact of a terrorist act, i.e. a major rupture in the various tanks/containers, have been analyzed (refer to Section 6).

4.1.4 Summary of selected substances

After the review and analysis of the information contained in sections 4.1.1 to 4.1.3, the selected substances that present a risk are the following:

- Acetylene
- Sodium cyanide
- Hydrogen cyanide
- Gasoline
- Ammonium nitrate
- Sodium nitrate
- Propane

Borax, activated carbon, quicklime, Magnalox flocculant, and ferric sulphate, in the event of a spill, do not pose a significant hazard due to their non-volatile and non-flammable nature. In case of a spill, diesel also does not pose a significant risk due to its low volatility. For these reasons, these products are not considered in greater detail further in this study.

4.2 Identification of external hazards

The external hazards in question are primarily related to third party activities, earthquakes, flooding, land movement, and other major forces.

Damages linked to third parties (e.g.: excavations)

Third-party damages are non-existent, as these third parties are several dozen kilometres away from the site.

Earthquake

The eastern part of Canada (Ontario, Quebec and the Maritimes) is located in a stable continental region of the North American tectonic plates with moderate seismic activity. Most earthquakes in the region are caused by the reactivation of existing faults or old weak points in the earth's crust. Seismic conditions are incorporated into the safety coefficient and construction flexibility requirements for mining infrastructure as required by the Dikes and Dams Regulation and Directive 019.

Flooding

There has never been flooding on the study site, as it is the headwaters of the watershed.

Ground movements

Hydrologic and geotechnical concerns are site-specific issues that are taken into consideration when establishing the project design. The design process aims to avoid potentially unstable slopes and saturated soils as much as possible, especially for tailings dams. When it is not possible to avoid them, the threat is reduced by means of conceptual elements. The threat of natural elements such as ground movement is reduced by design settlement processes; however, this risk cannot be completely eliminated.

Other external elements

Other external elements independent of the design, construction, and operation of the Project, such as fire and explosion, electrical damage, and intentional damage (sabotage and terrorism), can threaten the integrity of the installations. This threat category represents only a tiny fraction of incidents in mining environments, but it cannot be completely eliminated.

5 Identification of accident scenarios

5.1 General information on scenarios

The methodology used to identify accident scenarios and assess the consequences of accidents is defined in the US Environmental Protection Agency (USEPA) document "Risk Management Program Guidance for Offsite Consequence Analysis". It is the method of standard scenarios (Worst Case Scenario) and alternative accidents. This method makes it possible to assess the consequences of major accidents in two steps. The first step, the standard accident scenario study. In general terms, the preliminary diagnostic tool determines the worst-case consequences associated with an accident scenario. The second step, the alternative accident scenario study, makes it possible to assess the consequences of major industrial accidents in a more detailed and realistic way, when the impacts associated with the standard scenarios extend beyond a company's property limits. These latter scenarios are used for contingency planning.

Standard scenarios

A standard accident scenario for toxic gaseous and liquid materials is defined as the loss of containment of the largest quantity of a hazardous material that would result from the rupture of a container over a 10-minute period under worst-case weather conditions and leading to the worst consequences or impact radii.

For flammable and explosive liquids, the standard scenarios involve: the emission of radiation associated with the burning of the total amount of material spilled, the evaporation of vapours and their explosion, or the release of a flammable substance following the rupture of an over-pressurized container under the effect of heat (Deflagration or BLEVE).

In this study, the accidents in the standard scenarios were considered to occur in an area not drained by a worst-case sewer system. The spill of liquid material spread on the ground and forms a puddle of 800 m^2 inside a building and 2 cm thick outside. The outside temperature at the time of the accident was 25°C and the humidity level was 70%. The outdoor temperature and puddle thickness were set to be in accordance with the Risk Management Program Guidance for Offsite Consequence Analysis.

The employed method does not contain a definition for standard scenarios associated with solids, such as ammonium nitrate. In this case, MF Environnement defined the scenarios in such a way as to obtain slightly overestimated results.

All of the standard scenarios summarized in Table 5.2. The accident scenarios considered in this analysis correspond essentially to spills of the selected substances (see section 4.1.4).

Alternative scenarios

Two standard scenarios have impact radii outside the fictional property boundary: Scenario N4 hydrogen cyanide at thickness and Scenario N8 (propane, i.e. the tank for underground heating).

The alternative accident scenarios correspond to situations that are more likely and are generally associated with cyanide emanations at the thickener with a basic pH of about 9. This is more realistic, because of the presence of HCN detectors in the plant.

For propane, the alternative scenarios correspond to a line break on the propane tank following a collision with a vehicle equivalent to a leak involving a surface area with a diameter of 1 inch (major leak) and 1% of 1 inch diameter (minor leak), and corresponding to the weak element on the tank (level gauge) were considered. The alternative scenarios are presented in Table 5.2 and Table 5.3.

5.2 Operating conditions used

The operating conditions for the standard and alternative scenarios are presented in Table 5.1 for the various tanks/containers under worst-case operating conditions.

Table Selected operating conditions for accident scenarios

Installations	Standard and alternative scenarios
Acetylene cylinder	Cylinder volume: 91 litres (0.042 tonnes) Pressure : 16.0 bar (G) Temperature: 25°C
Sodium cyanide tank/tanker	Tank volume: 45,400 litres (52.2 tonnes) Tanker volume : 30,000 litres (34.5 tonnes) Pressure: atmospheric Temperature: 25°C
Thickness with hydrogen cyanide emission [1]	Volume of the thickener: 375,000 litres (0.2 tonnes of HCN) Pressure: atmospheric Temperature: 25°C
Fuel tank/tanker	Tank volume: 4,500 litres (3.6 tonnes) Tanker volume : 4,500 litres (3.6 tonnes) Pressure: atmospheric Temperature: 25°C
Propane tank/tanker	Tank volume: 68,400 litres (33.7 tonnes) Tanker volume : 55,000 litres (32.0 tonnes) Pressure : 10.2 bar (G) Temperature: 25°C
Above-ground ammonium nitrate storage	Quantity: 3000 kg 95 ammonium nitrate and 5 diesel Temperature : 25°C
Above-ground sodium nitrate storage	Quantity: 1000 kg Temperature: 25°C

(1 The maximum quantity is established for one of the two thickeners with a volume of 375 m^3. It is assumed that all of the sodium cyanide (at a concentration of 500 ppm) is converted to hydrogen cyanide 200 kg.

5.3 Standard scenarios

A standard accident scenario for liquids is defined as the loss of containment of the largest quantity of a hazardous material that would result from the rupture of a container or piping system over a 10-minute period under worst-case weather conditions. These scenarios consider passive protection systems, but not active protection systems such as detectors.

The standard accident scenario is a preliminary diagnostic tool and is very unlikely to occur. These standard scenarios are presented in Table 5.2.

Table. - Standard accident scenarios

Material	Standard scenario
N0 Tailings sludge	**Toxic** Rupture of the dike and discharge of 6.6 M m3 of sludge into the environment to the north and south**.**
N1 Acetylene (cylinder)	**Flammable** Spillage of the total volume of a 91 litre acetylene cylinder in 10 minutes during a summer day (25°C). Acetylene gradually evaporates into the air and there is a flashback (jet fire) or an explosion.
N2 Sodium cyanide (tank)	**Toxic** Spill of the total volume of the 45,400 litre sodium cyanide tank indoors on the building floor in 10 minutes during a 25°C summer day). Sodium cyanide forms a slick of 800 m^2 and then gradually evaporates into the air.
N3 Sodium cyanide (Tank)	**Toxic** Spill of the total volume of a 30,000 litre tank of sodium cyanide on the ground in 10 minutes during a 25°C summer day).Sodium cyanide forms a slick of 2 cm on the asphalt floor and then gradually evaporates into the air.
N4 Hydrogen cyanide (Thickener)	**Toxic** Emanation of the total volume of hydrogen cyanide bound at pH 7 generated at the thickener of 200 kg in 10 minutes during a 25°C summer day). Hydrogen cyanide forms a slick of 120 m^2 on the thickener and then gradually evaporates into the air.
N5 Hydrogen cyanide (Thickener)	**Flammable** Emanation of the total volume of hydrogen cyanide generated at the thickener of 200 kg in 10 minutes during a 25°C summer day). Hydrogen cyanide forms a slick of 120 m^2 on the thickener and there is a flashback (jet fire) or an explosion.
N6 Gasoline (Tank/tanker)	**Flammable** Spill of the total volume of the 4,500 litre gasoline tank onto the asphalt floor in 10 minutes during a 25°C summer day).Gasoline forms a slick 2 cm thick on the ground and gradually evaporates, and there is a fire or an explosion.
N7 Gasoline (Tank/tanker)	**BLEVE** The gasoline in a tank/tanker with a capacity of 4,500 litres is heated by an outside source during a summer day (25°C), thereby increasing the pressure to the point of wall rupture, resulting in the sudden release of all of the pressurized gasoline in the tank/tanker and a BLEVE.
N8 Propane (Tank)	**Flammable** Spill of the total volume of the 68,400 litre propane tank on the ground in 10 minutes during a summer day (25°C). Some of the propane evaporates instantly at atmospheric pressure The liquid part forms a slick on the ground which gradually evaporates and there is a flashback (jet fire) or an explosion.

Material	Standard scenario
N9 Propane (Tank)	**BLEVE** The propane in the 68,400 litre tank is heated by an outside source during a summer day (25°C), thereby increasing the pressure to the point of wall rupture, resulting in the sudden release of all of the pressurized propane in the tank and a BLEVE.
N10 Ammonium Nitrate (Above-ground storage)	**Flammable** Ammonium nitrate contained in the 3000 kg above-ground storage (95% ammonium nitrate and 5 diesel) comes into contact with an incompatible material and there is an explosion.
N11 Ammonium Nitrate (Above-ground storage)	**Toxic** Ammonium nitrate contained in the 3000 kg above-ground storage (95% ammonium nitrate and 5 diesel) leads to the formation of nitrogen oxide (1 kg) during the explosion.
N12 Sodium nitrate (Above-ground storage)	**Flammable** The sodium nitrate in the 1,000 kg storage comes into contact with an incompatible material and there is an explosion.
N13 Sodium nitrate (Above-ground storage)	**Toxic** The sodium nitrate contained in the 1,000 kg warehouse leads to the formation of nitrogen oxide during the explosion.

5.4 Alternative scenarios

The alternative accident scenarios correspond to situations that are more likely to occur and consider passive and active mitigation measures. The alternative scenarios modelled for this study are presented in Table 5.3.

Table. - Alternative accident scenarios

Material	Standard scenario
A1 Hydrogen cyanide (pH=9)	**Toxic** Hydrogen cyanide emanation (bound at a pH of 9 generated at the level of 1.29 kg/h) forms a toxic cloud.
A2 Propane (Major leak)	**Flammable** Following an accident, a leak occurs at the 1" level gauge on the 68,400 litre propane tank. The leakage area corresponds to 100% of the gauge area. Some of the compressed propane instantly evaporates at atmospheric pressure and the ejected liquid forms a slick on the ground that evaporates and forms a gas cloud that encounters a source of ignition and explodes.
A3 Propane (Minor leak)	**Flammable** Following an accident, a leak occurs at the 1" level gauge on the 68,400 litre propane tank. The leakage area corresponds to 1 of the gauge area. Some of the compressed propane evaporates instantly at atmospheric pressure and the ejected liquid forms a slick on the ground. This liquid evaporates and forms a cloud of gas that encounters a source of ignition and explodes.

6 Assessment of the consequences

6.1 Methodology for calculating impact

6.1.1 General information

The purpose of assessing the consequences of standard and alternative scenarios is to determine the distances at which the effect of hazards attributable to an accident could be felt. The danger zone is therefore a circle around the accident site.

For flammable materials (hydrogen cyanide, gasoline, and propane), this analysis considers the immediate ignition scenario leading to a puddle fire, as well as delayed ignition scenarios leading to a puddle fire, flash fire, or explosion (Ref.: Manual Bevi Risk Assessments, Rev. 3.2, RIVM, 2009).

6.1.2 Modelling tools

The modelling tool used for this analysis is the EPA Office of Emergency Management (ALOHA) and NOAA (Emergency Response Division) software version 5.4.7. It is a technically reliable and recognized software program for consequence analysis. It is also widely used internationally and its results are validated and recognized.

6.1.3 Effect threshold values

A) Toxic substances

In connection with this study, the consequences of the previously studied accident scenarios concern toxic effects. The applicable vulnerability criteria considered in the study are presented below.

AEGL

The Acute Emergency Guidance Levels (AEGL) were developed for use in emergency planning and management by the American Institute Hygiene Association (AIHA). The definitions of these threshold values are presented below:

AEGL-1: The concentration of a hazardous substance in the air above which exposed individuals, including sensitive individuals, could be significantly affected, irritated, or suffer some asymptomatic non-sensory effects. However, the effects are not incapacitating, and are short-lived and reversible when the exposure comes to an end. Concentrations below the AEGL-1 represent an exposure level associated with the perception of moderate odour, taste or other sensory irritation

AEGL-2 : The concentration of a hazardous substance in the air above which exposed individuals, including sensitive individuals, could develop serious, long-term or irreversible health effects or be unable to escape. Concentrations below AEGL-2 but at or above AEGL-1 represent exposure that can cause significant but reversible effects.

AEGL-3: The concentration of a hazardous substance in the air at which exposed persons, including sensitive persons, could suffer life-threatening or fatal effects. Concentrations below AEGL-3 but at or above AEGL-2 represent exposure that may cause serious, long-term or irreversible health effects or prevent escape.

Table 6.1 presents the recommended effect thresholds for emergency planning (AEGL-2) and for estimating life-threatening consequences (AEGL-3).

Table. - Selected vulnerability criteria for toxic effects - AEGL

Toxic products	Life-threatening concentration level (AEGL-	Selected criterion for emergency planning (AEGL-
Sodium cyanide (NaCN)	30.0 mg/m^3	14.0 mg/m^3
Hydrogen cyanide HCN	17.0 mg/m^3	7.8 mg/m^3
Nitrogen oxides (NO_2)	20 ppm	12 ppm

B) Flammable substances

The effect threshold values for flammable substances are shown below. These are consistent with the recommendations contained in the document entitled "*Les valeurs de référence des seuils d'effets pour la planification des mesures d'urgence et l'aménagement du territoire"* produced by the CRAIM in 2017.

<u>Fire – Slow kinetic event</u>

A spill of a flammable substance could cause a fire. In this case, the impact zone can be defined according to the level of thermal radiation (expressed in kW/m^2) emitted by the fire. As a result of prolonged exposure to the heat of the flames (thermal radiation), exposed receptors can suffer burns of varying degrees, depending on the duration of the fire and the distance of the fire from the receptor. The thermal radiation generated by a puddle fire or torch fire is greatest at the point of ignition and decreases with distance.

The recommended effect thresholds to be used in order to assess the distances associated with life-threatening consequences, emergency planning and destruction of equipment (Ref.: CRAIM, 2017) are:

- 5 kW/m^2: radiation level not to be exceeded for the human body normally clothed. This threshold can result in second degree burns after an exposure of more than 40 seconds recommended threshold for emergency planning - CRAIM).
- 12.5 kW/m^2: life-threatening radiation level following a 30-second exposure; Minimum energy threshold required to ignite wood in the presence of flames and to melt plastic.
- 37.5 kW/m^2: radiation level producing instantaneous incineration and corresponding to the heat flux sufficient to damage process equipment and cause a domino effect.
- 78,0 kW/m^2: Threshold applicable during a BLEVE for a lethal exposure dose in terms of thermal radiation of 1000 (kW/m^2)$^{4/3}$*s for a duration of three seconds (recommended threshold for emergency planning - CRAIM).

Flash fire and explosion

For a flash fire or explosion to occur, where applicable, the gas concentrations of a flammable substance must be between the lower and upper explosive limits. However, for these conditions to be present, the vapours must generally be contained in a confined or semi-confined space, which is not the case in this project.

For flash fires resulting from the ignition of a flammable vapour mixture, the software used to calculate the consequences (ALOHA) defines the impact zone as 60 of the lower flammability limit. However, for a flash fire to occur, a source of ignition must be present and the lower flammability limit must be reached. The impact radius results obtained with the software are therefore very conservative.

For the consequences of an explosion, where applicable, the area of impact is defined from the overpressure levels expressed in pounds/square inch psi from the explosion. Exposed receptors may experience mechanical effects (collapse of structures, rupture of eardrums, etc.). The overpressure is highest at the point of explosion and decreases with distance. The recommended effect thresholds for estimating life-threatening consequences and for emergency planning are presented below (ref.: CRAIM, 2017:

- 0.3 psi: level delimiting the zone related to glass breakage.
- 1 psi: level delimiting the zone of significant danger to humans as a result of injuries associated with shattering glass or falling debris recommended threshold for emergency planning - CRAIM).
- 3 psi: level delimiting the zone of very serious danger to human life that can lead to death. This threshold also corresponds to an overpressure sufficient to significantly damage structures and process equipment.

6.1.4 Meteorological data

Meteorological conditions and wind direction strongly influence the magnitude of the consequences of an incident involving the dispersion of a cloud of a substance. During the consequence analysis, various combinations of wind speeds and atmospheric stabilities were modelled to determine the most penalizing conditions. The employed weather conditions are presented below. The modelling results presented in the body of this document correspond to the most penalizing weather conditions (1.5 F and 3 D) and those generally used for analyses of this type.

Table Weather conditions considered

(1) **Condition**		
Wind speed e s p 1	1.5 m/s (5.4 km/h)	3 m/s (10.8 km/h)
Pasquill stability classes n d	F (Very stable)	D (Neutral)

(1) Parameter related to the atmospheric stability which ranges from A (very unstable) on a sunny day with low wind speed to F (very stable) at night with low wind speed. Stability conditions E and F can only occur at night.

6.1.5 Other assumptions used

The other assumptions used in the modelling are summarized below:

- outside temperature: 25°C
- relative humidity: 70 %
- Roughness: urban-forest
- Explosion: confined space for all substances, except propane which is unconfined in the open air
- Using the default settings of the software

6.1.6 Modelling results – Impact radius consequence

This section presents in Tables 6.3 (toxic substances) and 6.4 (flammable substances), the modelling results associated with the standard scenarios described in Section 5.4. The consequences are expressed in terms of distance from the point of release where concentrations reach the AEGL-2 and AEGL-3 thresholds (thresholds used for emergency planning for toxic substances, the thermal radiation thresholds of 5, 12.5, 37.5, and 78.0 kW/m^2 for flammable substances, and the overpressure thresholds of 1 and 3 psi for explosive substances.

The standard scenario leading to the largest impact radius concerns the release of hydrogen cyanide following a malfunction in the thickener. In this case, the impact radius is estimated to be nearly 2.6 km as a result of reaching the AEGL-2 toxicity threshold (see Table 6.3). For flammable materials, the radius of impact is estimated at 329 m for a flash fire involving propane (see Table 6.4). The results for the alternative scenarios presented in Section 5.4, i.e. the most plausible scenarios, are presented in Tables 6.5 (toxic substances) and 6.6 (flammable substances). In this case, the impact radius is small enough to ensure that the consequences of accidents do not extend beyond the property line.

The standard scenario corresponding to the failure of the dike and the release of 6.6 M m^3 of sludge into the environment is evaluated in terms of the distance impacted by the 6.6 M m^3 of sludge outside the property line. This distance is 3 km north to Bachelor Lake and 4 km south to Auger Lake. The impacted area does not contain any sensitive receptors. In addition, given the design criteria in the dike, the probability of a dike failure is minimal.

Table - Impact radii - Standard scenarios (toxics)

Standard scenarios	Atmospheric conditions	Impact radii (m)		Distance from the accident site to the property line	Property line reached (Yes / No)
		AEGL- : 14.0 mg/m	**AEGL- : 30 mg/m**		
N2-Sodium cyanide (tank)	1.5F	70	47	300	No
	3D	36	24	300	No
		AEGL- : mg/m	**AEGL- : 30 mg/m**		
N3-Sodium cyanide (Tank)	1.5F	121	80	300	No
	3D	66	43	300	No
		AEGL- : 7.8 mg/m	**AEGL- : 17 mg/m**		
N4-Hydrogen cyanide	1.5F	2,600	1,900	300	Yes
	3D	1,200	838	300	Yes
		AEGL- : 12 ppm	**AEGL- : 20 ppm**		
N11-Ammonium nitrate nitrogen oxide	1.5F	111	83	500	No
	3D	27	21	500	No
		AEGL-2 : 12 ppm	**AEGL-3 : 20 ppm**		
N13-Sodium nitrate nitrogen oxide	1.5F	61	47	300	No
	3D	16	12	300	No

[1] The impact radii are measured from the accident site. The details of ALOHA calculations and output files are presented in Appendix B.

Table - Impact radii - Standard scenarios (flammables)

Standard scenarios	Atmospheric conditions	Impact radii (m)							Distance from the accident site to the property line	Property line reached (Yes /No)
		Puddle fire - Delayed ignition (thermal radiation)			Flashback (flash fire)	Explosion (Overpressure)		BLEVE (Thermal radiation)		
		5 kW/m	12.5 kW/m	37.5 kW/m	60% (LII)	1 psi	3 psi	78.0 kW/m		
N1 Acetylene (flashback and explosion)	1.5F	--	--	--	78	122	71	--	300	No
	3D	--	--	--	29	64	33	--	300	No
N Hydrogen cyanide (flashback and explosion)	1.5F	--	--	--	63	58	48	--	300	No
	3D	--	--	--	23	27	19	--	300	No
N6 Gasoline (fire, flashback and explosion)	1.5F	96.6	61.1	35.3	--	n/r	n/r	--	300	No
	3D	96.6	61.1	35.3	--	n/r	n/r	--	300	No
N7 Gasoline (BLEVE)	1.5F	--	--	--	--	--	--	88	300	No
	3D	--	--	--	--	--	--	88	300	No
N8 Propane (flashback and explosion)	1.5F	--	--	--	329	n/r	n/r	--	300	Yes
	3D	--	--	--	180	n/r	n/r	--	300	No
N9 Propane (BLEVE)	1.5F	--	--	--	--	--	--	191	300	No
	3D	--	--	--	--	--	--	191	300	No
N Ammonium nitrate (explosion)	1.5F	--	--	--	--	188	83	--	500	No
	3D	--	--	--	--	188	83	--	500	No
N12 Sodium nitrate (explosion)	1.5F	--	--	--	--	131	58	--	300	No
	3D	--	--	--	--	131	58	--	300	No

n/r: not reached.

[1] The impact radii are measured from the accident site. The details of ALOHA calculations and output files are presented in Appendix B.

Table - Impact radii - Alternative scenarios (toxic substances)

Standard scenarios	Atmospheric conditions	Impact radii (m)		Distance from the accident site to the property line	Property line reached (Yes /No)
		AEGL- : 7.8 mg/m			
A1-Hydrogen cyanide pH=	1.5F	56	38	300	No
	3D	21	14	300	No

[1] The impact radii are measured from the accident site. The details of ALOHA calculations and output files are presented in Appendix C.

Table. - Impact radii - Alternative scenarios (flammable substances)

		Impact radii (m)							Distance from the accident site to the property line	Property line reached (Yes /No)
Alternative scenarios	Atmospheric conditions	Puddle fire - Delayed ignition (thermal radiation)			Flash fire	Explosion (Overpressure)		BLEVE (Thermal radiation)		
		5 kW/m	12.5 kW/m	37.5 kW/m	% (LII)	1 psi	3 psi	kW/m		
A2 Propane (major leak)	1.5F	--	--	--	124	n/r	n/r	--	300	No
	3D	--	--	--	67	n/r	n/r	--	300	No
A3 Propane (minor leak)	1.5F	--	--	--	11	n/r	n/r	--	300	No
	3D	--	--	--	<10	n/r	n/r	--	300	No

n/r: not reached

[1] The impact radii are measured from the accident site. The details of ALOHA calculations and output files are presented in Appendix C.

6.1.7 Domino effects

Domino effects can occur when an accident that has developed on one piece of equipment can affect adjacent equipment. As such, a domino effect could be caused by an accident on a tank that would affect an adjacent structure or by an accident involving a third-party structure that would have an impact on the Bachelor mine site.

The potential domino effects are of two kinds:

- Domino effect of the Bachelor mine on another industrial installation.
- Domino effect of another industrial installation on the Bachelor mine.

There are no potential domino effects on other industrial installations due to the large distance between the study site and these other industrial installations.

7 Mitigation measures and recommendations

The risk analysis confirms that the individual risk is acceptable according to MIACC criteria, taking into account the mitigation measures planned or already in place, which are based on the requirements of the current standards. Therefore, additional risk reduction measures are not recommended. However, attention should be paid to the following measures:

1. Ensure proper maintenance of the BTMA dikes;
2. Ensure that the cyanide detection and pH monitoring systems at the various basins in the plant are well maintained according to the manufacturer's specifications and that they are functional.

QC2-34: EMERGENCY MEASURES PLAN OF THE BARRY SITE (BONTERRA, 2022)

BONTERRA	**BARRY SITE EMERGENCY RESPONSE PLAN**	**Integrated Management System**

EMERGENCY RESPONSE PLAN
BARRY SITE
PMU-BAR-001

Female and Male: The text is written in the masculine in order to lighten, but implies both the feminine and the masculine genders.

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SUMMARY

The emergency response plan has been developed to provide an evolving and accurate approach to safeguard the health and integrity of Bonterra resource workers who may be exposed to an emergency measure that may involve a forest fire or an injured person to be evacuated. In addition, this emergency response plan serves as a response guide and establishes guidelines for the various emergency responders, regardless of the emergency response involved. At all times, this ERP must reflect the reality of the workplace.

1. APPLICATION

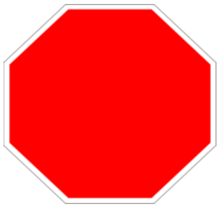
This ERP is intended for anyone working on the Barry site of Bonterra Resources Inc.

2. INTERPRETATION

The people responsible for preparing this procedure are the emergency response team. Any requests to amend, revise or update this document must be made to the emergency response team and must be approved by the executive committee.
In addition, the emergency response team is the only one that has the authority in the event of a dispute over the interpretation of this procedure.

3. DEFINITIONS

In this document, unless the text specifies a different meaning, the following terms are used:

CAMP LEADER	Each camp has its camp leader. The Camp leader is the resource person to whom you must report when evacuating the camps in case of a fire. We can recognise him by the red octagon posted on the door to his room. 
SMOKE DETECTOR	Safety device that reacts to the presence of smoke in the air or of steam particles, by emitting an audible alarm to alert the occupants of the premises of an onset of combustion or fire.
ERT	Emergency response team.
FIRE EXTINGUISHER	Apparatus used to put out, i.e. extinguish, a fire.
LSQ	City of Lebel sur Quévillon.
ERP	Emergency response plan
ASSEMBLY POINT	Safe area for evacuees of a disaster (the gate).
IMS	Integrated management system.
SOPFEU	Société de Protection des Forêts Contre le Feu. https://sopfeu.qc.ca

4. LIST AND TELEPHONE NUMBERS OF MINES WITH WHICH THERE IS AN ASSISTANCE AGREEMENT.

(These contacts will need to be verified as the existing agreement is with the Moroy site. Thereafter they must be checked every 6 months)

Eldorado:

Nico Charrois cell phone 819-860-7800 office 819-874-3100 extension 3100
Yves Beauchamps cell phone 819-733-0433 office 819-874-3100

Osisko Windfall

Salvador Spataro cell phone 819-856-1234 office 418-317-0421
Frédéric Côté cell phone 418-953-7384 office 418-317-0421
Nurse 418317-0421 extension 132104

Bonterra Moroy Project

Gilles Landry cell phone 819-444-8725 office 819-753-2043 extension 2041
Nurse cell phone 819-860-6224 office 819-753-2043 extension 2006

5. DIRECTORY OF RESOURCE PERSONS

5.1 QUALIFIED FIRST AIDERS:

Look for these posters, they are posted everywhere on the walls of the buildings. They are often displayed near telephones.

5.2 ADMINISTRATION MANAGER

"PERSONS TO BE CONTACTED IN AN EMERGENCY"

5.3 SOPFEU

If the building fire is conducive to a forest fire or spreads to the forest, contact SOPFEU (1-800-463-3389) and indicate 75° 46' longitude West/ 48° 59' latitude North

5.4 LSQ FIREFIGHTER

Fire in the extrication building, call 911 via a cell phone ask for the LSQ fire department.
(Time 2 hours)
Information request Yan Dupuis cell phone 819-755-7387.

5.5 LEBEL SUR QUÉVILLON HOSPITAL CRISIS CENTRE;

Weekend 819-755-4881 ask for "watch person"
During the week 819-755-4881 extension 30212.

5.6 AIRMEDIC

Transportation 1-877-999-3322
Satellite telephone 418-673-3322

5.7 CNESST

Telephone 1-866-302-2778

6 RESPONSIBILITIES

The definition of responsibilities clarifies the each stakeholder's roles with respect to emergency measures in accordance with the IMS.

6.1 EMPLOYER RESPONSIBILITIES:

The employer must:

- Demonstrate its commitment to industrial health, safety and hygiene and deploy human and financial resources to achieve the objectives of the ERP.
- Appoint a surface building manager at each site;
- Appoint the members of the emergency response team.

6.2 RESPONSIBILITIES OF THE LEADER OF THE EMERGENCY RESPONSE TEAM (ERT):

(The ERT is composed of the first aider, the building manager, electrician, machinery operator and other trades on shift at the discretion of the site manager.)

The ERT must:

- Prepare and coordinate the implementation of the ERP;
- Coordinate the annual practice sessions of the ERP;
- Ensure that workers are informed of the ERP;
- Review the ERP annually and as necessary;
- Establish a command post in the event of a disaster;
- Ask for radio silence at the beginning of an intervention;
- Coordinate emergency measures during the intervention;
- Respond safely to in the event of emergency measures;
- Sporadically notify management of the evolution of the situation during the intervention.

6.3 RESPONSIBILITIES OF WORKERS

The workers must:

- Be familiar with the ERP;
- Apply the ERP rules in practice and in real life situations;
- Notify the ERT of a situation that is not in accordance with the ERP;
- Follow the instructions issued by ERT or the gatekeeper;
- Not leave the premises without the permission of the ERT or the gatekeeper;
- Be available if necessary,

6.4 ROLE OF THE GATEKEEPER

The gatekeeper must:

- Properly manage the stress related to emergency measures;
- Take attendance;
- Call the LSQ fire department if a building fire, the SOPFEU if a forest fire;
- Call in the teams from the Moroy and Gladiator sites as reinforcements;
- Call in, if requested by the ERT, reinforcements from the mines with which Bonterra has an emergency assistance agreement;
- Notify the ERT when a worker does not answer roll call;
- Wait for instructions from the ERT which can be either;
    - Calling for reinforcements from the emergency response team who are on vacation:
    - Calling an ambulance;
    - Call the crisis team at the Lebel sur Quévillon hospital;
    - Send a worker to a location to help;
    - Other.

6.5 ROLE OF THE MEDICAL STAFF:

The medical staff must:

- Remain available for the ERT;
- Provide first aid to the injured;
- Coordinate the transportation of injured persons;
- If necessary, call Moroy and Gladiator medical staff for backup;
- If necessary, call the crisis unit of the Lebel sur Quévillon Hospital Centre.

6.6Role of THE SURFACE BUILDING MANAGER:

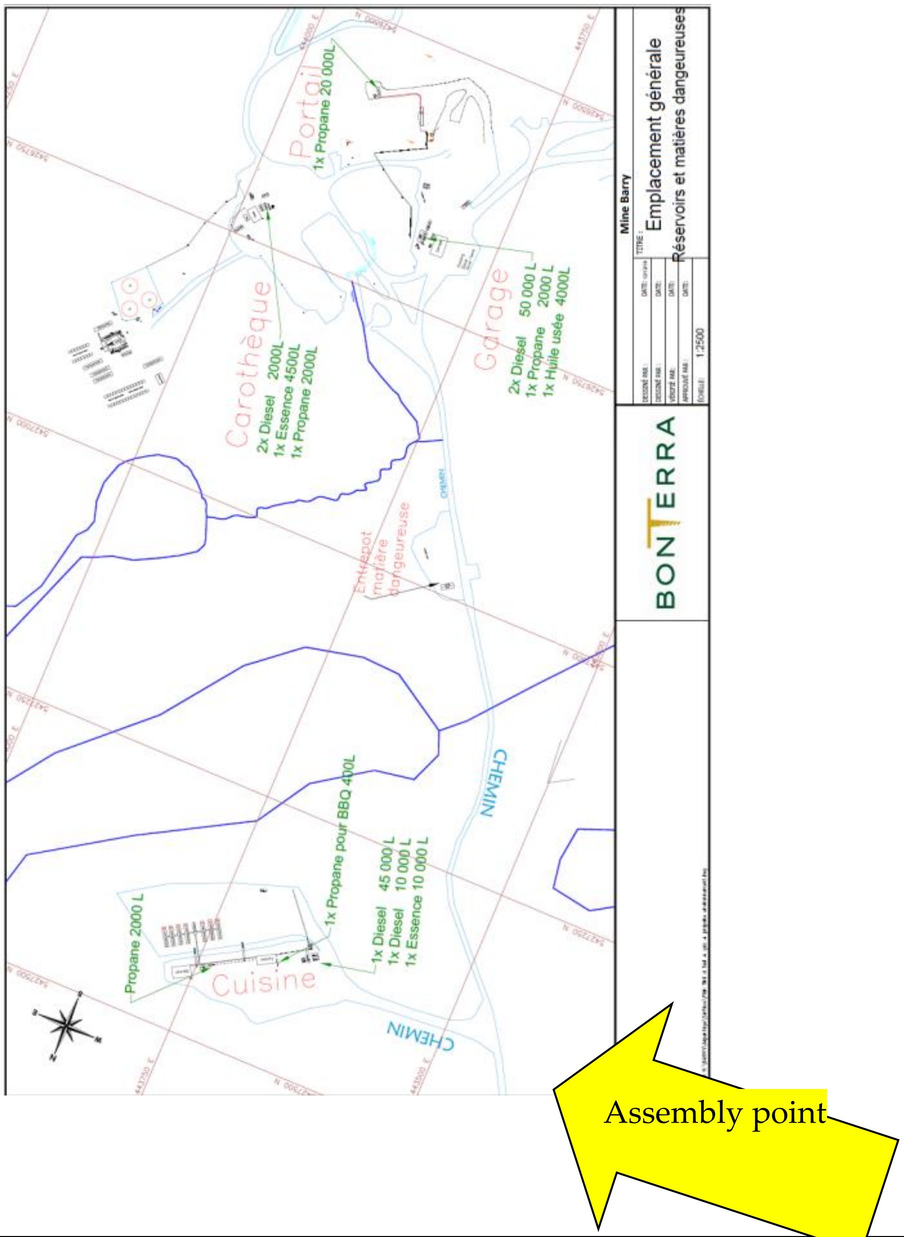
The surface building manager must:

- Remain calm when applying emergency measures;
- Designate a place to set up a command post;
- Advise and guide the ERT
- Know where each on-site hazardous product is stored;
- On his office door, he must be identified using his job title "surface building manager";
- Ensure that building evacuation plans are displayed either on the walls inside each building, with the indication "you are here" as well as an arrow indicating the nearest direction to evacuate the building.

7 EMERGENCY RESPONSE PLAN

The ERP is divided into a few chapters including the evacuation of buildings, campsites, the administrative office, the garage, the core bank and forest fire. Follow-up of casualty evacuation, environmental emergency, propane emergency.

Barry site map



7.1SURFACE FIRE EVACUATION OF THE ADMINISTRATIVE OFFICES:

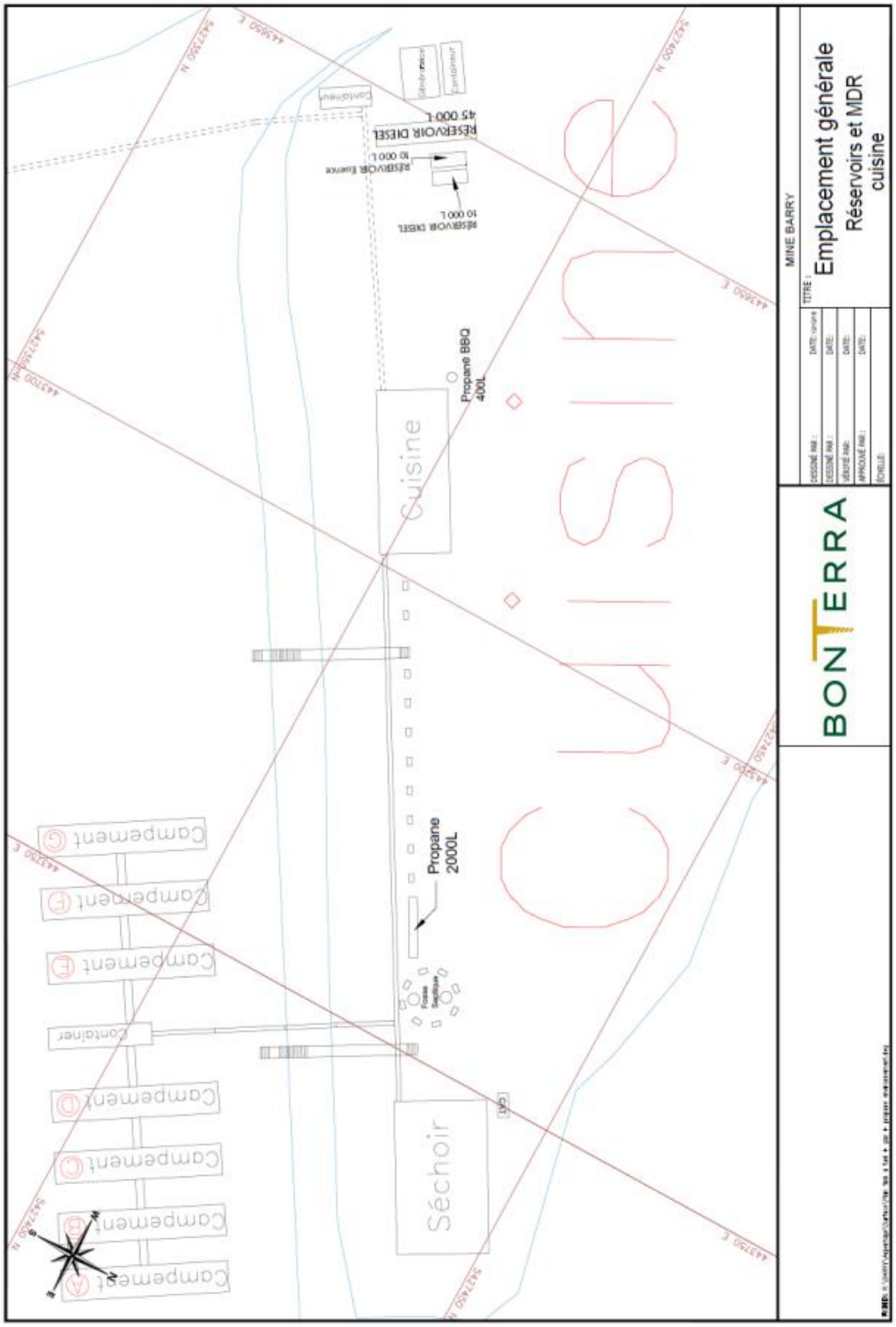
- If you hear the fire alarm, exit while closing, if possible, window and door (without barring), go to the assembly point (gate).
- When witnessing the onset of a fire, do not put your life or your health in danger;
- Stay calm;
- If the fire is small, use a fire extinguisher to extinguish it;
- If the fire is still active despite this intervention, sound the alarm if possible, close the door and window of the room where the fire is located;
- If the fire is large, sound the alarm and go to the assembly point;
- When going to the assembly point, (barrier) notify the people you meet that they should go to the assembly point;
- If you have a van assigned to you, use it to get to the assembly point, while picking up people who don't have a vehicle;
- Upon reaching the assembly point, identify yourself and wait for instructions;
- Do not leave the assembly point, nor the premises, nor the site without having obtained permission;
- Stay available, the emergency response team may need you.

7.2 BARRY SITE ADMINISTRATIVE OFFICES MAP

7.3 EVACUATION OF THE CAMPS:

- When witnessing the onset of a fire, do not put your life or your health in danger;
- Stay calm;
- If the fire is small, use a fire extinguisher to extinguish it;
- If the fire is still active despite this intervention, sound the alarm. If possible, close the door and window of the room where the fire is located;
- When going to the assembly point, (barrier) notify the people you meet that they should go to the assembly point;
- If you have a van assigned to you, use it to get to the assembly point, while picking up people who don't have a vehicle;
- Upon reaching the assembly point, identify yourself and wait for instructions;
- If you are the camp leader, you are the one who carries out the rollcall of the occupants of your camp,
  - Give the attendance sheet to the person in charge of the assembly point;
  - Notify the person in charge of the assembly point of any persons missing from the roll call.
- Do not leave the assembly point, nor the premises, nor the site without permission;
- Stay available, the emergency response team may need you.

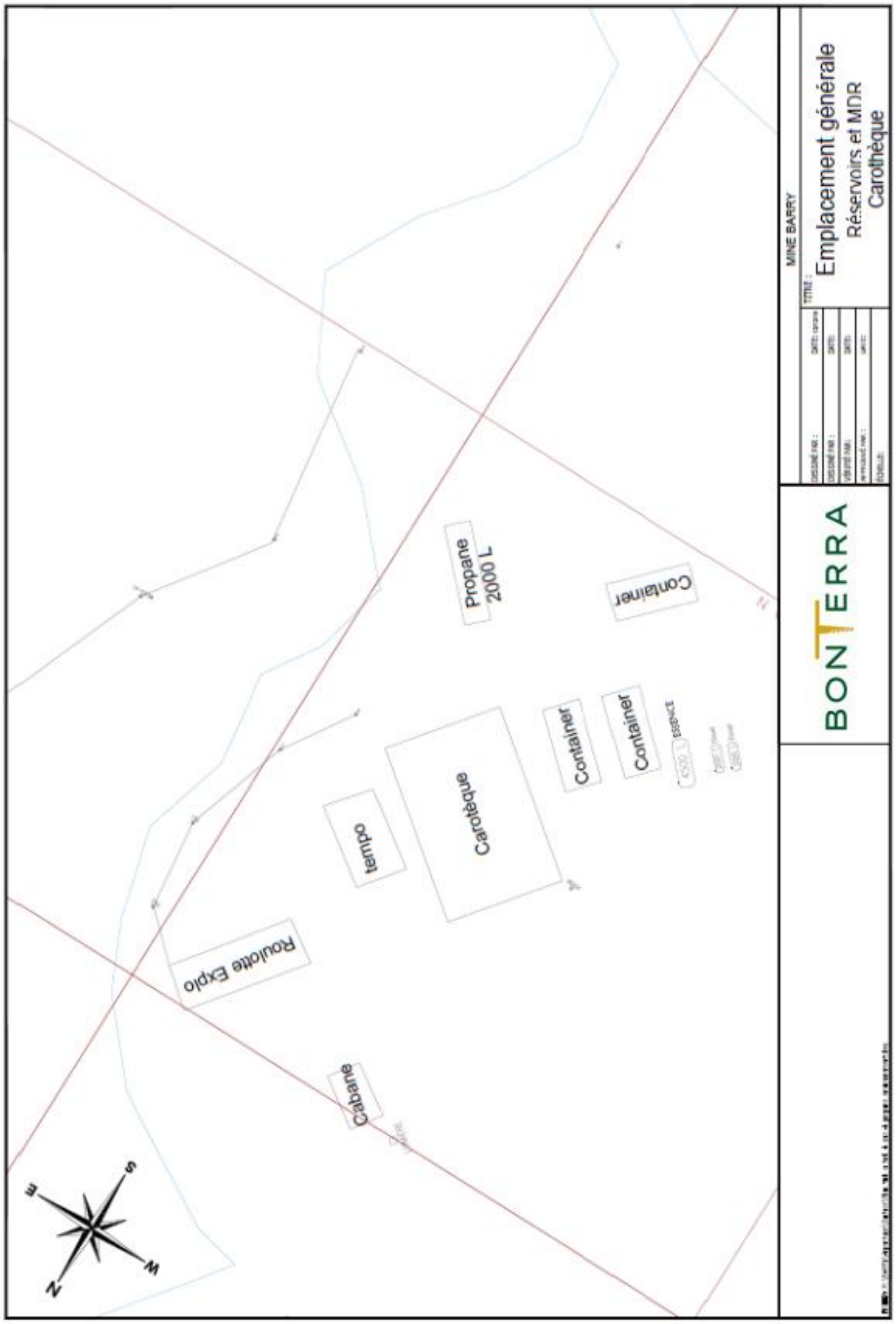
7.4 MAP OF THE CAMPS:

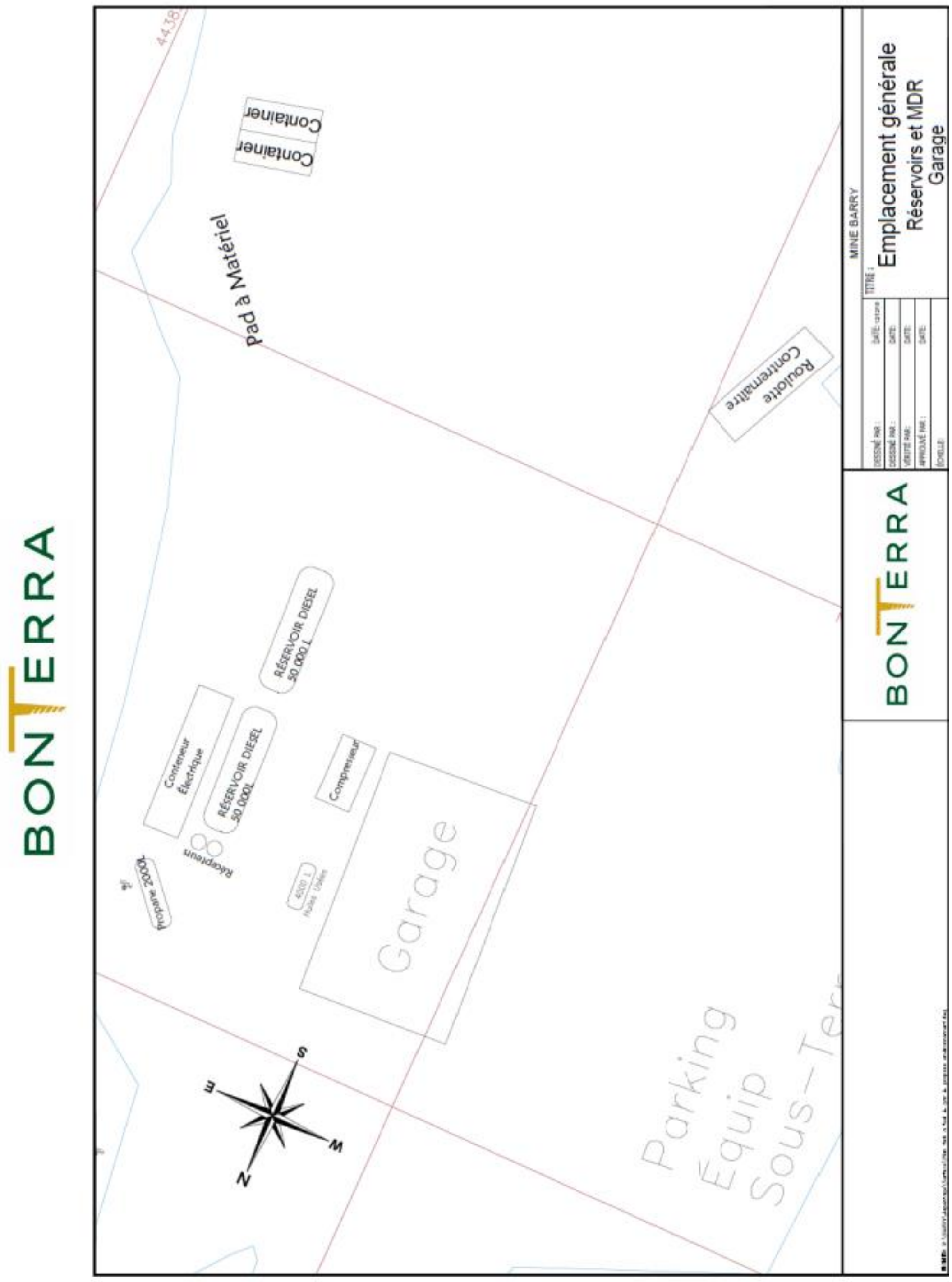

MINE BARRY
TITRE :
Emplacement générale
Réservoirs et MDR
cuisine
Cuisine
Séchoir
Propane BBQ
400L
Propane
2000L
RÉSERVOIR DIESEL
45 000 L
RÉSERVOIR DIESEL
10 000 L
RÉSERVOIR Essence
10 000 L
Container
Conteneur
Campement A
Campement B
Campement C
Campement D
Campement E
Campement F
Campement G
BONTERRA

7.5 EVACUATION OF THE GARAGE AND CORE BANK;

- If you hear the fire alarm, exit while closing, if possible, window and door (without barring), go to the assembly point (gate).
- When witnessing the onset of a fire, do not put your life or your health in danger;
- Stay calm;
- If the fire is small, use a fire extinguisher to extinguish it;
- If the fire is still active despite this intervention, sound the alarm if possible, close the door and window of the room where the fire is located;
- If the fire is large, sound the alarm without intervening and go to the assembly point;
- When going to the assembly point, (barrier) notify the people you meet that they should go to the assembly point;
- If you have a van assigned to you, use it to get to the assembly point, while picking up people who don't have a vehicle;
- Upon reaching the assembly point, identify yourself and wait for instructions;
- Do not leave the assembly point, nor the premises, nor the site without having obtained permission;
- Remain available for the ERT

7.6 MAPS OF THE CORE BANK AND GARAGE;

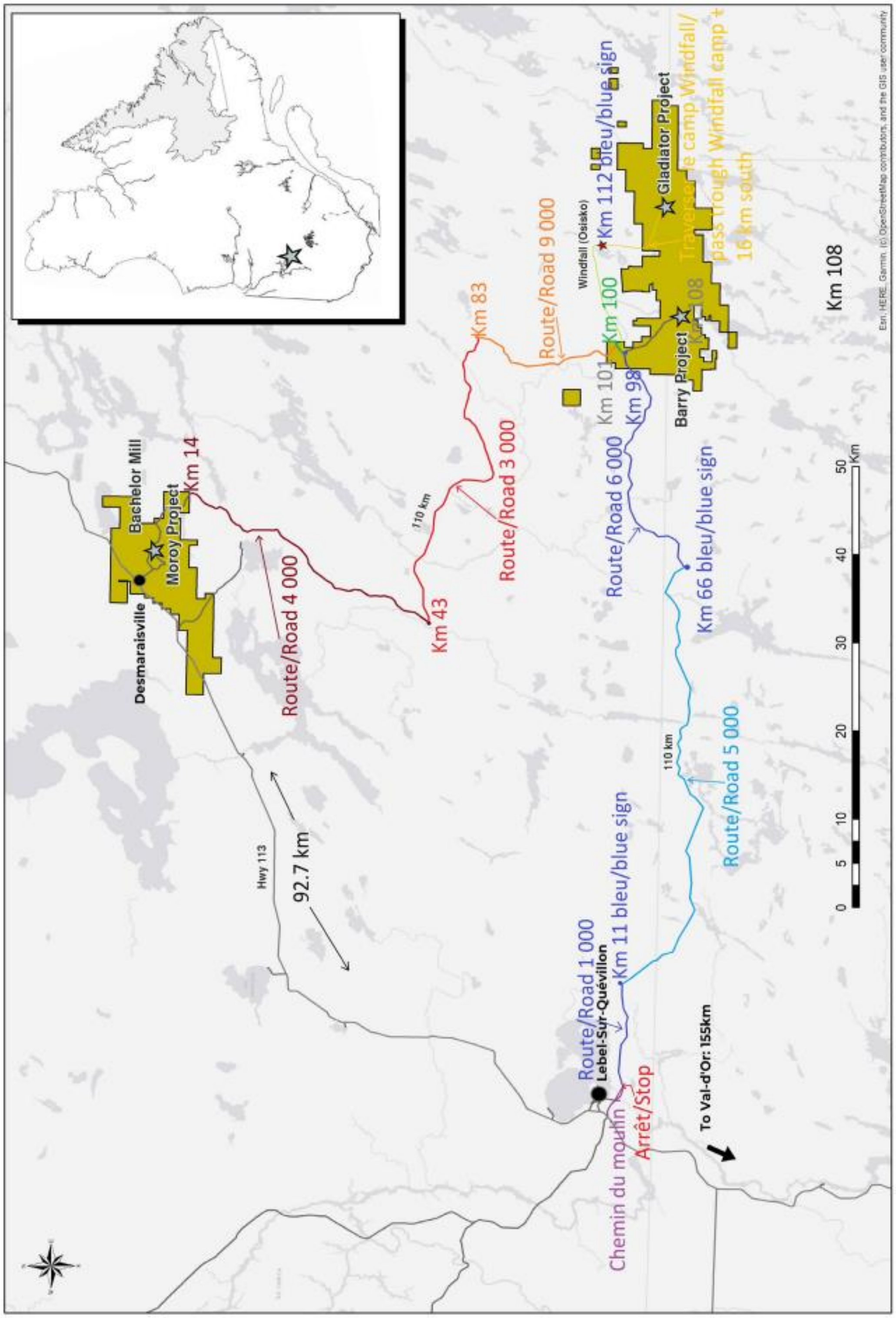

MINE BARRY
TITRE :
Emplacement générale
Réservoirs et MDR
Carothèque
BONTERRA
Propane
2000 L
Container
Container
Container
ESSENCE
Carotèque
tempo
Roulotte Explo
Cabane
S
E
W
N


MINE BARRY
TITRE :
Emplacement générale
Réservoirs et MDR
Garage
DESSINÉ PAR :
DESSINÉ PAR :
VÉRIFIÉ PAR :
APPROUVÉ PAR :
ÉCHELLE :
DATE :
DATE :
DATE :
DATE :
BONTERRA
4438
Container
Container
Pad à Matériel
Roulotte Contremaître
RÉSERVOIR DIESEL 50 000 L
Conteneur Électrique
RÉSERVOIR DIESEL 50 000L
Compresseur
Récepteurs
Propane 2000L
4000 L Huiles Usées
Garage
Parking Équip Sous-Ter
S
E
W
N

7.7 FOREST FIRE

- If you hear the fire alarm, exit while closing the door and window, if possible, go to the assembly point (gate);
- When witnessing the onset of a forest fire, do not put your life or your health in danger;
- Stay calm and don't panic;
- Immediately notify the ERT and sopfeu;
    - A forest fire, contact SOPFEU (1-800-463-3389) and indicate 75° 46' longitude West/ 48° 59' latitude North (Barry)
- When going to the assembly point, (barrier) notify the people you meet that they should go to the assembly point;
- If you have a van assigned to you, use it to get to the assembly point, while picking up people who don't have a vehicle;
- Upon reaching the assembly point, identify yourself and wait for instructions;
- Do not leave the assembly point, nor the premises, nor the site without having obtained permission;
- Wait for the sopfeu's instructions before evacuating, Sopfeu will tell you which evacuation route to use;
- Remain available for the ERT;
- The Evacuation will be carried out using the vans, they must be filled to full capacity before evacuating;
    - The driver must remain calm,
    - Observe the authorised speed limit,
    - Do not overtake the vans ahead of you,
    - Evacuation will be carried out in convoy to avoid loss of life,
    - Go to the LSQ or Chibougamau parking lot depending on the routes indicated by the Sopfeu for the evacuation.

7.8 AERIAL MAP OF FOREST ROADS


Route/Road 1 000
Lebel-Sur-Quévillon
Km 11 bleu/blue sign
Chemin du moulin
Arrêt/Stop
To Val-d'Or: 155km
Hwy 113
92.7 km
Route/Road 5 000
110 km
Km 66 bleu/blue sign
Route/Road 6 000
Km 98
Km 101
Barry Project
Km 108
Km 100
Windfall (Osisko)
Km 112 bleu/blue sign
Gladiator Project
Traverse le camp Windfall/
pass trough Windfall camp +
16 km south
Route/Road 9 000
Km 83
Route/Road 3 000
110 km
Km 43
Route/Road 4 000
Km 14
Bachelor Mill
Moroy Project
Desmaraisville
Km 108
0 5 10 20 30 40 50 Km
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

7.9 CASUALTY EVACUATION

Responsibility for evacuating a seriously injured person to the Hospital centre at Lebel sur Quévillon rests with the medical staff and, in their absence, with first aider.
Evacuation can be done in a van with driver, in an ambulance or helicopter.
The mode of transport is dictated by the severity of the injury and the risk of aggravation during transport. It is the nursing staff or first aider who decides how the injured person will be transported.

The medical staff should refer to the "evacuation and transport protocol for casualties «in order to decide on the means of transport for evacuation.

The nurse must use the evacuation form # «FO-INF-040 Health Assessment For Evacuation (20190130)'

For a minor injury, transport may be carried out by van with a driver.

Never dispatch an injured worker alone behind the wheel of a vehicle. If the worker begins to feel unwell and causes an accident, the responsibility lies with the person who authorised this transport method.

For a serious injury but without fear for the life and health of the injured worker, the evacuation can be done by van or ambulance; the nursing staff will be in charge of deciding on the means of transport.

- The LSQ city ambulance will be called beforehand,
    - The Barry site ambulance will depart with a driver qualified in Class 4A, 4B, 4C or with ALL CLASSES indicated on the driving licence,
    - The injured person and the nurse will be in the rear section of the ambulance throughout the journey;
    - The injured person will change ambulance when meeting up with the city ambulance;
    - The nurse may accompany the injured person to the LSQ hospital if the injured worker's condition is likely to deteriorate during transport and at the request of the paramedics;
    - A van will follow the ambulance to return the nurse to the Barry site.

- During the nurse's absence from Barry, it is up to the nurse from Gladiator to cover the Barry site in person, with the help of the Moroy nurse by cell phone, until the nurse returns to the Barry site.

- Helicopter evacuation when a worker is seriously injured or there are fears for his life.

- The nurse will have to make the decision and notify the Bonterra site manager.

The word "injury" is used in the text, but these means of transport also apply in cases of minor personal illnesses and serious personal illnesses.

7.10 HELICOPTER LANDING AREA

7.11 ENVIRONMENTAL EMERGENCY RESPONSE PLAN

7.12 PROPANE EMERGENCY

8 COMPLIANCE

Bonterra Policy

9 VALIDATION

This procedure was written by Nurse Louise Larochelle, and was submitted to the management team for approval. The Executive Committee approved it in April 2022 during a management review.

10 TRAINING

Training/information on the ERP for workers currently on site will be done following the approval of the ERP. For new workers, the ERP training will be done at orientation, afterwards a practice session will be held once a year.

Supervision of the execution of training in relation to compliance with the requirements of the AMQ and the CNESST

11 REVISION

The ERP will be revised each year so as to make corrections if necessary, when changing the structures of buildings, when changing the location of buildings or after a practice session.

In the spirit of continuous improvement, an internal audit in each department can be carried out in order to maintain the effectiveness of the ERP.

12 SIGNATURES

BARRY PROJECT
BARRY EMERGENCY RESPONSE PLAN
PMU-BAR-001

ISSUED ON: _2022-03-19__

REVISED ON: ____________________________

____________________________ General Manager	____________________________ Site manager
____________________________ Emergency response team leader	____________________________
____________________________	

QC2-37: BACHELOR EXPLOSIVES PERMIT (SÛRETÉ DU QUÉBEC, S.D.)

SÛRETÉ DU QUÉBEC POLICE

CONFIDENTIEL

PERMIS D'EXPLOSIFS

Numéro de permis : 51783

Titulaire (entreprise ou particulier): Ressources Métanor inc

N° de permis général d'explosifs: 133185

Date d'expiration (aaaa-mm-jj): 2023-11-25

Adresse du titulaire (numéro, rue, appartement/bureau, ville, village ou municipalité): 2872, Chemin Sullivan, Bureau 2, Val d'Or, Qc

Code postal: J9P 0B9

☐ VENTE

Endroit d'exploitation
Tous les établissements de vente du titulaire

☑ DÉPÔT

Règlement d'application de la Loi sur les explosifs (RLRQ, chapitre E-22, articles 37 et 38)

☑ **Lieu fixe**
Endroit d'exploitation: Desmaraisville, Qc, Mine Betchelor, surface
Code municipal: 99060

☐ **Lieu variable**
Endroit d'exploitation
Province de Québec

☐ **Usage immédiat**
Endroit d'exploitation
Code municipal

☐ **Temporaire**
Endroit d'exploitation : **Province de Québec**

Immatriculation	Marque	Année	Numéro de série	N° de véhicule

Dimensions du dépôt (uniquement pour un dépôt lieu fixe ou pour un dépôt lieu variable)
Longueur (m) : 7,30 Largeur (m) : 3,70 Hauteur (m) : 2,13

Numéro de plaquette d'identification: 8069

Quantité autorisée

Explosifs (kg): 23,903 Kg

☐ Ou (lieu variable)

Détonateurs: —

☐ Voie publique ou ☐ Terrain privé

Endroit d'exploitation
Province de Québec

☐ Pièces pyrotechniques

☐ Minipoudrière

Numéro de plaquette d'identification

SÛRETÉ DU QUÉBEC POLICE

CONFIDENTIEL

PERMIS D'EXPLOSIFS

Numéro de permis : 51782

Titulaire (entreprise ou particulier): Ressources Métanor inc

N° de permis général d'explosifs: 133185

Date d'expiration (aaaa-mm-jj): 2023-11-25

Adresse du titulaire (numéro, rue, appartement/bureau, ville, village ou municipalité): 2872, Chemin Sullivan, Bureau 2, Val d'Or, Qc

Code postal: J9P 0B9

☐ VENTE

Endroit d'exploitation
Tous les établissements de vente du titulaire

☑ DÉPÔT

Règlement d'application de la Loi sur les explosifs (RLRQ, chapitre E-22, articles 37 et 38)

☑ **Lieu fixe**
Endroit d'exploitation: Desmaraisville, Qc, Mine Bachelor, Surface
Code municipal: 99060

☐ **Lieu variable**
Endroit d'exploitation
Province de Québec

☐ **Usage immédiat**
Endroit d'exploitation:
Code municipal:

☐ **Temporaire**
Endroit d'exploitation : **Province de Québec**

Immatriculation	Marque	Année	Numéro de série	N° de véhicule

Dimensions du dépôt (uniquement pour un dépôt lieu fixe ou pour un dépôt lieu variable)
Longueur (m) : 2.40 Largeur (m) : 2,40 Hauteur (m) : 2,10

Numéro de plaquette d'identification: 6705

Quantité autorisée
Explosifs (kg): —
☐ Ou (lieu variable)
Détonateurs: 49 000 Unités

☐ Voie publique ou

Endroit d'exploitation

☐ Pièces pyrotechniques

☐ Minipoudrière

Numéro de plaquette d'identification

QC2-38: TEXT – ARCHÉO-MAMU (2018)

An initial study of archaeological potential was carried out in 2007 by Archéo-08 and Génivar, in the immediate area of the Barry-1 mining project. The vicinity of Lac la Loutre, where the mine is located, had a generally high archaeological potential. Five of the areas even had exceptionally high archaeological potential.

A second archaeological potential study was conducted in 2011 for a restricted area around the Bachelor mine site (i.e., the current study's ZEB, without the transportation route to the Barry site) (Chrétien, 2011). Several areas of archaeological potential were identified in the Socio-Economic Study Area (SEZ). However, on the level of the Biophysical Study Area (BSA), with the exception of the Bachelor Lake shoreline, the archaeological potential was low. Only two areas of archaeological potential were identified and their interest was too low to proceed to the next stage of the archaeological study process, namely the manual field survey. However, additional protective measures were recommended if the development was to be significantly closer to the shores of Bachelor Lake, where the archaeological potential is considered high.

No archaeological potential study exists for the road connecting the two mining projects. It should be noted, however, that this infrastructure already exists and will not be modified as part of the project, with the exception of seven culverts to be repaired. A minimal impact on the environment is foreseen.

As part of this study, the Aboriginal firm Archéo-Mamu Côte-Nord was asked to characterize the archaeological potential within a radius of 100 metres around the culverts to be repaired (Figure 01). Field photographs, recent satellite photographs and topographic plans were used for this purpose. The online database of the Inventaire des sites archéologiques du Québec (ISAQ, 2018), in addition to the map of the human environment, was also consulted. Table 01 summarizes the observations made for each of these locations. Generally speaking, they are located well away from the main rivers, where human settlements are normally likely to be found. The immediate environment is also poorly drained, further reducing the likelihood that human groups have settled there. Data from the human environment show, for their part, that the culverts to be repaired are all well away from the valued sectors. No archaeological site is identified within 6 km of the culverts and no archaeological information area intersects these spaces (figure 01). As a result, the archaeological potential of these areas is low to zero. No protective measures are therefore recommended by Archéo-Mamu Côte-Nord for the culverts to be repaired.

However, the recommendations made by the impact studies of the Barry and Bachelor mining projects remain relevant. If areas of high archaeological potential were to be affected, it would be up to the promoter to carry out additional archaeological studies (Archéo-08, 2007). Areas of medium archaeological potential should be inspected as a minimum, should they be affected by the project (Archéo-08, 2007). There may also be areas of archaeological potential outside of the areas in question (Archéo-08, 2007; Chrétien, 2011). If the promoter's plans change and other areas are affected, then it would be appropriate for an archaeologist to be consulted. Should archaeological remains appear during construction, it will be the responsibility of the contractor to suspend activities and immediately inform the promoter. The Ministry of Culture and Communications should also be informed. In agreement with the Ministry, protective measures should then be put in place and, if necessary, an archaeologist should intervene to assess the importance of the site and submit an action plan. If the identified remains could not be preserved due to the extent of the work, excavations would then be carried out at the earliest possible date, under the supervision of the archaeologist.

Note that this document was written by the former management of Archéo-Mamu Côte-Nord.

Table 01 : Summary of data that may affect the archaeological potential in the vicinity of the culverts to be repaired

Identifier	Latitude	Longitude	Drainage	Topography	Waterway	Human Environment	Potential	Recommendation
81	49.3440257	-76.1506971	Poor	Hollow	Possibly intermittent, away from major waterways and lakes	There is no evidence to suggest the possible presence of recent or old human occupation.	Low to nil	No protection
Route 3	49.2359336	-76.2368526	Poor, swampy	Plateau	Possibly intermittent, set back from the O'Sullivan River	About 500 metres from a valued section of the O'Sullivan River, including a permanent Cree camp	Low to nil	No protection
40	49.1808935	-76.0268432	Poor, swampy	Plateau	Possibly intermittent, away from major waterways and lakes	There is no evidence to suggest the possible presence of recent or old human occupation.	Low to nil	No protection
56	49.1948038	-75.9258742	Poor	Plateau	Possibly intermittent, away from major waterways and lakes	There is no evidence to suggest the possible presence of recent or old human occupation.	Low to nil	No protection
48	49.1914628	-75.9006626	Poor, swampy	Hollow	Possibly intermittent, away from major waterways and lakes	There is no evidence to suggest the possible presence of recent or ancient human occupation.	Low to nil	No protection
23	49.1459373	-75.8433002	Undetermined	Plateau	Possibly intermittent, far from major waterways and lakes	There are no data to support suspicion of possible presence of recent or ancient human occupations.	Low to nil	No protection
4	49.0389861	-75.8223212	Swampy	Hollow	None, remote marshy area (300 meters) from the Panache River	There is no evidence to suggest the possible presence of recent or ancient human occupation.	Low to nil	No protection

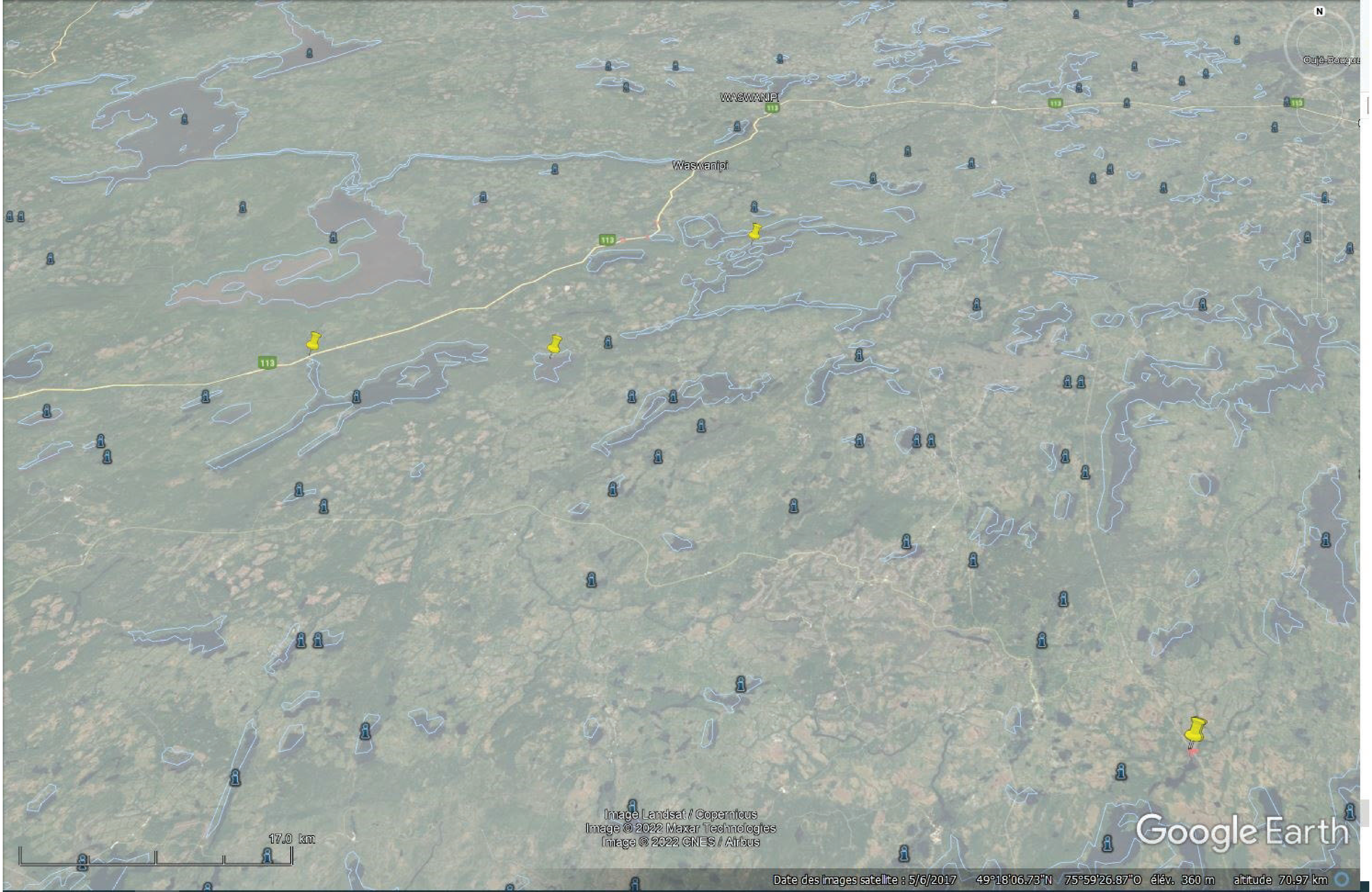


Image Landsat / Copernicus
Image © 2022 Maxar Technologies
Image © 2022 CNES / Airbus


N
WASWANIPI
Waswanipi
113
113
113
113
Image Landsat / Copernicus
Image © 2022 CNES / Airbus
15.6 km
Google Earth
49°19'03.47"N 75°56'47.50"O élév. 374 m altitude 65.31 km

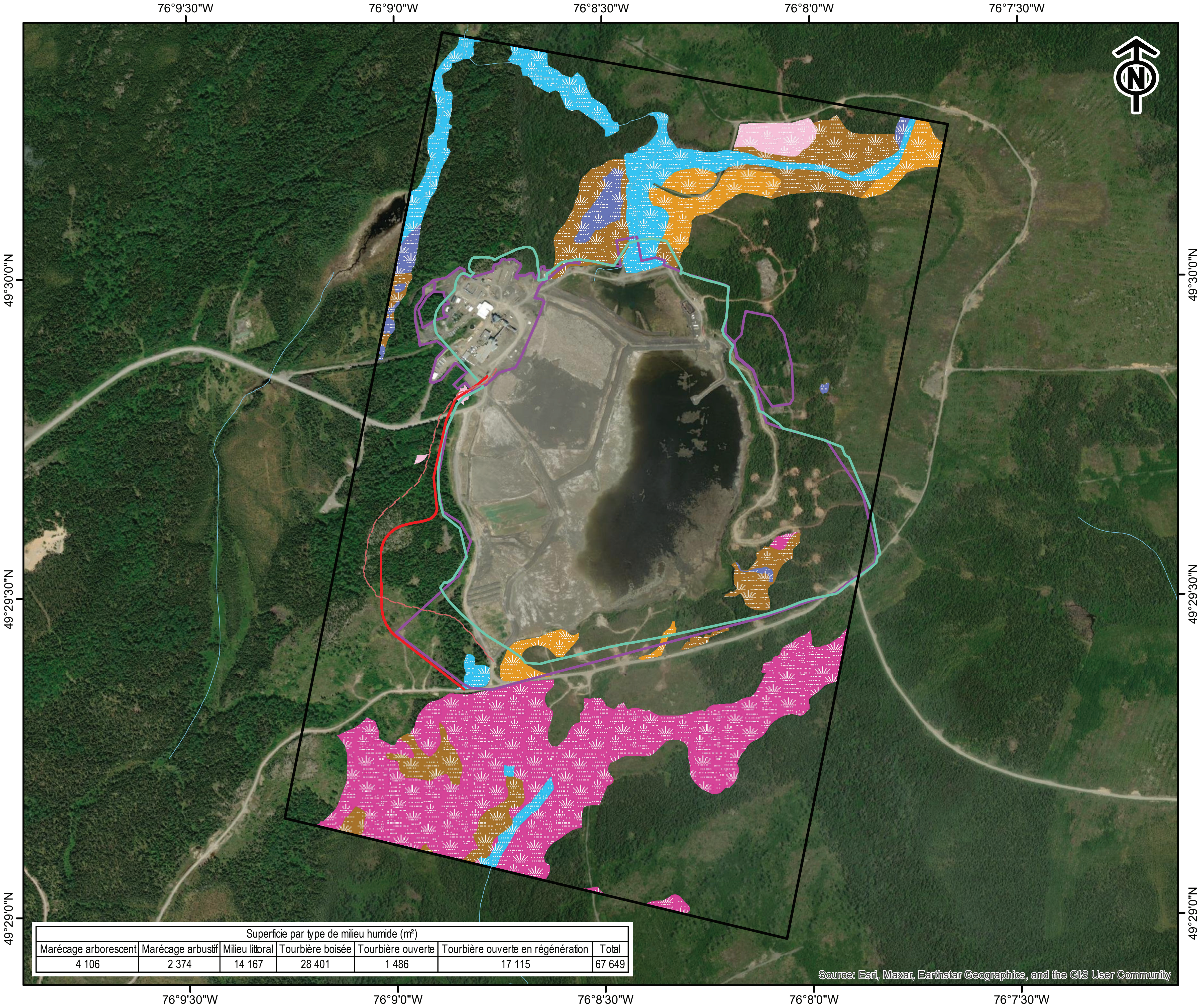
QC2-39: MAP OF PROJECTED INFRASTRUCTURE IN WETLANDS AND WETLAND AREAS

BONTERRA

Site Bachelor : Traitement aurifère du projet Barry

Emprise du projet sur les milieux humides

1 : 11 000
Système de coordonnées : MTM Zone 9 NAD83



Superficie par type de milieu humide (m²)						
Marécage arborescent	Marécage arbustif	Milieu littoral	Tourbière boisée	Tourbière ouverte	Tourbière ouverte en régénération	Total
4 106	2 374	14 167	28 401	1 486	17 115	67 649

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

0 125 250 500 Mètres

Légende

- Cours d'eau permanent
- Accès sud - Original
- Accès Sud -- Original-révisé
- Emprise du projet -- Original
- Emprises infrastructures -- Révisé
- ☐ Secteur d'étude

Milieux humides

- Marécage arborescent
- Marécage arbustif
- Milieu littoral
- Tourbière boisée
- Tourbière ouverte
- Tourbière ouverte en régénération
- Tourbière ouverte ombrotrophe

Réalisé par : Robert LeBrun
21 octobre 2022

21-0696-0784

GCM CONSULTANTS

QC2-43: PROTOCOL FOR THE EVACUATION AND TRANSPORT OF INJURED PERSONS
(CISSS DE L’ABITIBI-TÉMISCAMINGUE CRSSS DE LA BAIE-JAMES, 2018)

PREMIERS SECOURS ET PREMIERS SOINS

Procédure d'évacuation et de transport des blessés

QUI FAIT QUOI?

Afin d'éviter la confusion après un accident et afin d'augmenter l'efficacité de l'intervention tout en gagnant de précieuses minutes, il est recommandé de rédiger une procédure d'évacuation et de transport de blessés.

Lorsqu'un travailleur est blessé, le secouriste doit rester auprès de celui-ci et désigner un collègue pour organiser un transport ou pour appeler les services d'urgence et les accueillir sur les lieux de travail. Ces lieux de rencontre devraient être préalablement établis par l'entreprise.

Le secouriste évalue la situation et détermine la gravité des blessures ainsi que ses besoins de transport. Lorsque c'est possible et sécuritaire, le secouriste administre les premiers secours directement sur les lieux de travail.

Rappelons que le service d'urgence téléphonique 911 doit être contacté sans délai si :

- La situation n'est pas sécuritaire.
- Il y a plusieurs victimes.
- Il y a des soupçons de blessure à la tête ou à la colonne vertébrale.
- Il y a un état de conscience altéré.
- Vous êtes dans le doute.

Centre intégré
de santé et de services
sociaux de l'Abitibi-
Témiscamingue
Québec

Exemples pour l’élaboration d’un protocole d’évacuation et de transport des blessés

LE BLESSÉ DOIT-IL ÊTRE TRANSPORTÉ PAR AMBULANCE?

NON

OUI

Selon le jugement du secouriste en conformité des protocoles d’intervention appris.

Qui appelle le service ambulancier?
Nom et/ou titre

Qui va à la rencontre des ambulanciers?
Nom et/ou titre

Où les ambulanciers doivent-ils se présenter?
Nom et/ou titre

Qui accompagne la personne blessée?
Nom et/ou titre

Qui avise la famille de la personne blessée?
Nom et/ou titre

Qui avise la CNESST?
Nom et/ou titre

Qui complète le registre?
Nom et/ou titre

Qui assure le retour de l’accompagnateur?
Nom et/ou titre

Avec la participation de :

CENTRE RÉGIONAL
DE SANTÉ ET DE
SERVICES SOCIAUX
DE LA BAIE-JAMES

Le CISSS de l’Abitibi-Témiscamingue et le CRSSS de la Baie-James sont membres du :
Pour des milieux de travail en santé
Réseau de santé publique
en santé au travail