Deployment Project of Two Wind Turbines at the Nunavik Nickel Mining Complex

Tugliq Energy

AECOM

Nickel Wind Farm – Expo
Environmental and Social Impact Assessment

Volume 1 – Main Report
File Number: 3215-10-016

Impact Study Submitted to the Ministère de l'Environnement et de la Lutte contre les changements climatiques
November 4, 2022

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List of acronyms

°C	Degrees Celsius
ARVCC	Assessment of risks and vulnerabilities to climate change
ATV	All-Terrain Vehicule
CAR	Clean Air Regulation
CCC	Canadian Center for Climate Services
CER	Ecological reference classification
CH_4	Methane
CO_2	Carbon dioxide
CO_2 eq	Carbon dioxide equivalent
CRI	Canadian Royalties Inc.
CVAA	Protection criteria for aquatic life against acute effects (Critère de protection pour la vie aquatique contre les effets aigus)
CVAC	Protection criteria for aquatic life against chronic effects (Critère de protection pour la vie aquatique contre les effets chroniques)
dBA	Weighted decibels
DTM	Digital Terrain Model
ECCC	Environment and Climate Change Canada
EQA	Environmental Quality Act
ESIA	Environmental and Social Impact Study
G	Gravity of Consequences
GCM	Global Climate Models
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GWP	Global warming potential
HLSG	High Level Screening Guide
IPCC	Intergovernmental Panel on Climate Change
JBNQA	James Bay and Northern Québec Agreement
KEQC	The Kativik Environmental Quality Commission
KRG	Kativik Regional Government
L	Likelihood
LAeq	Equivalent Noise Level
LRH	Leaf River Herd
MAMH	Ministère des Affaires municipales et de l'Habitation
MCC	Ministère de la Culture et des Communications

MDDELCC	Ministère du Développement durable, de l’Environnement et de la Lutte contre les changements climatiques
MDDEP	Ministère du Développement durable, de l’Environnement et des Parcs
MELCC	Ministère de l’Environnement et de la Lutte contre les changements climatiques
MFFP	Ministère des Forêts, de la Faune et des Parcs
N_2O	Nitrous oxide
NNiP	Nunavik Nickel Project
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
PAECI	Environmental improvement program in Inuit communities (*Programme d’amélioration environnementale dans les communautés inuites*)
R	Risk
RCM	Regional County Municipalities
RCP	Representative Concentration Pathway
REEIE	Regulation respecting the environmental impacts assessment and review of certain projects
TSS	Total suspended solids
VCE	Valued Components of the Environment

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1 Background

1.1 Presentation of the Proponent

TUGLIQ Energy is a Canadian company, based in Montréal, with the mission to offer alternative energy solutions to standalone grids and microgrids, such as islands, remote communities and mining operations that currently depend heavily on fossil fuels for their energy production.

TUGLIQ has proven itself in the renewable energy field, including wind energy, solar energy and energy storage, specifically adapted to extreme weather in isolated environments that are difficult to access and present logistical challenges, such as the Canadian Arctic, the Caribbean and remote regions of Africa.

1.2 Presentation of the consultant and its mandate

TUGLIQ Energy has mandated AECOM Consultants Inc. to carry out the environmental and social impact assessment of this project. AECOM is a specialized engineering and environmental firm that operates in many countries around the globe. In Québec, AECOM has been involved in conducting various environmental and social impact assessments for over 50 years.

The contact information of the initiator of the project and the consultant involved can be found in Table 1-1.

Table 1-1: Contact information of the initiator of the project and the consultant involved in the impact assessment

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Fax:	(+1) 819-373-7573
Project leads:	Claudia Cossette (Project Director) Sylvain Lacasse (Project Manager)
Email of project leads:	claudia.cossette@aecom.com sylvain.lacasse@aecom.com
Québec Enterprise Number (NEQ):	1161553129

1.3 Summary presentation of the project

Canadian Royalties Inc. (CRI) is a private mining company based in Montréal, which operates a copper and nickel mine in Nunavik, under the name of Nunavik Nickel Project (NNiP). CRI is wholly owned by the Chinese mining company Zhongze Holding Group Co. Ltd. This mining project's production began in 2013 and relies on a mill with a capacity of 4,500 tonnes/day, supplied by various mineral deposits, including the Allammaq, Mequillon and Expo deposits.

CRI has called on TUGLIQ Energy to reduce the carbon footprint of its Expo site in the Nunavik Nickel Project by substitution of renewable energy for fossil fuels.

Since the opening of the Nunavik Nickel mining complex by CRI in 2013 and to date, power generation at the Expo site is ensured by diesel-powered generators, with a total capacity of 19.8 MW (6 generators of 3.3 MW each), which emit large quantities of CO_2. However, the winds present in this region are powerful and thus can be exploited by wind turbines.

The project involves the installation of two wind turbines of 3 MW each, coupled with a battery energy storage system. These wind turbines will be installed a few kilometres from the Expo mine site, between 2 and 3 km east of this site. Once installed, it is estimated that these wind turbines will generate 17,500 MWh of electricity annually. To generate these 17,500 MWh under the current conditions, the diesel generators consume 4.5 million litres of diesel (assuming generation of 3.8 kWh of electricity by generators per litre of diesel consumed). Consumption of 4.5 million litres of diesel by the generators emits over 14,000 tonnes of CO_2 equivalent into the atmosphere. The wind farm thus will allow the abolition of these greenhouse gas emissions, representing a 10.5% reduction of total GHG emissions currently produced by the CRI mining complex.

1.4 Project insertion context

1.4.1 The wind energy sector: global, national and provincial context

The International Energy Agency (IEA), recognized worldwide for its annual report entitled *Wind Energy Outlook*, forecasts that global wind energy growth in the next few years will be faster than in the past five years. As of their last report, the IEA predicts a mean annual addition of 75 GW over the 2021-2026 period. Moreover, the Agency emphasizes three necessary recommendations to fuel the growth of wind energy production: cost reduction, improvement of technologies and rapid deployment of projects.[1]

On the Canadian scale, Statistics Canada assesses that wind energy in 2020 supplied 5.6% of Canadian power generation, ranking the country 9th in the world.[2] The roadmap published by the Government in 2019 forecasts that, by 2025, Canada will become a world leader in the supply of high technology in wind energy.

In 2020, Québec was responsible for 32.4% of Canadian wind generation, for a total of 10,640 GWh, putting the province in second place behind Ontario (36.4%). The "2030 Energy Policy" reflects the province's intention to increase its wind energy capacity, particularly for Northern industries and communities, which are not connected to the Hydro-Québec grid.[3]

TUGLIQ Energy therefore becomes part of these dynamics by prioritizing decarbonization of one of the most greenhouse gas-emitting industries in Québec, the mining industry.

[1] https://www.iea.org/fuels-and-technologies/wind
[2] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2510002001&request_locale=en
[3] https://mern.gouv.qc.ca/energie/energie-eolienne/filiere-eolienne/

1.4.2 History of the project

This first feasibility studies of this project were produced in 2014-2015. A wind measuring tower with a LiDAR module allowed production of a report on the winds and wind energy potential in the geographic area of the mine (Hatch, 2015). The operable wind energy potential then could be determined for the Expo mine site and the results of this study proved favourable enough to allow TUGLIQ to go ahead with this project.

At the present time, no partnership has been established with the Nunavik communities for this project; however, some services will be provided by Inuit-owned Nunavik companies (more details on this subject will be provided in section 3). Since the relationship with the surrounding communities is already governed by the Nunavik Nickel impact and benefit Agreement between the mining operator (CRI) and these communities, the project does not currently have any additional measures in place other than those mentioned in this Agreement, since the benefits of the project for the mining operator will be distributed in accordance with the agreements in effect. During all phases of the project, it will therefore be subject to the same conditions as those of the Agreement already in place between the mining operator and the communities.

TUGLIQ operates a wind energy project similar to the one projected on the Expo mine site, the Raglan Mine wind energy project, located in the same region. This Glencore mining operation installed two wind turbines of the same size, respectively in 2014 and 2018, both also coupled with a battery energy storage system (Figure 1-1).

Figure 1-1: Photo of the two wind turbines installed on the Raglan Mine site

1.4.3 Rationale of the project

Canadian Royalties Inc. (CRI) is the third biggest consumer of fossil fuel in the Canadian Arctic, with 48 million litres of diesel consumed annually.[4] Of this quantity, 60% is dedicated to power generation. The Expo depends 100% on diesel for generation of electrical and thermal energy. This energy is used for the mine's operating requirements: production of power and heat, underground ventilation, exploration and expansion. The needs of the personnel are also covered: housing, drinking water and wastewater filtration, maintenance.

Due to its high diesel consumption, Canadian Royalties is also one of the leading GHG emitters in the Canadian Arctic, annually emitting over 133,000 tonnes of CO_2eq (GHG) in one of the most fragile ecosystems on the planet. Since 2013, these annual CO_2eq emissions have been subject to the Québec cap-and-trade provisions. This puts Canadian Royalties at a competitive disadvantage compared to the neighbouring jurisdictions not subject to similar regulatory provisions.

Canadian Royalties also faces unprecedented economic pressures, because the cost of diesel delivered to the mining complex has increased considerably over the past few years. Yet energy is the second leading cost for this mining complex, with first place occupied by labour costs.

Moreover, diesel presents a marine and terrestrial spill risk with a growing impact, resulting from the increasing quantities used by Canadian Royalties and in many mining and industrial enclaves located in a vast territory.

To mitigate these problems, the mining companies and neighbouring communities must reduce the costs of the impacts and risks of using fossil energy. It is proposed to accomplish this objective by diversifying the Canadian Royalties energy portfolio by the introduction of renewable energy from an industrial wind farm.

This project will be the second industrial deployment of renewable energy in Nunavik, the first being located at the Raglan Mine, only 30 kilometres northwest of the Canadian Royalties Expo site. The territory concerned is favoured by one of the world's best wind energy resources; the cold climate guarantees dense and therefore powerful air with a mean wind speed of 8.9 m/s at 80 m of altitude (height of the wind turbine hub), an energy resource that tragically remains unexploited to date. It also will favour the development of a new economic development vector for remote communities, while improving the quality of life of local workers and communities.

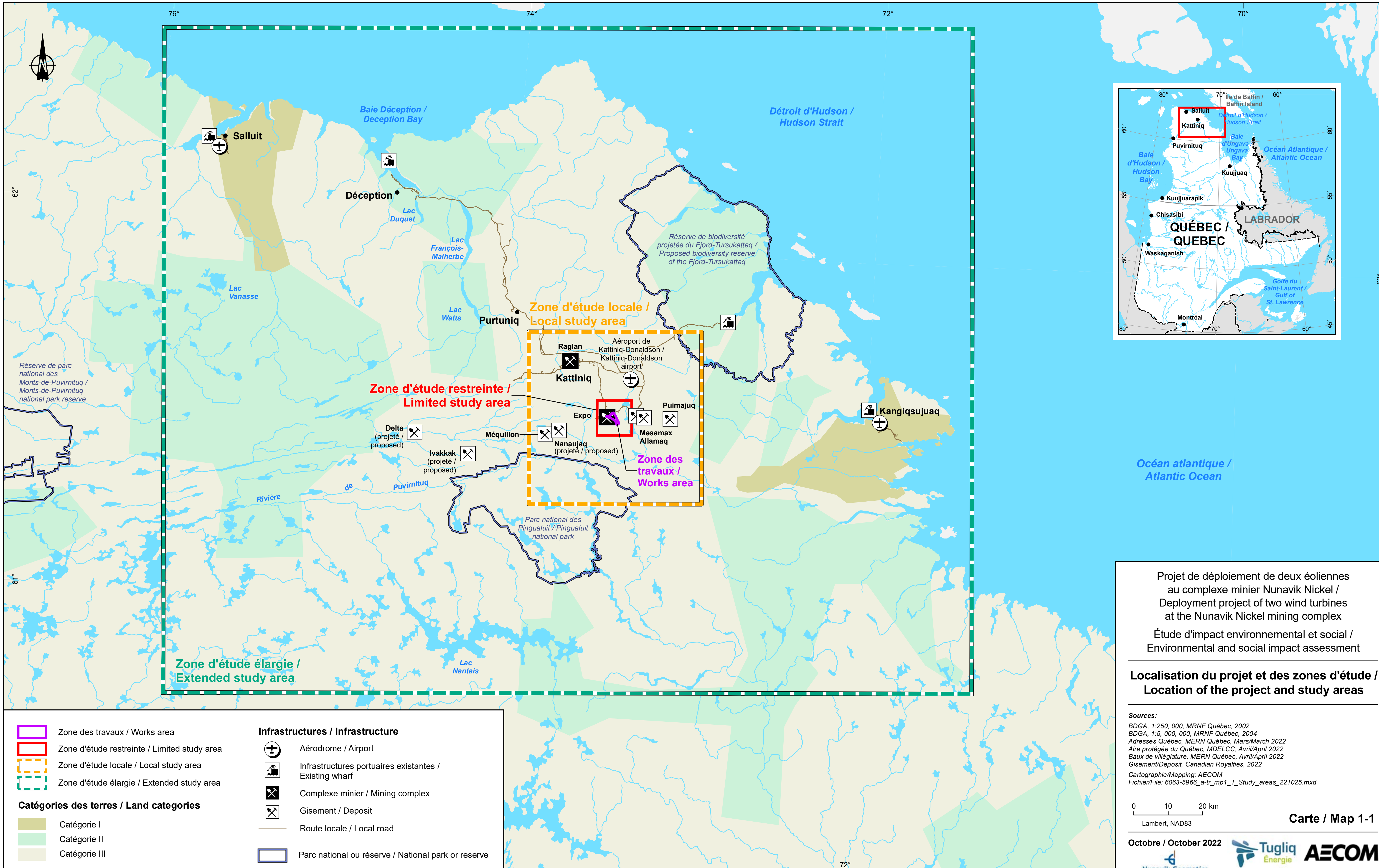
Table 1-2 indicates the geographic coordinates of the projected wind turbines at the Expo mine site, while Map 1-1 illustrates the location of the project.

Table 1-2: Geographic coordinates of the projected wind turbines at the Expo site

	NAD83 - UTM zone 18N	
	Latitude	Longitude
Wind Turbine 1	586 051,64	6 826 456,93
Wind Turbine 2	586 534,21	6 825 924,10

Éoliennes projetées	WGS84	
	Latitude	Longitude
Wind Turbine 1	61° 33' 43 703 N	73° 22' 49 100 O
Wind Turbine 2	61° 33' 25 611 N	73° 22' 16 833 O

[4] The data indicated in this section is discounted as of November 2021.



76°
74°
72°
70°
62°
61°
Salluit
Déception
Baie Déception /
Deception Bay
Détroit d'Hudson /
Hudson Strait
Lac
Duquet
Lac
François-
Malherbe
Lac
Vanasse
Lac
Watts
Purtuniq
Zone d'étude locale /
Local study area
Réserve de biodiversité
projetée du Fjord-Tursukattaq /
Proposed biodiversity reserve
of the Fjord-Tursukattaq
Raglan
Aéroport de
Kattiniq-Donaldson /
Kattiniq-Donaldson
airport
Kattiniq
Zone d'étude restreinte /
Limited study area
Expo
Puimajuq
Mesamax
Allamaq
Delta
(projeté /
proposed)
Méquillon
Nanaujaq
(projeté / proposed)
Ivakkak
(projeté /
proposed)
Zone des
travaux /
Works area
Kangiqsujuaq
Réserve de parc
national des
Monts-de-Puvirnituq /
Monts-de-Puvirnituq
national park reserve
Rivière
de
Puvirnituq
Parc national des
Pingualuit / Pingualuit
national park
Océan atlantique /
Atlantic Ocean
Zone d'étude élargie /
Extended study area
Lac
Nantais
Île de Baffin /
Baffin Island
Salluit
Kattiniq
Détroit d'Hudson /
Hudson Strait
Puvirnituq
Baie
d'Ungava /
Ungava
Bay
Baie
d'Hudson /
Hudson
Bay
Océan Atlantique /
Atlantic Ocean
Kuujjuaq
Kuujjuarapik
Chisasibi
LABRADOR
QUÉBEC /
QUEBEC
Waskaganish
Golfe du
Saint-Laurent /
Gulf of
St. Lawrence
Montréal
Zone des travaux / Works area
Zone d'étude restreinte / Limited study area
Zone d'étude locale / Local study area
Zone d'étude élargie / Extended study area
Catégories des terres / Land categories
Catégorie I
Catégorie II
Catégorie III
Infrastructures / Infrastructure
Aérodrome / Airport
Infrastructures portuaires existantes /
Existing wharf
Complexe minier / Mining complex
Gisement / Deposit
Route locale / Local road
Parc national ou réserve / National park or reserve
Projet de déploiement de deux éoliennes
au complexe minier Nunavik Nickel /
Deployment project of two wind turbines
at the Nunavik Nickel mining complex
Étude d'impact environnemental et social /
Environmental and social impact assessment
Localisation du projet et des zones d'étude /
Location of the project and study areas
Sources:
BDGA, 1:250, 000, MRNF Québec, 2002
BDGA, 1:5, 000, 000, MRNF Québec, 2004
Adresses Québec, MERN Québec, Mars/March 2022
Aire protégée du Québec, MDELCC, Avril/April 2022
Baux de villégiature, MERN Québec, Avril/April 2022
Gisement/Deposit, Canadian Royalties, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp1_1_Study_areas_221025.mxd
0 10 20 km
Lambert, NAD83
Carte / Map 1-1
Octobre / October 2022
Nunavik Geomatics
Tugliq Énergie
AECOM

1.5 Legal and regulatory context

The *James Bay and Northern Québec Agreement* (JBNQA), by its Sections 22 and 23, establishes an environmental and social protection regime in northern Québec, respectively south and north of the 55th parallel. Some aspects of these chapters are under the jurisdiction of the Government of Canada, the Gouvernement du Québec or both levels of government. Those under Québec jurisdiction were included in Chapter II of the *Environment Quality Act* (EQA) (Chapter Q-2). This chapter of the EQA presents the environmental and social impact assessment and review procedures that apply in the James Bay region (s. 133 of the EQA) or in the territory of Nunavik (s. 168 of the EQA).[5]

In the provincial context, the projects located in Nunavik (north of the 55th parallel) thus are governed by Section 23 of the JBNQA and Chapter II of the EQA. Specific environmental assessment procedures are provided for the project located in the territory governed by the JBNQA. The Kativik Environmental Quality Commission (KEQC), composed of representatives of the Inuit community and the Gouvernement du Québec, is responsible for the assessment and review of projects located in the territory of Nunavik. The KEQC is also responsible for defining the nature and scope of the impact assessment to be produced, when the project is subject to this procedure.

The projects mentioned in Schedule A of the EQA must be subject to one of the procedures applicable in the northern environment, contrary to those mentioned in Schedule B, which are not subject to them. Those that are not covered by these schedules are considered to be “grey area” projects. These projects therefore must be submitted to the KEQC, which will determine whether they are subject to one of the procedures applicable in the northern environment.

According to the *Regulation respecting the environmental impact assessment and review of certain projects* (Q-2, r. 23.1), construction for electric power generation purposes of a wind farm or any other type of power generating plant or facility with a capacity equal to or greater than 10 MW is subject to the environmental and social impact assessment and review procedure. In the case of this project, given that the installed capacity of the wind turbines will be 6 MW, this is a “grey area” project. TUGLIQ Energy thus prepared a project notice and submitted it to the KEQC on January 22, 2022 for the deployment project of two wind turbines with a battery energy storage system at the Nunavik Nickel mining complex. The KEQC determined, in a letter[6] dated March 7, 2022, that the TUGLIQ wind farm project is subject to the environmental and social impact assessment process, in accordance with section 195 of the Environment Quality Act (EQA). The KEQC then issued its directive for the preparation of the impact assessment on May 17, 2022.[7] This environmental and social impact assessment was prepared on the basis of this KEQC directive.

The *Regulation respecting the regulatory scheme applying to activities on the basis of their environmental impact* (Q-2, r. 17.1; RRSAEI), which seeks to specify the regulatory scheme of activities subject to a departmental authorization, under section 22 of the EQA, will also be applicable for this project. Indeed, section 94 of this Regulation specifies that the construction and subsequent operation of a wind farm are subject to a departmental authorization under subparagraph 10 of the first paragraph of section 22 of the EQA.

At the federal level, according to the *Physical Activities Regulations* (SOR/2019-285) arising from the *Impact Assessment Act* (IAA), the deployment project for two wind turbines with a battery storage system at the Nunavik Nickel mining complex does not constitute a designated project and thus is not subject to the federal impact assessment procedure.

[5] www.mddelcc.gouv.qc.ca/evaluations/mil-nordique/index.htm

[6] Letter addressed by Mr. Pierre Philie, Chair of the KQEC, to Mr. Marc Croteau, Deputy Minister and Administrator of Chapter 23 of the James Bay and Northern Québec Agreement, MELCC.

[7] Directive pour le projet de déploiement de deux éoliennes avec système de stockage d’énergie à batterie à la mine Nunavik Nickel par TUQLIQ Énergie S.A.R.F. en partenariat avec Canadian Royalties Inc.

1.6 Main environmental and social issues of the project

The issues of a project are related to the risks it may induce in the study area, by generating a modification, an alteration, a gain or a loss of certain components of the receiving environment to which concerns are attributed and the analysis of which could influence the decision regarding the authorization of said project. The main environmental and social issues identified for this wind energy project are as follows:

- Conservation and protection or wetlands and water environments during of the project infrastructure;
- The risk of collision of avian wildlife with the wind turbines during the operating phase of the project, particularly in the case of birds of prey;
- Land use by the Inuit communities, particularly the use of wildlife resources in the vicinity of the sector planned for the wind farm;
- Visibility of wind farms and their effects on the landscape, particularly for the users of Pingaluit National Park;
- The socioeconomic impacts related to carrying out the project;
- The reduction of greenhouse gas (GHG) emissions associated with the project.

Because the project is situated in the territory of the Arctic tundra and in the permafrost zone, the natural environment is rich in wetlands and water environments on which the wildlife depends in part. The construction of the project's infrastructure must therefore seek to avoid and minimize infrastructure encroachments on the wetlands and water environments as much as possible, particularly by access roads, in order to reduce the project's footprint on these sensitive environments.

The integration of the wind turbines must also account for the presence and migration of avian wildlife in the sector, because this is an important issue in carrying out any wind energy project, particularly in the case of birds of prey. Indeed, the risk of collision of birds with wind turbines constitutes an impact that is well documented in the scientific literature.

Although the population, the majority of which is Inuit, using the study area is few in numbers and spread over a vast territory, it nonetheless remains that certain traditional activities are practiced in the vicinity of the projected wind turbine implementation sector as well as in the mining operation sector. The wind energy project must account for these activities performed by the Inuit communities in the sector, particularly harvesting of wildlife resources, such as caribou, waterfowl and ptarmigans.

Carrying out of the project is also an important socioeconomic issue for Inuits and non-Natives, and for companies in the region, because it will allow consideration of jobs and hiring of new resources in Nunavik during the project's construction, operating and dismantling phases.

Because Pingaluit National Park is located within a radius of about 15 to 50 km of the projected wind farm implementation site, the use of this protected area is also an issue of the project, to the extent the wind turbines potentially could be visible for people who visit the park and thus affect the neighbouring natural landscape. The study of the landscape and the visibility analysis of the wind turbines thus is particularly important for this project.

Greenhouse gas (GHG) emissions and climate change remain an issue for any project. As previously mentioned in section 1.3, carrying out this project will allow elimination of consumption of 4.5 million litres of diesel per year, related to the mining activities of the Nunavik Nickel Project (NNiP), and reduction of CO_2 equivalent emissions into the atmosphere of 14,000 tonnes per year. This represents a 10.5% reduction of total GHG emissions currently produced annually by CRI's mining activities in Nunavik. On the scale of the project's lifecycle, over the 10-year guaranteed lifecycle of the mine, emissions will be reduced by140,000 tonnes of CO_2 equivalent, and on the scale of the wind turbine's 25-year lifecycle, this reduction will reach 350,000 tonnes of CO_2 equivalent. This is a considerable positive impact in terms of GHG reduction in the northern environment, where the effects of climate change will be the most perceptible in the future.

Finally, let us mention that TUGLIQ Energy is subject to a major issue concerning this project's implementation schedule for the following two reasons: 1) the mineral deposits mined by CRI have a limited lifecycle, because the guaranteed lifecycle of operation of this mining complex is currently estimated at a maximum of 10 years; 2) the harsh weather conditions in Nunavik considerably limit the duration of the period when construction of wind turbine infrastructure is possible. TUGLIQ therefore is seeking to carry out the project during the next possible construction period, between May and December 2023, so that the project's costs then can be amortized and made profitable over a nine-year operating period.[8] This tight schedule implies that a delay in obtaining departmental authorizations could lead to a judgment that the project is unprofitable and results in its non-performance, thereby nullifying the anticipated positive impacts of this project in terms of reduction of GHG emissions and the socioeconomic impacts for Nunavik.

[8] Note: 1 year of construction + 9 years of operation = 10 years guaranteed lifecycle

2 Analysis of project alternatives

2.1 Wind farm location alternatives

The wind farm plan is to increase the energy supply to the Expo site of the Nunavik Nickel complex. The chosen installation site of the wind turbines thus should be located as close as possible to the Expo site for technical and economic reasons. Several options were studied to reduce the project installation costs while maximizing electric power generation.

The installation cost of the wind farm is greatly dependent on the distance separating it from the electrical connection point. Indeed, electrical cabling for the Arctic allowing connection of the wind turbines to the mine's power grid is very expensive; only one kilometre of cable represents nearly 1% of the project's total budget (about $320,000/km of cable). This cost constraint thus the number of available locations near the Expo mine site.

The proximity of a wind farm to an existing road is another important criterion to consider in the selection of the installation site. With the objective of minimizing the construction costs and the greenhouse gas emissions of the project, the closer the wind farm is located to an existing road, the fewer access roads will have to be constructed, thus mobilizing less heavy machinery.

However, the first selection criterion for the final location of the wind farm is the best wind profile obtained by simulation. Because power generation by the wind turbines is highly dependent on wind characteristics, a slight depreciation of the wind profile may result in heavy power generation losses, jeopardizing the project's viability. A wind study therefore was conducted by Hatch (2015) with the assistance of meteorological measurements taken directly on in situ, near the Expo site, over a one-year period. In the context of this study, three possible wind turbine location options were analyzed in the vicinity of the mine site. The first two options were located about 3 km east and northeast of the Expo site, while the third option was located between 3 and 4 km southwest of the Expo site (see Figure 2-1). It is important to mention that these three location options are outside the blast zone of the mine site. Moreover, these three options are all located on hills surrounding the Expo site where the winds are stronger. The results of the simulations indicate that Option 1, located east of the Expo site, could lead to net energy generation of 10.725 MWh/year for each wind turbine installed, which is about 3% greater than Option 2 and about 9% greater than Option 3 (Hatch, 2015).

The different selection criteria analyzed thus led TUGLIQ to choose a wind farm installation site combining a small ecological footprint and a low construction cost, while maximizing electric power generation. Consequently, Option 1, located about 3 km east of the Expo site, was chosen for installation of the wind farm because it represented the best alternative in economic, technical and environmental terms.

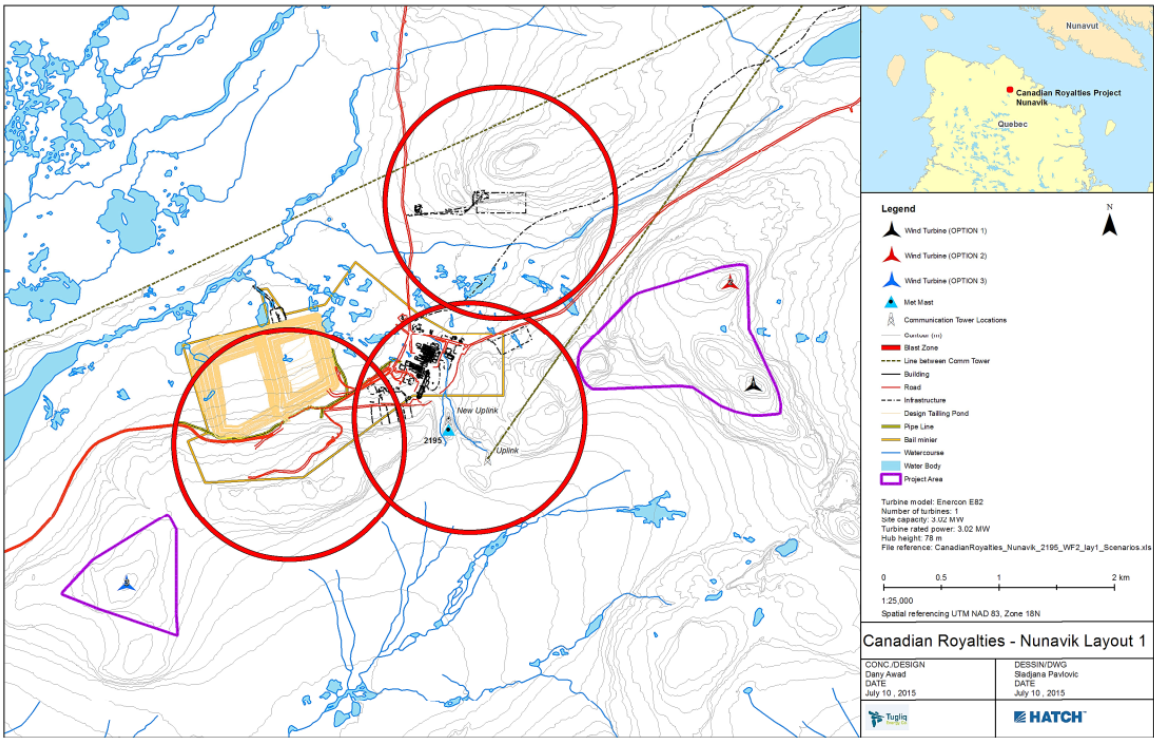


Figure 2-1: Wind farm location options analyzed near the Expo site (taken from Hatch, 2015)

2.2 Technological alternatives

The implementation project for two wind turbines on the Expo site results from the success of a comparable project at the Raglan Mine, where TUGLIQ Energy installed two wind turbines coupled to a battery storage system. The equipment proposed for this project then is similar to the equipment installed in 2014 and 2018 for the Raglan Mine's two wind turbines.

Since the E-82 wind turbine by the German manufacturer ENERCON has provided its efficiency over the years at the Raglan Mine, the same model was chosen immediately. It is well adapted to the cold and resistant to Northern climate conditions. The wind energy technicians employed by the Proponent are already trained on this model, making it the ideal choice for the project covered by this impact study. For these reasons, the selection of the wind turbine make and model focused on ENERCON. TUGLIQ studied the possibility of installing larger-calibre wind turbines than those installed at the Raglan Mine, but an internal economic study did not show an economic justification for these models, so that the E-82 wind turbine was retained as the preferred model.

Likewise, for construction of the wind turbine's foundation, the design is already established and its efficiency was proved during the operating years of the wind farm at the Raglan Mine. In a continuous improvement perspective, TUGLIQ will install an improved version of this foundation design for this project, with the goal of using fewer materials. The design principle and performances remain the same.

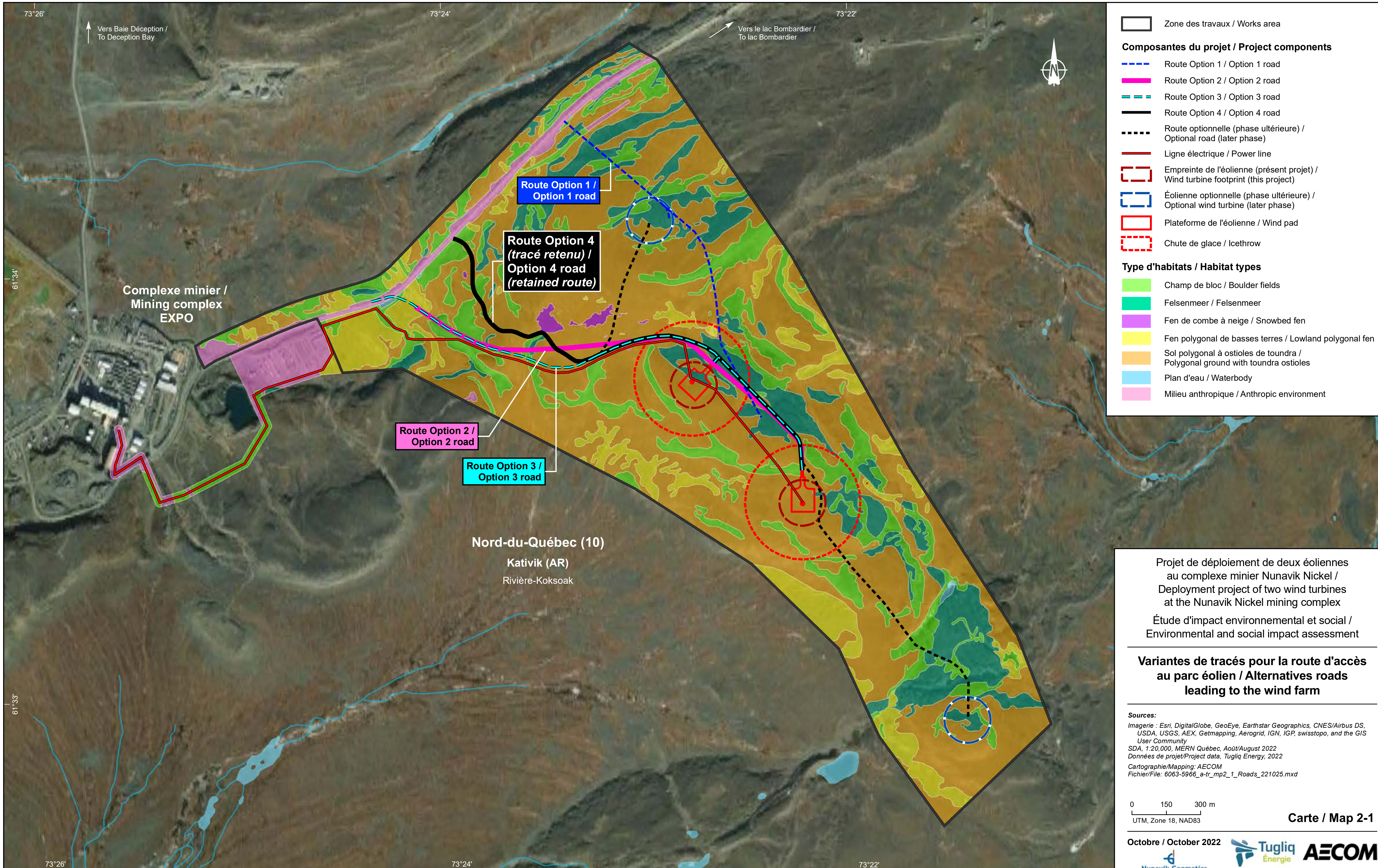
The Raglan Mine wind energy was meant to be a wind technology demonstration project coupled to a complete energy storage system (combining short, medium and long-term storage via flywheel, battery and hydrogen technologies). Following analysis of the results of Raglan Mine wind turbines throughout the operating years, TUGLIQ considered the use of a single battery energy storage system sufficient to ensure integration of wind energy into the mine's grid. This single storage facility reduces the project's footprint, because only one container will be required to house the batteries and it will be installed in the anthropogenic environment of the Expo mine site.

2.3 Wind farm access road route alternatives

Once the final choice of the wind farm installation site was determined (see section 2.1), different route alternatives for the access road to be developed were analyzed. The selection criteria had to account for the technical constraints related to transport of large equipment parts for construction of wind turbines, as well as the environmental constraints related to the presence of sensitive environments. The main technical constraints to be respected for road construction are as follows: maximum slope of 10% and maximum outer radius of curvature of 35 m. In the case of environmental constraints, the road route had to comply the MELCC's "avoid-minimize" principle concerning encroachment on wetlands and water environments.

The first route option analyzed ran through the northern portion of the work area (see Option 1 on Map 2-1). This first option was quickly abandoned due to the excessive technical constraints encountered in this sector, particularly the excessively steep slopes.

The second route option (Option 2, Map 2-1) was located a little more southwest compared to the first route. This second route was first optimized according to the preliminary results of photo-interpretation of the wetlands and water environments by the AECOM specialists, in order to avoid and minimize the passage of the road route in the different wetlands and water environments identified in the work areas. Subsequently, this last road route (Option 3, Map 2-1) was optimized even further after the field inventories conducted by AECOM in summer 2022, which allowed validation of the preliminary photo-interpretation results and better delineation of the wetlands and water environments present in the work area. Thus, the road route finally selected (Option 4, Map 2-1) is the one that allows reduction of encroachment on the wetlands and water environments to the strict minimum necessary, while respecting the technical constraints related to transport of wind energy equipment on the site.



73°26'
73°24'
73°22'
61°34'
61°33'
Vers Baie Déception / To Deception Bay
Vers le lac Bombardier / To lac Bombardier
Complexe minier / Mining complex EXPO
Route Option 1 / Option 1 road
Route Option 4 (tracé retenu) / Option 4 road (retained route)
Route Option 2 / Option 2 road
Route Option 3 / Option 3 road
Nord-du-Québec (10)
Kativik (AR)
Rivière-Koksoak
N
Zone des travaux / Works area
Composantes du projet / Project components
Route Option 1 / Option 1 road
Route Option 2 / Option 2 road
Route Option 3 / Option 3 road
Route Option 4 / Option 4 road
Route optionnelle (phase ultérieure) / Optional road (later phase)
Ligne électrique / Power line
Empreinte de l'éolienne (présent projet) / Wind turbine footprint (this project)
Éolienne optionnelle (phase ultérieure) / Optional wind turbine (later phase)
Plateforme de l'éolienne / Wind pad
Chute de glace / Icethrow
Type d'habitats / Habitat types
Champ de bloc / Boulder fields
Felsenmeer / Felsenmeer
Fen de combe à neige / Snowbed fen
Fen polygonal de basses terres / Lowland polygonal fen
Sol polygonal à ostioles de toundra / Polygonal ground with toundra ostioles
Plan d'eau / Waterbody
Milieu anthropique / Anthropic environment
Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex
Étude d'impact environnemental et social / Environmental and social impact assessment
Variantes de tracés pour la route d'accès au parc éolien / Alternatives roads leading to the wind farm
Sources:
Imagerie : Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
SDA, 1:20,000, MERN Québec, Août/August 2022
Données de projet/Project data, Tugliq Energy, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp2_1_Roads_221025.mxd
0 150 300 m
UTM, Zone 18, NAD83
Carte / Map 2-1
Octobre / October 2022
Nunavik Geomatics
Tugliq Énergie
AECOM

3 Description of the project

3.1 Location of the Wind Turbines

The project site is located in Nunavik near the Expo mine site that is part of the Nunavik Nickel Project (NNiP) (see Map 1-1). Canadian Royalties' operations are located between Katinniq-Donaldson Airport and the Raglan Mine site. The project site will occupy an area of 0.25 km^2 on the 1,039 km^2 of the Canadian Royalties mining leases. Canadian Royalties' territory includes 2,504 mineral exploration rights.

As mentioned in the previous chapter (section 2.1), several possible implementation sites were studied to accommodate the project based on the proximity of the roads and the existing energy grid, as well as the constancy and strength of the winds. Since the current mining site of the Expo deposit has a potential for extension to the Southwest and Northeast, the area selected for implementation of the wind farm is found East-Southeast of the Expo site (Figure 3-1).

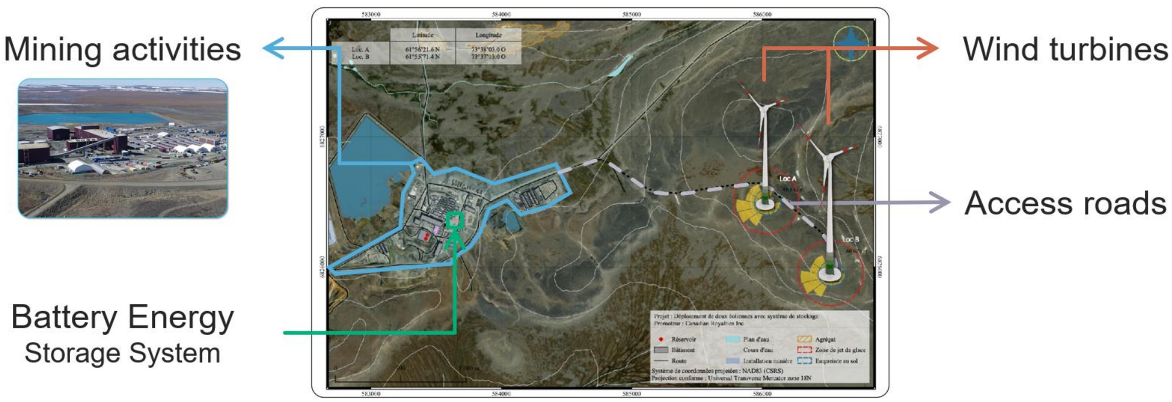


Figure 3-1: Arrangement of the Project on the Expo Mining Site

3.2 Wind Farm Characteristics

The kinetic energy of the wind is captured by the wind turbines and converted into mechanical energy via the blades and the hub, then into electrical energy via the hub and the generator. The electrical voltage is adjusted by the transformers. Then the current is transported by the power collection network to the mine's electric power grid. Each wind turbine will be accessible by an access road to ensure its maintenance.

The project will include two (2) wind turbines with a rated power of 3 MW each. The model chosen is the E82 E4 turbine made by the German manufacturer ENERCON (see the technical data sheet in Appendix A). The wind turbine includes the following components:

- The foundation, for which the design was developed by TUGLIQ Energy, is specially designed for the special Arctic soil conditions;
- The tower, composed of steel tubular sections, supports the nacelle;
- The nacelle, which contains the generator;
- The rotor, composed of the hub and the blades;
- The transformer, located at the base of the wind turbine, allowing the voltage produced by the generator to be raised to the voltage of the mine power grid.

3.2.1 Description of the Wind Turbines

The wind turbine selected for this project is the same model currently used and operated by TUGLIQ Energy in the Raglan Mine wind farm. This wind farm is also composed of two E82 E4 wind turbines manufactured by ENERCON. This wind turbine is particularly adapted to northern climates, because it is equipped with ice build-up detection technology on the surface of the blades and a de-icing system included in each of the three blades.

<u>Foundation</u>

Unlike the majority of the foundations built for wind turbines, the design developed by TUGLIQ Energy is based on an above-ground foundation and mounted on piles by means of a “spider” structure around a steel ring (Figures 3-2 and 3-3).

Thus, the base is impermeable and protected from melting of the ice lenses in the Arctic permafrost. Over the wind turbine’s 25-year lifecycle, the old ice lenses could melt due to the acceleration of climate warming in the Arctic. Spider legs installed on piles deeply anchored in the bedrock will protect against the risk of tilting of the wind turbine over time. They thus render the wind turbine more resistant to the 160 km/h wind gusts that can be observed during Arctic blizzards.

A set of 12 steel piles filled with Arctic concrete, composed of a chemical formula specially studied for cold climate and permafrost, form a circle that supports the wind turbine.

The total depth reached by the piles remains variable. It is important that it reach a depth of about 10 m in sound rock to ensure stable support. In all, the depth of the piles may reach 18 m in the present case. The piles have a diameter of 16 in. (40.6 cm).

The professional opinion provided in Appendix B indicates that the anchoring of the piles and the foundation type designed for this project will ensure the stability of the wind turbines based on the current and future climate.

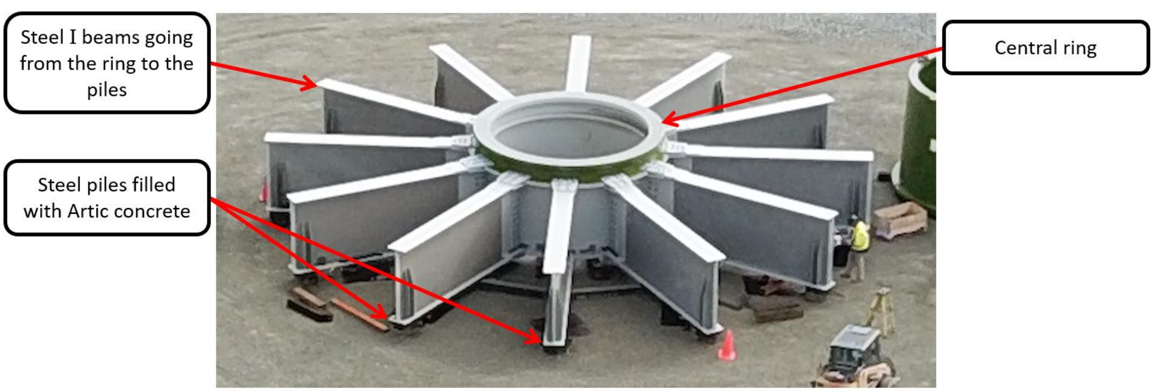
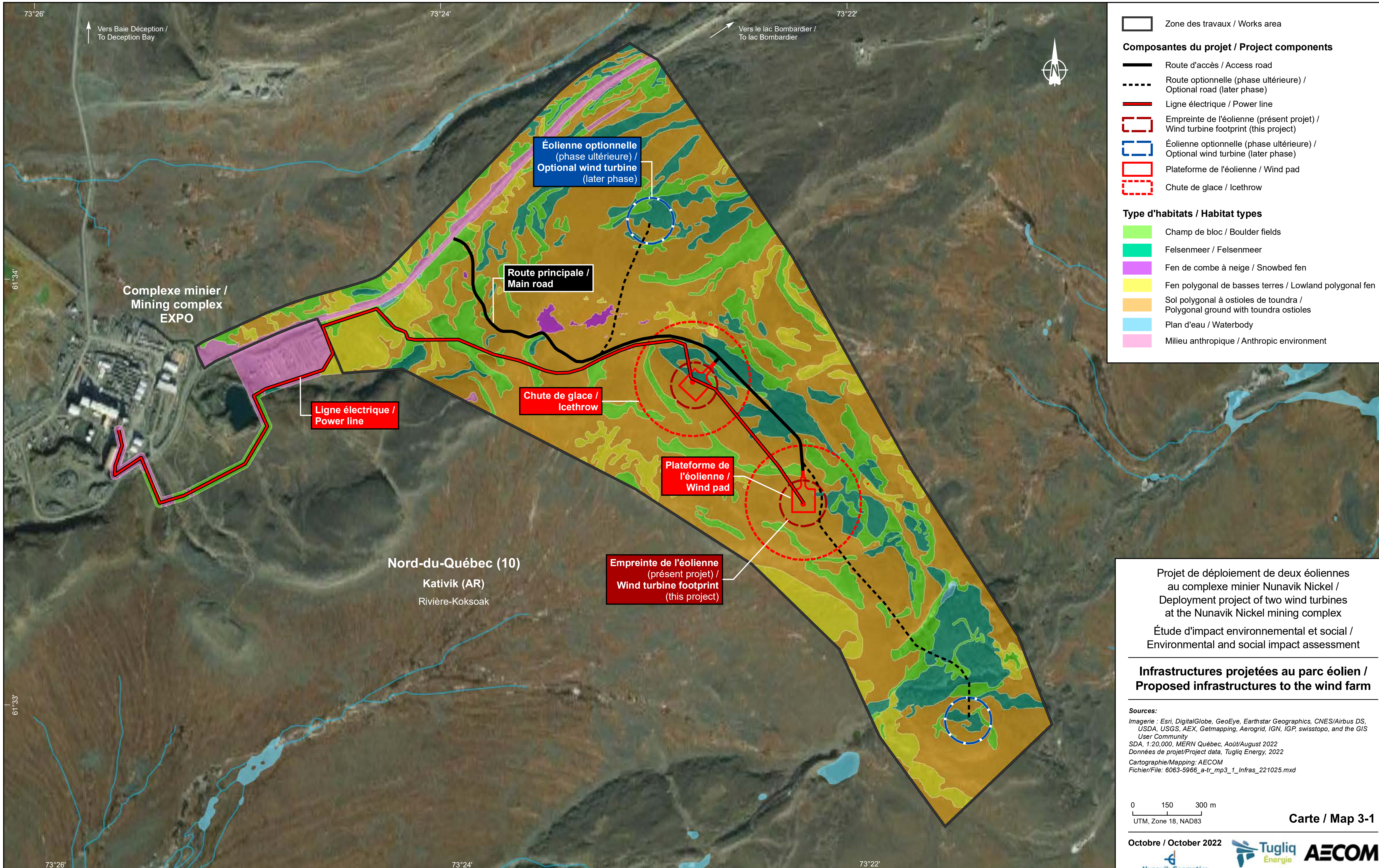


Figure 3-2: Steel “Spider” Structure Resting on the Piles.



73°26'
73°24'
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Vers Baie Déception / To Deception Bay
Vers le lac Bombardier / To lac Bombardier
61°34'
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N
Complexe minier / Mining complex EXPO
Éolienne optionnelle (phase ultérieure) / Optional wind turbine (later phase)
Route principale / Main road
Chute de glace / Icethrow
Ligne électrique / Power line
Plateforme de l'éolienne / Wind pad
Empreinte de l'éolienne (présent projet) / Wind turbine footprint (this project)
Nord-du-Québec (10)
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Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex
Étude d'impact environnemental et social / Environmental and social impact assessment
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0 150 300 m
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Nunavik Geomatics
Tugliq Énergie
AECOM

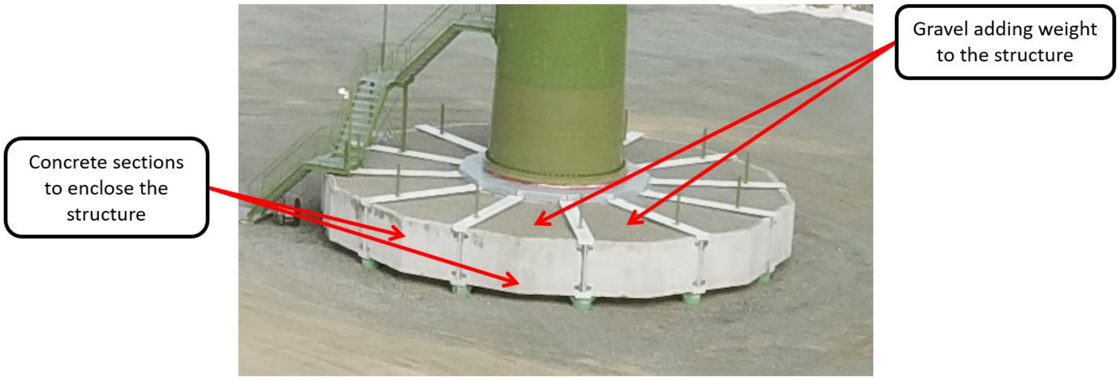

Figure 3-3: Final Exterior Appearance of the Foundation

The foundation design reduces the necessary quantity of concrete by 90%, which is advantageous because the costs of concrete are prohibitive in the Arctic (four times higher, or \$1,200 per m^3 compared to \$300 per m^3 in the South). Moreover, mobile cement mixers have a limited capacity, preventing the continuous pouring necessary according to the civil engineering specifications for solid anchoring purposes. Local sources of aggregates are exploited to the maximum and imports of aggregates are reduced to the minimum, which reduces the GHG emissions related to transport of these materials.

Several impacts associated with this new foundation design are found:

- A new reference in future construction of wind pads in the Arctic and in the South;
- A reduction of GHG and the carbon footprint thanks to the elimination of transport of heavy aggregates;
- A more robust and more universally applicable design, regardless of the soil composition.

<u>Annular Generator</u>

Composed of the rotor and the stator, the annular generator is the central element of the concept of the E-82 E4 wind turbine. Associated with the hub of the rotor with which it forms a unit, it delivers an optimum energy flow.

The wind turbine does not include gear systems, thus reducing the size of the nacelle, the volume of lubricant necessary, the mechanical wear of the parts, and the noise emissions.

<u>Nacelle</u>

The nacelle is the wind turbine's "electrical box". It controls the machine room, which houses all the fixed components, as the main support, the aeration modules and the power electronics elements. The drive shaft assembly rests on the main support designed to withstand strong dynamic stresses.

The wind turbine is equipped with a nacelle orientation system, with the objective of maximizing generation of electricity regardless of the wind direction. If a change in wind direction is detected by the measuring devices located on the wind turbine's nacelle, then the orientation of the rotor is changed accordingly.

The equipment present high on the wind turbine allows detection of situations that may prove dangerous and that could damage the turbine. If the blades turn too quickly, then the rotor is unbalanced, or if the turbine overheats, the wind turbine goes to emergency stop and communicates with the operators by a signal.

E-module

The E-module can be called the wind turbine's "control centre", located at the base of the wind turbine and accessible via a service stairway. This is the place where the technicians can control the wind turbines manually and perform maintenance. It is also where the main transformer is found. The E-module contains the power cabinets and other components, which then are easy for the technicians to access. It also contains the inverter, which allows conversion of direct current into alternating current adapted to the grid.

Hub and Rotor Blades

The hub is the junction element between the blades and the machine. It is an integral part of the direct drive technology used by the wind turbine.

The blades are designed to provide maximum performance, while limiting noise emissions. They are adapted to all weather circumstances, because the ENERCON blades are equipped with a self-heating system that is activated in the presence of ice.

Tower

The tower of the E-82 E4 wind turbine is composed of 5 steel tubular sections mounted on top of each other to reach the desired height of the hub.

The German manufacturer ENERCON offers four different hub heights to respond efficiently to all possible wind conditions. TUGLIQ Energy chose a hub height of 78 m. The wind turbine therefore has a total height of 120 m, adding the radius of the rotor. The dimensions of the wind turbine are described in Figure 3-4.

Light Signals

Chapter 12.2 of Standard 621[9] on Obstruction Marking and Lighting, in effect since 2016, specifies the conditions to be respected in terms of day and night protection. For day protection, the blades, the rotor, the nacelle and the upper part (two-thirds) of the tower must be painted white or light grey. The wind turbine must be equipped with a CL-864 beacon for use at night or twilight. This light must always be visible by a pilot regardless of the aircraft's angle of approach.

The mass-produced E-82 E4 wind turbine complies with all of these conditions.

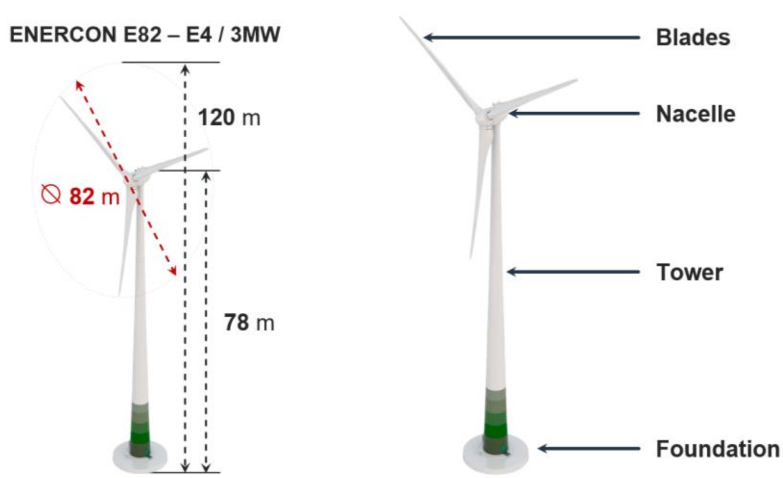

Figure 3-4: Diagram of the Enercon E82 E4 Wind Turbine

[9] https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433/standards/standard-621-obstruction-marking-lighting-canadian-aviation-regulationss-cars

Avian Fauna Protection System

To mitigate the environmental impacts effective from the project design phase, TUGLIQ Energy chose to implement a wind turbine programming system to protect avian fauna from collision risks. This system will allow the operator to define conditions for which the wind turbines will be shut down, based on the time parameters or data from sensors, or a combination of both.

The parameters indicated below, coming from sensors installed on the wind turbine, will be operable by the protection system:

Data	Scale	Unit
Wind speed	0.1	m/s
Nacelle position	1	°
Air humidity	1	%
Precipitation	0.001	mm/min
Visibility	0.1	km
Ambient brightness	1	lx
Ambient temperature, nacelle	1	°C
Ambient temperature, tower	1	°C

Some birds are known for flying under special weather conditions or adapting their flight characteristics to certain adverse conditions. For example, precipitation, fog or a low cloud ceiling could force birds to fly at a lower altitude, and thus near the wind turbines, exposing them more to collision risks (Environment Canada, 2007). The protection system thus will allow limitation of mortality because of impact with the turbine's rotating blades, accounting for certain weather conditions. Moreover, in peak migration periods or based on a known risk for avian fauna, the wind farm then may be programmed remotely to cease its operation.

TUGLIQ will implement this protection system when the wind farm is commissioned, and the proponent is currently in discussion with biologists to draw up a list of periods and weather conditions favourable to the flight of birds in the vicinity of the wind turbine. If this system does not prove totally functional upon startup, TUGLIQ may consider complementary decision-response solutions, such as systems using 2D, 3D or even radar technologies to detect the presence of birds in the vicinity of the wind turbine and shut it down immediately, when required.

3.2.2 Energy Transmission Grid

The low-voltage electrical energy from the generator is transmitted to the transformer located at the base of the wind turbine, which will raise the voltage for the medium-voltage (15 kV) power collection network. This allows reduction of the losses by joule effect during transmission of electricity to the mine grid. The two wind turbines and the battery (energy storage system) will both be connected to the power collection network, which then will be adapted and connected to correspond to the characteristics of the mine's power grid.

From the base of the wind turbine (at the transformer output), the cables then run to the ground and are buried 1.6 m deep under the wind pad for several decametres. This burial will be based on a precise protocol to avoid damaging the cables during the passage of heavy equipment, such as trucks or cranes. Operations involving this equipment may be performed during the construction phase, operational phase (in case or maintenance or repair) and dismantling phase. It is therefore important that the cables be protected adequately for the entire lifecycle of the project.

Between the turbines and the mine (Expo site), the 15 kV cables will only be buried at the edge of the access roads and covered with a layer of materials (soil) available in situ to protect them from the passage of light vehicles, snow plows, etc. Adequate signage will be put in place to identify the presence of the cables at the edge of the access roads. At the other locations between the wind turbines and the mine, in the sectors not bordering the access roads, the cables will simply be unwound, deposited on the ground and identified with appropriate signage.

3.2.3 Lithium-Ion Battery Energy Storage System

A lithium-ion battery energy storage system was chosen to compensate for the irregularities of wind energy generation. This storage system will be installed within the mine infrastructure, on the Expo site, and connected to the wind turbines by the power collection network.

The batteries will be installed on the surface and will be enclosed in one or more 20-to-40-foot containers. These containers will be heated to fight the northern climate and preserve the battery's autonomy. The containers rest on a metal structure, also supported on piles in the ground.

3.2.4 Access Roads and Work Areas

Roads are required to transport equipment and access the wind turbine sites in the construction, operational and dismantling periods. The use of existing roads, particularly used to transport ore from the Expo site to Deception Bay, is preferred. However, a new access road section, 2.4 km long, will have to be built between the existing road and the sites chosen for installation of the two wind turbines.

The right of way of the road will have an average total width of 12 m (ranging between 8 and 20 m, depending on the sectors and the topography of the terrain). The driving surface of the road will be 6.0 m wide to allow the passage of the cranes and other heavy vehicles necessary for construction of the project. The plans provided in Appendix C illustrate the route of the road in detail, according to the chainage, and a typical cross-section of its layout.

At the location of each wind turbine, the access road will end at a work area (wind pad) measuring 80 m x 80 m to allow construction work. This work area will allow the cranes to install the wind turbine and will include a space for assembly of the rotor before erection.

For the operational phase, the access road leading to the wind farm will be retained with the same width as during the construction phase. The wind pads will also be maintained in place to allow maintenance and repair of the wind turbines, as needed. No new road will be developed specifically for the operational phase.

3.2.5 Adaptation of Equipment to the Cold Climate

3.2.5.1 Wind Turbines

The ENERCON E-82 E4 wind turbine is equipped with two forms of protection against the cold Arctic climate: a passive solution and an active solution.

The technology chosen for the wind turbine is particularly adapted to this climate. The direct drive allows reduction of the use of lubricants and the number of mechanical parts, real advantages under climate conditions where the outdoor temperature may fall to -30°C. The innovative foundation developed by TUGLIQ Energy provides the wind turbine with increased resistance to the powerful wind gusts that can be found in the region. The wind turbine thus is perfectly adapted to the harsh conditions by its design, which makes it a passive solution for action against the cold climate.

However, when the weather is compromising, ice formation on the wind turbine blades is possible, which leads to a reduction of aerodynamic performance and thus a loss of energy generation. Moreover, the presence of ice on the blades may unbalance the rotor, making it dangerous for the turbine to operate. A safety perimeter is planned in case of projection of pieces of ice by the blades. In this case, the design of the wind turbine is not enough on its own and the deployment of an active solution is required.

To remedy this, ENERCON has developed an ice build-up detection system. When the onboard computers detect an anomaly (e.g. decrease in performance, rotor imbalance, for example), the machine starts each of the three heating systems present in the base of the wind turbine, which will allow hot air to ventilate within the blades. If the quantity of ice is minor, the system can be triggered even when the turbine is in operation. Conversely, if there is a large quantity of ice on the blades, the wind turbine stops and triggers operation of the heating systems. This process may take up to several hours. Over the past few winter seasons on the Raglan Mine site, where TUGLIQ operates two identical wind turbines, shutdowns due to ice have been relatively rare. On the average, during the past three years, these shutdowns amounted to 57 hours/year (variation between 20 and 100 hours/year).

Finally, the wind turbines are configured in “cold climate” option. While the wind turbine is operating, the power curve remains unchanged down to a temperature of -30°C. Below this temperature, the maximum power of the wind energy converter is reduced gradually to 25% to a temperature of -40°C. At temperatures below this value, the wind turbine is stopped but remains ready to operate. The wind turbine will be restarted once the temperature rises back to -35°C (Figure 3-5).

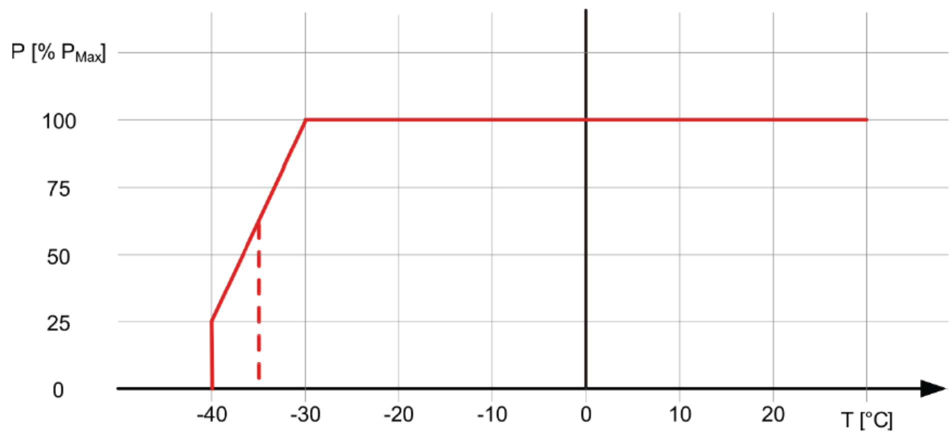

Figure 3-5: Cold Climate Power Curve of the ENERCON E-82 Wind Turbine

3.2.5.2 Power Cables

The power cables are also chosen to withstand Northern climate conditions. They are composed of the following protective layers (from outer to inner):

- Outer envelope: PVC resistant to low temperatures, moisture and sunlight;
- Aluminium shield;
- Inner envelope: flame-retardant and moisture-resistant PVC;
- Insulation shield: extruded thermohardenable semiconductor.

The colour of the sheath through which the power cables will pass will be chosen for visibility and heat retention reasons.

3.3 Main Phases of the Project

The project activities detailed in this part are divided into three distinct phases: construction, operational and dismantling.

3.3.1 Construction Phase

3.3.1.1 Preparation of the Work and the Job Site

In a first phase, a survey is required. This activity will make it possible to determine precisely where the work will be done within the limits of the project. Marking and signage will be used to identify the location of the access road, the wind turbines and the power cable passages.

Technical assessment by geotechnical and civil engineers is required for the site preparation activities. This activity particularly includes the geotechnical assessment, crucial in the case of the project, because the foundation will rest on piles several metres deep in sound rock. This geotechnical assessment indicates the exact depths to which the concrete piles must be drilled to ensure adequate support for the turbine. The geotechnical study required for this project has already been done (WSP, 2022) and is provided in Appendix D.

This is followed by the soil stripping stage, in which the material is moved to prepare the work areas required for the construction activities. The material moved will be reused, whenever possible, for rehabilitation of the temporary areas.

3.3.1.2 Deployment of Works

Access Road and Wind Pads

The access road and the wind pads will be developed with standard road construction equipment (bulldozer, excavator) and will use materials present on the site whenever possible. As needed, materials from an off-site source could be used.

Depending on the topography of the terrain, stripping, excavation, grading and/or backfilling may be required to develop the access road. In some places, it will also be necessary to deploy culverts for the flow of surface water or develop roadside drainage ditches. These elements are specified in the plans of Appendix C. The majority of the materials excavated in the work area will be reused directly on the site for backfilling, except for a surplus of 3,038 m^3 of materials for disposal off-site. These excess materials will be managed by the mine in their usual process.

Road construction will comply with the compaction indications required by the wind turbine manufacturer. It will allow truck traffic transporting the wind turbine components. The same applies for the work areas (wind pads) where the main crane and the secondary crane will carry out the assembly and installation of the wind turbines.

Deployment of the Foundation

Pile drilling and Arctic concrete pouring will be done upstream of the arrival of the wind turbine components and the steel “spider” base. The concrete will be prepared on the Expo site and transported by cement mixer truck to the work site.

Construction of the foundation includes pile drilling and concreting, as well as erection and installation of the wind turbine base (steel structure). This phase will extend over a period of about two months during the summer (July, August), which will precede the arrival and erection of the wind turbine on the project site.

These construction operations will be successive, because once construction of the first foundation is completed, the material will be moved to the second wind pad to ensure construction of the foundation of the second wind turbine.

Erection of the Wind Turbines

The sections of the tower, the nacelle and the rotor (which includes the hub and the blades) will be assembled by using two cranes, an 800-tonne main crane and a second smaller crane that will support the first one. The use of the cranes will be brief. Assembly of the wind turbine will last only a few days once all the components are in place and the foundation is prepared.

The sections will be installed on top of each other, then the nacelle will be hoisted and installed on the tower. The rotor will be assembled on the ground in advance in the work area adjacent to the tower, then hoisted and installed on the hub.

Installation of the Power Grid

Once the foundation is installed and the first section of the wind turbine is erected, the crane will allow the cables to be pulled through the sheaths, which will have been buried in advance under the wind pad. Then it will only be necessary to deposit the cables on the ground between the wind pads and the Expo mining complex to make the connection.

3.3.1.3 Rehabilitation of the Work Areas After Construction

The work areas used for a project on this scale remain minimal. The job site is located less than three kilometres from the Expo site's mining infrastructure. A trailer equipped with toilets will be installed temporarily on the wind pads. The components will be stored directly on each of the two wind pads. These areas will be maintained in good condition after construction in the context of maintenance activities. The access roads will also be maintained in good condition to ensure traffic of pickups and site machinery during the operational phase.

3.3.2 Operational Phase

3.3.2.1 Operation of Wind Turbines

The wind turbines will operate permanently when the wind speed is high enough and will stop only when the wind speed is too low or too high (these speeds are determined by the supplier) or during the maintenance periods.

Once the two turbines are in operation, they will be controlled and monitored remotely and semi-automatically at all times through the SCADA (System Control and Data Acquisition) program. In the context of operation of the two wind turbines present on the Raglan Mine site, TUGLIQ is capable of making real-time adjustments to the wind turbine operating parameters, setting the production regime, proceeding with an emergency shutdown, etc.

The wind turbines will be equipped with an automatic system that will manage operation according to several parameters collected directly on the site (e.g. weather conditions, electrical, mechanical). An intrinsic safety system will be able to proceed with an emergency shutdown at the least sign of a problem.

An operator might have to intervene on the wind turbine due to an unusual shutdown that would require, depending on the procedures, either a remote restart from TUGLIQ's offices, or a field inspection. In the context of operation of the wind energy project at the Raglan Mine, two technicians employed by TUGLIQ are in charge of field interventions, on 15-day ON/OFF rotations. These same technicians may also take charge of the wind turbines installed near the Expo mining site. As needed, additional technicians could be hired, if required, under this project.

3.3.2.2 Maintenance of the Wind Turbines and the Wind Farm

Periodic maintenance will have to be performed under a prevention program with the aim of anticipating and minimizing the eventual mechanical or technical problems. This maintenance is performed every year and the wind turbine is stopped for a few days. Apart from this maintenance, no major work is anticipated in the operational area.

The wind turbines will be maintained continuously, including lubrication of the parts, tightening of the nuts and bolts, change of hydraulic filters, analysis of lubricants, routine equipment tests, etc.

The oil or fuel spill risks are very mitigated, because the wind turbines chosen have a gearless energy generation technology and do not require any oil. Only sealed grease tubes are used and a few litres of glycol are necessary for the generator's cooling system.

Maintenance of the access road during the operational phase will include, as needed, snow removal in winter, resurfacing of the access road specific to the project, maintenance of the drainage ditches and culverts, and manual control of vegetation.

Little traffic is anticipated during the operational phase on the access road, which will remain operational for the entire lifecycle of the wind farm. Only the technicians and operators will use these roads.

3.3.3 Dismantling Phase

The wind farm's lifecycle is currently projected over 10 years, which corresponds to the anticipated operational period of the CRI mineral deposits according to the current information. However, the life cycle of the wind turbines is 25 years according to the manufacturer (ENERCON). In anticipation of the end of the wind farm's lifecycle, the proponent undertakes to comply with the directives and regulations in force intended to govern dismantling.

The dismantling steps are similar to those of construction of the project: site preparation, improvement of existing roads, preparation of work areas, etc.

The access road to the wind farm will be rehabilitated, as needed to ensure transport of the components of the dismantled wind turbines. The number of trucks necessary for dismantling will be in the same order of magnitude as for construction of the wind farm. The foundations of the wind turbines will be razed to the ground, leaving piles of steel and concrete in the upper layers below the surface.

Everything found above ground will be dismantled, reprocessed and recycled, whenever possible and depending on the technological advances of future years, all in accordance with the directives and regulations in force. This activity will require the involvement of a plentiful and skilled workforce.

3.4 Greenhouse Gases (GHG)

This section presents the balance of greenhouse gas (GHG) emissions related to the implementation of two wind turbines on the Nunavik Nickel Project (NNiP) site. Given the fact that the mining facilities are located off the Hydro-Québec power grid, the energy required for all of the mine site's activities currently depends on diesel.

The assessment of the GHGs emitted during each phase of the project, namely for the construction, operational and dismantling phases, was produced as specified in the document entitled *Les changements climatiques et l'évaluation environnementale – Guide à l'intention de l'initiateur du projet*[10] (Climate change and environmental assessment – Guide for the project initiator) (MELCC, 2021). This guide indicates a set of parameters applying to the project to be taken into account, such as the GHGs considered, the emission sources, the carbon sinks and the quantification methods. These parameters are detailed in the following sections.

3.4.1 Methodology

3.4.1.1 GHGs Considered

The global warming potential (GWP) of the GHGs considered in this assessment are presented in Table 3-1.

Table 3-1: GHGs Considered

GHG	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous oxide (N_2O)	298

Source: Fourth IPCC assessment report (Government of Canada, 2022c).

[10] https://www.environnement.gouv.qc.ca/evaluations/directive-etude-impact/guide-intention-initiateur-project .pdf

These GHGs generally are emitted during combustion of fossil fuels used by heavy equipment, transportation modes and generators.

In accordance with the MELCC *Guide de quantification des émissions de gaz à effet de serre*[11] (Guide to quantification of greenhouse gas emissions) (MELCC (2019)), the global warming potential (GWP) considered is that of report AR4 of the Intergovernmental Panel on Climate Change (IPCC). This potential allows conversion of GHGs into tonnes of CO_2 equivalent (CO_2 eq). To continue this assessment, the emissions according to the different sources are given in tonnes of CO_2 equivalent.

3.4.1.2 Scope of Analysis

The operational limits of this assessment pertain to the wind farm construction and dismantling activities. It includes direct GHG emissions by:

- The stationary equipment and mobile equipment used for construction and dismantling of the wind farm;
- The transportation modes (truck, boat and airplane) for transport of concrete, wind turbines and other equipment necessary for construction.

Certain emissions were excluded from the assessment, such as:

- Emissions related to deforestation, because the project is being conducted in a region where forests are absent;
- Emissions related to the wind farm's operational phase. The wind turbine maintenance activities will only involve the movement of TUGLIQ technicians between the wind farm site (Expo site) and the base camp. The truck used is a 100% electric truck that will only be supplied with power by the wind turbines. The operational phase then is free of greenhouse gas emissions.

3.4.1.3 GHG Emission Sources

The list of GHG emission sources considered in this assessment is presented in Table 3-2, for the wind farm construction and dismantling phases.

Table 3-2: GHG Sources Considered

Activities	Sources	CO_2	CH_4	N_2O
Transport of material and equipment to the work site	Mobile combustion systems	✓	✓	✓
Construction and dismantling of the wind farm	Mobile combustion systems	✓	✓	✓
	Stationary combustion systems	✓	✓	✓

According to the *Guide de quantification des émissions de gaz à effet de serre*[12] (Guide to quantification of greenhouse gas emissions) (MELCC, 2019), the emissions of the project in question are limited to the transport of material and equipment to the project site, the construction of the wind farm and its dismantling.

3.4.2 GHG Quantification Method

This section presents the GHG emission quantification method for each emission source identified in Table 3-2. It is based on the *Guide de quantification des émissions de gaz à effet de serre* (Guide to quantification of greenhouse gas emissions) (MELCC, 2019).

[11] https://www.environnement.gouv.qc.ca/changements/ges/guide-quantification/guide-quantification-ges.pdf
[12] https://www.environnement.gouv.qc.ca/changements/ges/guide-quantification/guide-quantification-ges.pdf

3.4.2.1 Transport of Material and Equipment on the Project Site

Marine and road transportation will be used to bring the required equipment and materials to the project site. Knowing the mass of each article to be brought to the site and the distance to be travelled, the GHG emissions of each transportation mode then are calculated by a unit factor of one tonne of freight over a distance of one kilometre. The data is specified for transportation by boat and by truck in Table 3-3.

Table 3-3: Emission Factor for Each Transportation Mode Used

Transportation mode de transport	CO_2 eq emission factor	
Truck	0.1873	kgCO_2 eq/tonne-km
Boat	0.0057	kgCO_2 eq/tonne-km

Source: Natural Resources Canada, GHGenius version 4.03 or more recent, “freight emissions” page.

Three major items are to be transported for erection of the wind turbines on the Expo site, i.e. the concrete for the foundations, the wind turbines themselves and the main crane that will be used for erection of the wind turbine’s components. Two types of concrete constitute the foundation, 35 MPa and 60 MPa concrete. They will be transported by boat, then by truck to the site. The wind turbines will first be transported by boat from the city of Bremen, Germany, then by truck to the site. The crane, from Southern Québec, will be transported by boat and truck to the mine site. The calculation of the carbon emissions associated with transport is presented in Table 3-4.

It should be noted that transport of auxiliary equipment (trailers, containers, battery storage system, etc.) was not included in the following table, because their tonnage and the distance to be travelled are relatively low and the applicable emissions then are considered negligible. The same is true for transport of fuel, estimated as negligible in the context of this project.

In all, it is estimated that transport of material and equipment to the construction site will emit **122 tonnes of CO_2 equivalent**.

Table 3-4: Calculation of GHG Emissions Associated with Transport of Material and Equipment to the Work Site

Calculation of emissions for transport of material and equipment					
Transport	Distance travelled (km)	Quantity transported (tonnes)	Tonne-kilometre	Associated emissions	
35 MPa concrete, by truck	700	115	80 500	15,08	tCO_2 eq
35 MPa concrete, by boat	3 000	115	345 000	1,97	tCO_2 eq
60 MPa concrete, by truck	700	30	21 000	3,93	tCO_2 eq
60 MPa concrete, by boat	3 000	30	90 000	0,51	tCO_2 eq
Wind turbines, by boat	6 000	1246	7 476 000	42,6	tCO_2 eq
Wind turbines, by truck	200	1246	249 200	46,7	tCO_2 eq
Crane, by boat	3 300	204	673 200	3,8	tCO_2 eq
Crane, by truck	200	204	40 800	7,6	tCO_2 eq
			TOTAL	**122**	**tCO_2 eq**

Source: Data based on construction of the wind farm at Raglan by TUGLIQ Energy (2018).

3.4.2.2 Construction of the Wind Farm

Construction of the wind farm encompasses the preparation and construction of the access road to the pads, pile drilling, construction of the foundations, erection of the wind turbines and installation of the auxiliary equipment (e.g. collector, batteries). The GHG emissions for construction of the wind farm are associated with the use of heavy machinery, the details of which are provided in Table 3-5.

The emission factors associated with diesel combustion of heavy vehicles and stationary equipment are presented in Table 3-6.

The wind farm construction phase will emit a total of **121 tonnes of CO_2 equivalent** due to diesel combustion by heavy equipment.

Table 3-5: Calculation of GHG Emissions for the Wind Farm Construction Phase

Calculation of emissions for wind farm construction								
Activities, Machinery used	Equipment required			Total hours	Diesel consumption		Associated emissions	
	number	days	hours/ day		hourly (L/h)	total (litres)		
Preparation of the access road *1 bulldozer*	2	10	11	220	25	5 500	14,92	
1 excavator	2	10	11	220	51	11 220	30,43	tCO_2 eq
Excavation *1 excavator*	1	3	11	33	51	1683	4,56	tCO_2 eq
Pile drilling *1 drill (including compressor)*	1	15	11	165	70	11 550	31,32	tCO_2 eq
Installation of foundations *1 crane, 275 t*	2	20	11	440	5	2 200	5,97	
1 cement mixer truck (concrete)	2	20	11	440	5	2200	5,97	tCO_2 eq
Installation of wind turbines *1 crane, 800 t*	2	30	11	660	5	3 300	8,95	
1 crane, 275 t	2	30	11	660	5	3 300	8,95	tCO_2 eq
Installation of the power collection network *1 pickup*	2	5	11	110	6	660	1,79	
1 bulldozer	2	5	11	110	25	2 750	7,46	tCO_2 eq
Installation of the battery container *1 crane, 275 t*	1	5	11	55	5	275	0,75	tCO_2 eq
						TOTAL	**121**	**tCO_2 eq**

Table 3-6: Emission Factor for Diesel Combustion of Heavy Vehicles and Stationary Equipment

Machinery	CO2 eq emission factor	
Diesel combustion – heavy vehicles	0,002712	tCO_2 eq/L diesel
Diesel combustion – fixed equipment	0,002790	tCO_2 eq/L diesel

By way of reference, the fuel consumption cited corresponds to the consumption by machinery equivalent to what would be used on the site. Table 3-7 shows the models and the associated fuel consumption.

Table 3-7: Type of Machinery and Models Similar to Those Used for Construction

Type of machinery	Make – model	Consumption (L/h)
Bulldozer	*Caterpillar D8T*	25
Excavator	*Caterpillar 390F*	51
Crane, 275 t	*LTM 1300*	5
Crane, 800 t	*LTM 1750 Tyven*	5
Drill *(including compressors)*	*Epiroc D76*	70
Cement mixer truck	*International 7400SB*	5
Pickup	*Ford F250*	6

3.4.2.3 Wind Farm Dismantling Phase

The dismantling phase of the project will be organized at the end of the life cycle of the wind turbines, 25 years after construction of the wind farm. It is envisioned that the dismantling of the wind turbines, the power cable and battery container and rehabilitation of the site represents work equivalent to the construction phase. The machinery used will be the same, except for the drill, which will be replaced with an excavator to raze the foundation piles. The times of use are estimated as similar to and even less than those of the construction phase.

Moreover, the estimate presented remains conservative, given that the technology could evolve in 25 years. Consumption by the thermal engines would decrease according to the time and a transit to electrical machinery, which itself would be powered by renewable energy, can be imagined.

Table 3-8 provides the detailed calculation of GHG emissions for the wind farm dismantling phase. This phase will emit a total of **84 tonnes of CO_2 equivalent** due to diesel combustion by heavy equipment.

Overall, on the scale of the entire project, it is estimated that greenhouse gas emissions will amount to a total of **327 tonnes of CO_2 equivalent** (Table 3-9).

Table 3-8: Calculation of GHG Emissions for the Wind Farm Dismantling Phase

Calculation of emissions for dismantling of the wind construction								
Activities, Machinery used	**Equipment required**			**Total hours**	**Diesel consumption**		**Associated emissions**	
	number	days	hours/ day		hourly (L/h)	total (litres)		
Rehabilitation of the access road *1 bulldozer*	2	10	11	220	25	5 500	14,92	tCO2 eq
1 excavator	2	10	11	220	51	11 220	30,43	tCO2 eq
Excavation *1 excavator*	1	3	11	33	51	1 683	4,56	tCO2 eq
Razing the foundations *1 excavator*	2	20	11	440	5	2 200	5,97	tCO2 eq
Dismantling of the wind turbines *1 crane, 800 t*	2	30	11	660	5	3 300	8,95	tCO2 eq
1 crane, 275 t	2	30	11	660	5	3 300	8,95	tCO2 eq
Dismantling of the power collection network *1 pickup*	2	5	11	110	6	660	1,79	tCO2 eq
1 bulldozer	2	5	11	110	25	2 750	7,46	tCO2 eq
Dismantling of the battery container *1 crane, 275 t*	1	5	11	55	5	275	0,75	tCO2 eq
						TOTAL	**84**	**tCO2 eq**

Table 3-9: Total GHG Emissions by Emission Source for the Entire Project

GHG source	Emissions	
Transport of material	122	tCO_2 eq
Site preparation and construction activities	121	tCO_2 eq
Dismantling of the wind farm	84	tCO_2 eq
TOTAL GHG emissions of the project	**327**	**tCO_2 eq**

3.4.3 GHG Emissions Avoided

The emissions described in the previous sections are associated with the installation of the wind farm on the mine site. This portion of the project will extend over a period of about one year.

The wind turbine installation project on the Expo site has the purpose of reducing consumption of diesel, currently used by the generators to generate electricity. It is estimated that, over one year, energy generation from the two wind turbines will reach 17,500 MWh (8,750 MWh per wind turbine according to a wind study produced by Hatch (2015); this value is conservative because it involves a P99 scenario). On the average, the generators generate 3.81 kWh of electricity per litre of diesel consumed. Thus, electric power generation of 17,500 MWh by a diesel generator farm would consume 4,593,176 litres of diesel. To this must be added 10% diesel for transport to the mine according to the ISO 14 064 standard.[13] These estimates are based on real data from the two wind turbines already installed at the Raglan Mine, which have generated electricity for over four years.

[13] https://www.iso.org/standard/66454.html

Thus, the implementation of a wind farm of two wind turbines corresponds to the elimination of 5,052,493 litres of diesel consumed on an annual basis. Reapplying the emission factor related to diesel combustion of stationary equipment in Table 3-6, the wind farm would allow avoidance of annual emissions of **14,096 tonnes of CO_2 equivalent**, for an annual reduction of **10.5%** of the current GHG emissions of the CRI mining complex.

3.5 Jobs and Training

The Expo mine wind energy project is divided into three distinct phases: construction, operational and dismantling. Each phase will generate economic impacts throughout the province, but also for the local and regional communities that will benefit directly and indirectly from the project. The following section presents the details of these anticipated impacts.

3.5.1 Wind Farm Construction Phase

The project's construction phase involves a large number of players ranging from project engineering to erection of the wind turbine. The actual cost invested in the project is in the vicinity of $40 million Canadian and the order volume TUGLIQ plans to allocate to Québec businesses corresponds to 70% of this invested cost.

Construction or the roads and wind pads for installation of the wind turbines, pile drilling, installation of the foundations, erection of the wind turbines and electrical connection constitute the construction phase. Multiple spheres of activity are therefore concerned by this phase:

- Engineering: civil and electrical
- Construction: civil, electrical and mechanical
- Manufacturing of specific parts for the Expo mine wind farm
- Transport of equipment on the site
- Leasing of heavy machinery

All these streams will generate an order volume that will guarantee maintenance of employment by businesses landing the contracts offered by TUGLIQ.

At TUGLIQ, a 9-person team is working on the project. A team of 4 engineers supervised by a project manager divides the project's tasks. Each engineer assigned to a task is responsible for ensuring planning and follow-up. The engineers in charge of the complete organization of the project are followed by the company's administrative and executive team. The construction phase of the project will require mobilization of two engineers present alternately on the site, to supervise the smooth running of operations. TUGLIQ's engineers intervene at different levels on several corporate projects; the complete mobilization of two engineers dedicated to the project during the construction phase thus will probably lead TUGLIQ to recruit a new engineer to handle the related tasks of these two engineers.

The order volume mentioned above will also include business opportunities for the local and regional communities. For equivalent offers, TUGLIQ will prefer businesses held (in whole or in part) by local interests (Salluit and Kangiqsujuaq) or regional interests (Nunavik) when awarding contracts related to the project. This will favour the project's local and regional financial impacts.

The construction phase will allow maintenance or creation of jobs in several fields, such as civil engineering, electrical and mechanics. TUGLIQ estimates that up to 25 employees will have to be assigned to different tasks related to the project during the construction phase. Some of these jobs may be held by local or regional workers. The construction phase thus will ensure maintenance of the employment of workers who are already employed by businesses, but will also lead to hiring of new workers.

To this effect, the project proponent anticipates that road transportation between Deception Bay and the work area will be entrusted to Katinniq Transport Inc., held in part by Salluit interest. Moreover, TUGLIQ wishes to work with Nunavik Construction for the use of heavy machinery. These two companies already carry out contracts on behalf of mining companies (CRI and Glencore) in the territory. We should also mention that, for the preparation of the environmental and social impact assessment, Nunavik Geomatics was involved in the preparation of geomatics and mapping products.

The construction phase of the project thus will ensure economic impacts throughout the province with a resulting order volume, but also on a more local or regional scale with opportunities for the communities.

3.5.2 Wind Turbine Operational Phase

Once constructed the wind turbines will require little attention. The number of jobs generated thus will be less significant than in the construction phase. Two wind energy technicians then will be necessary to ensure maintenance and servicing of the assets on the site. Currently, two technicians are already employed at TUGLIQ and look after maintenance and operation of the two wind turbines developed at the Raglan Mine. Depending on the workload, TUGLIQ is studying the possibility of mobilizing the technicians dedicated to Raglan wind turbines to look after maintenance of the proposed wind turbines at the Expo site. It is also likely that TUGLIQ will have two new technicians to look after this task. The two new wind turbines then would ensure the employment of two to four technicians for another several years (depending on the mine's lifecycle).

It is also possible that an additional technician will be recruited to support those who will look after maintenance of the proposed wind turbines. As applicable, TUGLIQ plans to proceed with hiring and training of an Inuit worker. For this purpose, TUGLIQ will contact the people responsible for labour in the two local communities (Salluit and Kangiqsujuaq) and, as needed, other Nunavik communities, to identify potential candidates. The chosen candidate will be trained in operation and maintenance of the wind turbines by the TUGLIQ technical teams.

The hiring and training of an Inuit technician will constitute a starting point for TUGLIQ, allowing it both to favour local employment and to develop training opportunities in the renewable energy fields in the Inuit communities of Nunavik. TUGLIQ wishes to benefit from this experience to establish relationships with the local communities and develop partnerships that could be renewed in the event of the development of new wind energy projects in Nunavik.

3.5.3 Wind Farm Dismantling Phase

The proposed wind farm will be developed on a mine site. The contract established with the proponent of this project (TUGLIQ) and the mining company operating the site (CRI) is based on the mine's lifecycle as currently known. This is currently assessed at 10 years and thus shorter than the lifecycle of the proposed wind turbines, which is 25 years according to the manufacturer.[14] The end of the wind farm's life depends on the guaranteed lifecycle of the mine (currently 10 years). It is foreseeable that this lifecycle will be lengthened, in which case, the wind farm's lifecycle will be aligned with that of the mine (if it remains less than 25 years). Otherwise, two scenarios are envisioned: 1) the dismantling of the assets, or 2) the transfer of these assets to the local communities.

If the wind turbines had to be dismantled after a 10-year operational period, the work performed would generate essentially the same jobs as those forecast for the construction phase. The number of jobs maintained or created thus would be comparable to the number indicated in section 3.5.1, of about 25 positions held during the dismantling year.

Instead of being dismantled, the two wind turbines could also remain in place. Their management and operation then could be assigned to the local communities of Salluit and Kangiqsujuaq, or to the Kativik Regional Government. However, this scenario remains hypothetical because the villages of Salluit and Kangiqsujuaq are located 140 km and 80 km away respectively. The installation of a power line over such distances would be very costly.

[14] However, it is possible that the mine's lifecycle may be extended by the operation of new deposits. The mine then could be in operation for the entire lifecycle of the wind turbines.

3.6 Development Schedule and Project Lifecycle

The development of the site and construction of the project extend over an 8-month period from mobilization of the first equipment on the Expo mine site to connection to the mine's power grid scheduled for December 2023.

The project's lifecycle is equal to the lifecycle of the wind turbines estimated by the manufacturer ENERCON, or 25 years. Table 3-10 below specifies the main stages of the project's life. The detailed project schedule is presented in Appendix E.

Table 3-10: Project Development Stages

Production of the project's impact assessment	May 2022 - October 2022
Public consultations	August - October 2022
Deposit of the impact assessment	Beginning of November 2022
Obtaining the environmental permits	Spring 2023
Construction	June 2023 – December 2023
Operation guaranteed by contract	January 2024 to January 2034 (10 years)
Possible operation (according to the lifecycle of the wind turbines)	January 2024 to January 2049 (25 years)
Dismantling	2049 (about 25 years after commissioning)

The project's lifecycle is aligned with the guaranteed lifecycle of the mine, currently estimated at 10 years. The operation of the wind farm will follow the evolution of the mine's lifecycle as long as the maximum duration of operation of the wind turbines, 25 years, is not exceeded.

If the mine has to interrupt its activities before that date, TUGLIQ will study the possibility of transferring the assets to the local communities.

3.7 Project Costs

3.7.1 Project Development

The development cost of the project is estimated at $36 million to $40 million. The project proponent wishes to promote the participation of local businesses and resources to maximize the economic impacts for the region.

3.7.2 Project Maintenance

The maintenance cost of the project is estimated at $500,000 to $2 million a year. This cost includes the employment of technicians by TUGLIQ, the purchase of spare parts, the logistics for the manufacturer's visits and a reserve for major breakage that could occur.

3.7.3 Project Dismantling

The dismantling of the wind farm will be part of the dismantling process of the mine at the end of its lifecycle.

3.8 Related Development and Projects

Mining at the Expo site currently depends only on diesel to produce its electricity and heat. The implementation of the wind farm will eliminate 10.5% of the greenhouse gas emissions of the CRI mining complex, which is significant compared to the current situation. TUGLIQ Energy, in partnership with CRI, therefore has the ambition to develop a second phase of the project in the future, by installing two additional wind turbines over the next few years. The first two wind turbines, which are analyzed in this impact assessment, constitute Phase 1 of the project, while the next two wind turbines will form Phase 2.

The environmental and social impact assessment produced here encompasses a fairly large study area allowing inclusion of the location chosen for the two additional wind turbines. They will be located within a few hundred metres of the first two. This environmental and social impact study therefore covers the future implementation areas. Moreover, the field inventories conducted by AECOM in summer 2022 allow coverage of the projected areas for implementation of the future wind turbines of Phase 2 of the project.

Furthermore, the access road built for Phase 1 will be reused for transport of material. Only two additional road sections will be built to reach the two new wind pads during Phase 2 of the project.

The two new wind turbines of Phase 2 will be identical to those installed for Phase 1 of the project. Likewise the power cables that can reach the power collection network will be identical to those already installed. If electrical engineering requires it, the lithium-ion battery energy storage system could be redimensioned to support the load of 4 wind turbines on the power collection network. In this case, an additional battery will be installed on the Expo mine site, in the anthropogenic environment.

The construction and equipment installation methods for Phase 2 will be similar to those used for Phase 1 of the project. This involves an extension of the project, which the proponent cannot develop in a single phase, for reasons of logistics, but also technical and economic reasons. The integration of a large quantity of renewable energy into a micronetwork is delicate, and the proponent therefore wishes to schedule this integration over several phases.

3.9 Project Development Constraints

The construction of the project faces several constraints that may delay and even jeopardize the project throughout its lifecycle. The development constraints for construction of two wind turbines on the site of the CRI mining complex are mainly related to the geographic location.

The Expo site is located in northern Québec, in the Canadian Arctic, inaccessible by road from southern Québec, thus restricting transport of equipment to marine transportation. The equipment therefore will be sent to the site via icebreakers, travelling about 3,000 km between Ville de Québec and Deception Bay. The equipment then will be trucked to the construction site. This condition presents significant constraint for transportation logistics, because an agreement between the mining companies (CRI and Glencore) and the Inuit community prohibits navigation by icebreakers during the seal breeding period to preserve the ice pack, leaving few opportunities during the year for boats to transport equipment to the site. Indeed, the ships must avoid crossing Deception Bay between mid-March and mid-June, during the seal pupping period and the height of the hunting season for Inuit users.

Once the equipment arrives on the site, construction of the wind farm is heavily dependent on the weather. The construction season is very short at this latitude and the winter conditions (wind and snow) do not allow erection of the wind turbines. In summer, if the winds are too strong, this can delay erection of high parts (tower, nacelle and rotor).

The logistics of the project are complex, because the lateness or absence of a component on the construction site may result in a one-year delay. Major preparation, far in advance, is necessary to anticipate the manufacturing and delivery delays of each component.

Each of the constraints also has an impact on the cost of the project, given that greater preparation to deal with the isolation of the site leads to an additional cost. Moreover, access to human resources in Nunavik is limited.

The wetlands and water environments present in the work area are also an environmental issue for the wind energy project. To avoid these areas, which are difficult to apprehend, the routes of the access roads and the power cables must be adapted to avoid and minimize their encroachment on the wetlands and water environments.

To summarize, the geographic location of the project is the source of the main development constraints. The Canadian Arctic is difficult to access, the weather is harsh and the environment is unique. In addition, the proponent's teams cannot access the site on a regular basis; everything is managed remotely within a very tight development window.

3.10 Project Footprint

To calculate the project footprint, a right of way with an average width of 12 m was considered for the access road that will be developed up to the implementation sites of the two wind turbines. Moreover, a right of way 0.5 m wide was considered for the passage of the 15 kV power transmission cable that will be deposited on the ground, between the wind pads and the Expo mine site. Finally, a right of way corresponding to a circle of about 200 m in diameter was considered for the wind pads. Table 3-11 presents the areas calculated for the footprint of each infrastructure of this wind energy project. The project's total footprint is estimated at 9.13 ha (91,287 m^2) in the work area.

No other footprint is taken into account for this project outside the work area because the energy storage system (batteries) will be installed on the Expo site, in an already anthropogenic environment, while the existing access roads will be used for transport of equipment and materials between Deception Bay and the Expo site.

Table 3-11: Footprint of the Project Infrastructure in the Work Area

Infrastructure	Footprint (ha)	Footprint (m^2)
Wind pads	6,29	62 908
Access road	2,63	26 310
Power transmission cable	0,21	2 069
Total project footprint	**9,13**	**91 287**

3.11 Sustainable Development

3.11.1 Integration of the 16 Principles of Sustainable Development

Like the integration of climate change into the project's planning and design approach, sustainable development remains at the centre of the priorities of CRI, which will benefit from the proposed wind turbines. In fact, the company is committed to protection of the environment, just as it as to occupational health and safety. This is the sense in which it initiated this project, which will limit its diesel consumption and greenhouse gas emissions, to the benefit of clean and renewable energy. It is important to specify that all the activities taking place in the NNiP's territory, including the present wind farm project, are anchored by CRI's Environment, Health and Safety Policy (presented in the following section) and the Nunavik Nickel Agreement on the impacts, benefits and mitigation measures of the mining project.

TUGLIQ Energy's main objective is to replace fossil fuels with local, clean and sustainable energy sources. It thus develops energy supply alternatives (solar, wind, biomass) specifically designed for environments that cannot be reached by the conventional hydroelectric grid. Sustainable development thus is an integral part of this company's vision and values.

It is therefore not surprising that the various principles of the MELCC's *Sustainable Development Act* (chapter D-8.1.1) have been taken into account in the design of this project. Thus, they will be implemented throughout the construction, operation and, eventually, dismantling of the proposed wind turbines. Table 3-12 more specifically illustrates how each of these 16 principles will be applied.

3.11.2 Environment, Health and Safety Policy

To implement its commitments, CRI has adopted an environmental policy, ratified by upper management, to minimize the hazards, risks and impacts on the natural and human environments, Diagram 3-1 and in Diagram 3-2 in Inuktitut. TUGLIQ Energy's Occupational Health and Safety (OHS) Policy is presented in Diagram 3-3. Moreover, the Emergency Preparedness Plan (presented in Appendix M and discussed in section 7 of the impact assessment) provides more details on TUGLIQ Energy's environmental policy.

Table 3-12: Evaluation of the Project According to the 16 Principles of Sustainable Development

Principle	Application of the principle	Assessment
1. Health and quality of life Protect health and maintain, and even improve, the population's quality of life	• Production of clean energy and reduction of diesel fumes from the EXPO mine site; • Compliance with the standards in force for the noise climate; • Application of mitigation measures for the potential impacts on the human environment (economy and jobs, Inuit land occupancy and use, non-Native land occupancy and use, noise climate).	Neutral effect
2. Social equity and solidarity Account for intragenerational and intergenerational equity, ethics and social solidarity.	• Production of an impact assessment of the project's potential effects on the human environment; • Job creation; • Policy to favour local and regional businesses when awarding contracts; • Consultation of the population and elected officers of the northern villages of Kangiqsujuaq and Salluit, as well as representatives of the Nunaturlik and Qaqqalik landholding corporations; • Compliance with the standards issued and environmental processes established by the authorities of Nunavik, Québec and, when applicable, Canada; • Production of renewable energy.	Positive effect
3. Environmental protection Ensure environmental protection and maintenance of biodiversity	• Production of an impact assessment of the project's potential effects on the physical and biological environments, particularly accounting for the effects on climate change; • Compliance with the applicable environmental standards; • Application of mitigation measures for the potential impacts on the physical and biological environments (air, soil, water, hydraulic and sedimentary regime, vegetation, avian fauna, terrestrial fauna); • Application of an environmental monitoring and follow-up program; • Application of a waste management program.	Neutral effect
4. Economic efficiency Ensure economic efficiency geared toward innovation, prosperity and social progress, while ensuring environmental protection	• Contribution to local and regional economic prosperity, particularly by creation of: • economic opportunities for local and regional businesses; • employment and training opportunities for the workforce of local and regional communities.	Positive effect
5. Participation and commitment Favour the participation and commitment of citizens and/or groups that represent them to defined a concerted vision of development and ensure its environmental, social and economic sustainability.	• Consultation of the population and elected officers of the northern villages of Kangiqsujuaq and Salluit, as well as representatives of the Nunatirlik and Qaqqalik landholding corporations; • Consultations of businesses and organizations related to the use by non-Natives of the territory concerned by the project (Glencore Canada, Canadian Royalties Inc., Katinniq-Donaldson Airport, Pingualuit National Park).	Positive effect

Table 3-12: Evaluation of the Project According to the 16 Principles of Sustainable Development (cont'd)

Principle	Application of the principle	Assessment
6. Access to knowledge Encourage access to education and training, share information and favour public participation in the implementation of development, stimulate innovation.	• Presentation of the results of the inventories conducted to date in the context of the impact assessment (presentation to the population and elected officers of the northern villages of Kangiqsujuaq and Salluit, and representatives of the Nunatirlik and Qaqqalik landholding corporations); • Sharing of the results of the environmental follow-ups with the local communities; • Training workers concerning the operation and maintenance of the wind turbines.	Positive effect
7. Subsidiarity Delegate powers and responsibilities to the appropriate level of authority. Adequately distribute decision-making centres with the goal of bringing them as close as possible to the citizens and communities concerned.	• Transparency of the proponent concerning the distribution of powers and responsibilities.	Neutral effect
8. Inter-governmental partnership and cooperation Collaboration by governments to render development sustainable from the environmental, social and economic point of view. The actions taken in a territory must account for their impacts outside that territory.	• Project carried out by accounting for the standards issued and environmental processes established by the authorities of Nunavik, Québec and, when applicable, Canada.	Neutral effect
9. Prevention In the presence of known risks, provide for preventive, mitigating and corrective actions.	• Production of an impact assessment of the project's potential effects on the physical, biological and human environments, particularly accounting for the effects on climate change; • Compliance with the applicable environmental standards; • Application of mitigation measures for the potential impacts on the physical, biological and human environments; • Consultation of the population, elected officers and representatives of the Kangiqsujuaq and Salluit community landholding corporations; • Consultation of businesses and organizations related to non-Native use of the land concerned by the project (Glencore Canada, Canadian Royalties Inc., Katinniq-Donaldson Airport, Pingualuit National Park); • Application of an environmental monitoring and follow-up program; • Application of an emergency preparedness plan; • Application of a waste management program.	Neutral effect

Table 3-12: Evaluation of the Project According to the 16 Principles of Sustainable Development (cont'd)

Principle	Application of the principle	Assessment
10. Precaution When there are risks of serious or irreversible damage, lack of full scientific certainty must not be used as a pretext to postpone the adoption of effective measures to prevent environmental degradation.	• Production of an impact assessment of the project's potential effects on the physical, biological and human environments, particularly accounting for the effects on climate change; • Compliance with the applicable environmental standards; • Application of mitigation measures for the potential impacts on the physical, biological and human environments; • Consultation of the population, elected officers and representatives of the Kangiqsujuaq and Salluit community landholding corporations; • Consultation of businesses and organizations related to non-Native use of the land concerned by the project (Glencore Canada, Canadian Royalties Inc., Katinniq-Donaldson Airport, Pingualuit National Park); • Application of an environmental monitoring and follow-up program; • Application of an emergency preparedness plan; • Application of a waste management program.	Neutral effect
11. Protection of cultural heritage Ensure the identification, protection, transmission and enhancement of the cultural heritage, taking its fragility into account.	• Production of an impact assessment of the project's potential effects on the archaeological heritage and the landscape; • Deployment of mitigation measures to protect archaeological resources that could be discovered fortuitously during construction or dismantling of the project.	Neutral effect
12. Biodiversity preservation Ensure maintenance of species, ecosystems and natural processes that maintain life is essential to maintain the quality of human life.	• Development of the project in an areas already impacted by mineral exploration; • Production of an impact assessment of the project's potential effects on the physical and biological environments, particularly accounting for the effects on climate change; • Compliance with the applicable environmental standards; • Application of mitigation measures for the potential impacts on the physical and biological environments (air, soil, water, hydraulic and sedimentary regime, vegetation, avian fauna, terrestrial fauna); • Minimization of the project's physical footprint; • Avoidance of sensitive environments and respect for their integrity; • Rehabilitation of the area planned for development of the wind turbines after their dismantling; • Application of an environmental monitoring and follow-up program; • Application of a waste management program.	Neutral effect
13. Respect for ecosystem support capacity Respect the support capacity of ecosystems and ensure the perenniality of the ecosystem.		Neutral effect

Table 3-12: Evaluation of the Project According to the 16 Principles of Sustainable Development (cont'd)

Principle	Application of the principle	Assessment
14. Responsible production and consumption Adopt modes of production and consumption that are more socially and environmentally responsible. In particular, this can be done by avoiding waste, optimizing the use of resources and favouring energy efficiency.	• Reduction of diesel consumption at the Expo mine site to the benefit of use of clean energy; • Business opportunities for local and regional businesses, and for Québec businesses; • Favouring local and regional businesses to award contracts; • Job opportunities for the workforce of local and regional communities; • Training opportunity for the workforce of local and regional communities.	Positive effect
15. Polluter pays In the case that development causes pollution or environmental degradation, assume all of part of the costs related to the mitigation and offset measures to be deployed.	• Compliance with the applicable environmental standards; • Application of mitigation measures for the potential impacts on the physical and biological environments (air, soil, water, hydraulic and sedimentary regime, vegetation, avian fauna, terrestrial fauna); • Rehabilitation of the area planned for development of the wind turbines after their dismantling; • Application of an environmental monitoring and follow-up program; • Application of a waste management program; • Application of an emergency preparedness program.	Positive effect
16. Internalization of costs Ensure that the value of goods and services reflects all of their costs for society throughout their lifecycle, from design to consumption and final disposal.	• Reduction of diesel consumption at the Expo mine site to the benefit of use of clean energy; • Application of a waste management program; • Integration into the project of the projected dismantling of the wind turbines; • Rehabilitation of the area planned for development of the wind turbines after their dismantling.	Positive effect

CANADIAN ROYALTIES INC.

Environment, Health and Safety Policy

Canadian Royalties Inc. is a metal mining company committed to occupational health & safety and environmental protection. Canadian Royalties Inc. will act in a manner that minimizes dangers, risks and impacts and will continually seek to improve its performance. Canadian Royalties Inc. will engage the commitment and involvement of all of its employees and contractors to ensure that environmental, health and safety performance objectives are met.

Canadian Royalties Inc. is committed to:

- Evaluating the dangers, risks and impacts for the natural, human and social environments with a focus on the goals of prevention and protection.
- Implementing prevention and response programs in order to minimize and mitigate impacts and adverse events.
- Complying with current laws and regulations wherever the company is engaged in mining or mining-related activities.
- Ensuring responsible use of energy, water and consumable goods.
- Informing employees, subcontractors and suppliers of the company's policies and programs and their required involvement to ensure successful implementation.
- Conducting monitoring programs and periodic audits in order to identify opportunities for improvement and implementing corrective actions where required to improve environmental and organizational health and safety performance.
- Identifying stakeholders and undertaking dialog with the inclusion of governmental authorities and the public in order to improve Canadian Royalties Inc.'s practices and performance.
- Reclaiming the impacted environment to a condition as near to its original state as is reasonably possible, upon the termination of mining and mining-related activities.
- Ensuring that sufficient human, material and financial resources are available to implement this policy.

James Xiang
Chief Executive Officer
Canadian Royalties Inc.
May 08, 2020

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Diagram 3-1: CRI Environment, Health and Safety Policy

CANADIAN ROYALTIES INC.

ᓯ2ᒥᓕᓇᓂᖅ, ᐊᒪ ᕿᑭ/ ᒧᒃ ᓯᖅᖃ ᖅᑐH ᒧᒥᓪᓗ ᓴᕈᖕ

Canadian Royalties Inc. ᓴᕕᕋᔭᕐᓂᒃ ᐅᔭᕋᕐᓂᐊᕕᐅᑦᓯᓂ ᑲᒻᐸᓂᐅᑉ ᑐᓂᒪᑦᓯᓂ ᐱᓇᓱᐊᕕᒥ ᐃᓗᓯᓕᓇᓂᕐᒧᑦ ᖃᓄᐃᖕᖏᓯᐊᕐᓂᒧᑦ ᐊᐃᑎᒥᓪᓗ ᐅᖓᒧᒪᑦᓯᓂᕐᒧᑦ. Canadian Royalties Inc. ᐱᓇᓯᐊᓚᖓᕗᑉ ᐊᑦᑕᓇᕐᑐᒥᑦᑎᓯᑦᑌᓕᓂᕐᒥᒃ, ᓇᖏᐊᕐᓇᑐᓂ ᐊᒻᒪᓗ ᑲᔪᓯᔪᒥᒃ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᓯᐊᓚᖓᑦᓯᓂ ᐱᓇᓯᑦᑕᒥᓂᒃ. Canadian Royalties Inc. ᐃᓚᒥᔭᐅᑎᑦᓯᓯᐊᓚᖓᕗᑉ ᑐᓂᒪᓂᖏᓪᓚᑦ ᐃᓚᐅᓂᖏᓪᓚᓗ ᐱᓇᓯᑦᑎᓕᒫᑦ ᐊᒻᒪᓗ ᐱᓇᓱᒍᑦᓭᓂᕐᒧᑦ ᐊᖏᖅᑲᑎᒌᒍᑎᓖᑦ ᓯᖅᑭᐃᓯᐊᖅᑯᓗᒥᑦ ᐊᐃᑎᓕᓇᓂᖅ. ᐃᓗᓯᓕᓇᓂᖅ ᖃᓄᐃᖕᖏᓯᐊᕐᓂᓗ ᐱᓇᓯᑦᑕᐅᓱᑦ ᑐᕌᒐᖏᑦ ᑎᑭᐅᑎᔭᐅᑦᓯᐊᖅᑯᓗᒥᑦ.

Canadian Royalties Inc. ᑐᓂᒪᕗᖅ ᐅᑯᓄᖓ:

- ᖃᐅᔨᓴᖃᑦᑕᓗᓂ ᐊᑦᑕᓇᕐᑐᓂᒃ, ᓱᒃᑯᐊᖃᒍᑕᐅᒍᓐᓇᑐᓂᒃ, ᓱᕐᕈᒍᓐᓇᑐᓂᒃ ᓄᓇᓂᒃ, ᐃᓄᓐᓂᒃ ᐃᓅᖃᑎᒌᓪᓗ ᐊᐃᑎᖓ ᑐᕌᒐᖃᕐᓗᓂᒃ ᐃᑯᓪᓚᑎᑦᓯᒪᓯᐊᕐᓂᒥᒃ ᐅᖓᒪᓂᕐᒥᓗ.
- ᑲᔪᓯᑎᑦᓯᓗᓂ ᓱᒃᑯᐊᕿᑦᑎᓯᑦᑌᓕᒍᑎᓂᒃ ᐊᒻᒪᓗ ᐃᑲᔫᓯᐅᑎᐅᒪᔭᕐᑐᓂᒃ ᐱᓇᓱᓐᓂᓂᒃ ᐃᕿᓕᐅᒥᖁᓗᒥᑦ ᓱᕐᕈᓯᑦ ᓈᒪᓇᖕᖏᑐᐃᓪᓗ ᐱᔦᖃᕐᓂᑦ.
- ᒪᓕᓪᓗᑎᒃ ᑕᒪᑕ ᐱᖁᔭᓇᔭᐅᔪᓂᒃ ᒪᓕᒐᓕᐊᒍᓯᒪᔪᓂᓪᓗ ᖃᖓᑐᐃᓐᓇᖅ ᑲᒻᐸᓂ ᐅᔭᕋᕐᓂᐊᓕᕐᑉᐸᑦ ᐅᐃᒍᓐᓂᑦ ᐅᔭᕋᕐᓂᐊᕐᓂᕐᒨᓕᖓᔪᓂᒃ ᐱᓇᓱᐊᓕᕆᓂ.
- ᖃᐅᔨᒪᑎᑦᓯᖃᑦᑕᓗᓂ ᐱᓇᓯᑎᓂᒃ, ᐱᓇᓱᒍᑦᓭᓂᕐᒧᑦ ᐊᖏᖅᑲᑎᒌᒍᑎᑎᒍᑦ ᐱᓇᓯᑦᑐᓂᒃ ᑎᑭᓴᕕᓐᓂᓗ ᑲᒻᐸᓂᐅᑦ ᒪᓕᒐᖏᓐᓂᒃ ᐱᓇᓯᑦᑕᖏᓐᓂᓗ ᐊᒻᒪᓗ ᐃᓚᐅᑎᐊᖃᕐᓂᖏᓐᓂᒃ ᓯᖅᑭᐃᖅᑯᓗᒥᑦ ᐱᑦᓯᐊᑐᒥᒃ ᑲᔪᓯᖅᑯᓗᒥᑦ.
- ᑲᔪᓯᑎᑦᓯᖃᑦᑕᓗᑎᒃ ᐃᑉᐱᒍᓱᑦᑐᓂᒃ ᓇᓪᓕᐅᑎᑦᑐᓂᓪᓗ ᑕᒪᓯᒪᔦᕐᓯᐅᑕᐅᓂᕐᒥᒃ ᓇᓗᓃᕐᓯᖅᑯᓗᒥᑦ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᔭᕐᑐᓂᒃ ᑲᔪᓯᑎᑦᓯᓗᑎᓪᓗ ᐋᖅᑭᐊᕈᑎᓂᒃ ᐊᐅᓚᑦᔭᓇᐊᕈᑕᐅᒥᐊᓕᓐᓂᒃ ᒥᐊᕐᑲᓕᕈᑎᒃ ᐱᐅᓯᐅᒥᑎᑦᓯᒪᓯᐊᕐᓗᑎᒃ ᐊᐃᑎᓕᓇᓂᕐᒥ, ᐱᓇᓱᐊᕕᓂ ᐃᓗᓯᓕᓇᓂᕐᒥ ᖃᓄᐃᖕᖏᓯᐊᕐᓂᒥᓪᓗ ᐊᑏᑎᔭᐅᓂᕐᒥᒃ.
- ᓇᓗᓃᕐᑎᓯᓗᑎᒃ ᑲᖏᓯᑦᑐᓂᒃ ᑲᔪᓯᑎᑦᓯᓗᑎᓪᓗ ᐅᖅᑲᖅᑎᒦᓐᓂᒃ ᐃᓚᐅᑎᓪᓗᑦ ᑲᕙᒪᒃᑯᓂ ᐱᓇᓯᑏᑦ ᐊᒻᒪᓗ ᓇᐅᓕᒫᑦ ᐱᐅᓯᐅᒥᖁᓗᑦ Canadian Royalties Inc. ᐱᐅᓯᓇᖑᖅᑦ ᐊᑑᑎᖑᖅᑎᓪᓗ.
- ᓴᑐᐃᒥᐊᓗᓂ ᓯᕋᑕᐅᓯᒪᔪᒥᒃ ᐊᕙᑎᒥᒃ ᐱᒧᓐᓇᕕᓕᒫᖅᑲᓄᑦ ᐱᐅᓯᕕᓂᖅᑲᓄᑦ ᐃᓂᓪᓚᕋᓯᐊᓚᖅᑲᓗᒍ, ᐃᓯᓗᑐᐊᕐᑉᑦ ᐅᔭᕋᕐᓂᐊᓂᖅ ᐅᔭᕋᕐᓂᐊᓂᕐᒥᓗ ᐊᐅᓚᑕᐅᔪᑦ.
- ᓯᖅᑭᐃᓯᓗᑎᒃ ᓈᒪᓂᖅᑲᓂᒃ ᐱᓇᓯᑏᑦ, ᐱᐅᒃᑐᑏᑦ, ᑮᓇᐅᔭᓗ ᐊᑐᐃᓐᓇᐅᓯᐊᔭᓗᐊᕐᒪᖅᑲᑦ ᑲᔪᓯᑎᑕᐅᖁᓗᒍ ᑖᓐᓇ ᒪᓕᒐᖅ.

James Xiang
President/Chief Operating Officer
Canadian Royalties Inc.

May 30, 2022

Diagram 3-2: CRI Environment, Health and Safety Policy in Inuktitut

Tugliq Énergie Co. LA SÉCURITÉ ET LA SANTÉ AU TRAVAIL UN ATOUT POUR L'ENTREPRISE

TUGLIQ Énergie S.A.R.F

POLITIQUE DE SANTÉ ET SÉCURITÉ AU TRAVAIL.

TUGLIQ ÉNERGIE S.A.R.F.

TUGLIQ Énergie S.A.R.F.T (« TUGLIQ ») considère que ses employés ont le droit de bénéficier d'un environnement de travail sain et sécuritaire. Dans cette perspective, la direction de TUGLIQ mise sur la prévention et l'élimination des accidents, des blessures et des maladies professionnelles afin de favoriser leur mieux-être physique et psychologique.

TUGLIQ a choisi de s'engager fermement dans cette démarche afin de favoriser la prévention et l'élimination des événements accidentels en milieu de travail ainsi qu'une gestion équitable de la réadaptation et du retour à l'emploi des travailleurs blessés.

Afin de réaliser ce projet collectif, TUGLIQ est déterminé à instaurer et à favoriser une culture fondée sur la mise en place progressive et continue de son programme de prévention, de son plan d'action et de son plan de mesures d'urgence. Il revient à tous et à chacun de s'impliquer pleinement dans cette démarche.

Ainsi, avec l'appui et la participation de l'ensemble du personnel de TUGLIQ la gestion intégrée de la SST contribuera à développer, à actualiser et à maintenir le niveau d'excellence que nous nous sommes fixés pour le service aux clients, et ce, dans un milieu de travail sécuritaire.

Laurent Abbatiello, PDG

19 septembre 2022

Date

Diagram 3-3: TUGLIQ Energy Occupational Health and Safety Policy

Upon cessation of mining activities and activities related to the mine on the land occupied by the NNiP, CRI undertakes to comply with the *Guide de préparation du plan de réaménagement et de restauration des sites miniers au Québec*[15] (Guide to preparation of the redevelopment and restoration plan of mine sites in Québec) regarding the rehabilitation of mine sites in the northern environment, in respect for the neighbouring environment. At the end of the mining project's lifecycle, the dismantling and rehabilitation of the wind farm will be included in the cessation of activities related to the mine. The same commitments are therefore made by the developer of the wind energy project in accordance with the mine operator.

3.11.3 Environmental, Social and Governance Initiatives

CRI integrates the general principles of sustainable development into its activity management strategies, while the primary mission of TUGLIQ Energy's activities is to replace hydrocarbons with better alternatives in vulnerable regions.

3.11.3.1 Past and Present Initiatives

Energy efficiency and reduction of fossil fuel consumption (CRI)

Because the NNiP is located off the Hydro-Québec grid, the energy required for all of its activities depends on diesel, transported by sea to the port facilities of Deception Bay.

Out of a concern for responsible consumption of this non-renewable resource, CRI, over the years, tracked diesel consumption rigorously, especially for the generators. They represent the greatest proportion of diesel consumption, which is mainly used to generate electricity. The efforts to reduce consumption can be summarized in two streams.

On the one hand, the studies of the consumption trends of generators on satellite sites made it possible to consolidate consumption on certain sites on a more limited number of generators, particularly via power cables. Since 2017, it has been estimated that 4,339,000 L, or 13.5% of annual consumption, could be saved in this way.

On the other hand, in 2019, CRI mandated the firm BBA to optimize the central group of generators, which supplies power to the metal concentrate mill and part of the Expo camp. This allowed maintenance of diesel consumption at a relatively stable level, despite more sustained occupancy of the camp.

By its projects to reduce its carbon footprint, CRI affirms its commitment to be a constructive partner in fighting climate change.

Participation in the "Towards Sustainable Mining" initiative (CRI)

Since 2017, CRI has adhered to the *Towards Sustainable Mining* (TSM) initiative of the Mining Association of Canada. CRI undertakes to respect the guiding principles of the program, and to implement them by integrating the program's seven performance protocols into its activities and management systems. CRI also undertakes that its actions are consistent with each of the strategic frameworks of the protocols.

This world-renowned program allows CRI to better discern and manage its main environmental and social risks. CRI tends to show leadership via its commitment to communities, the health and safety of employees and communities, and energy efficiency.

PAECI – giving back to communities (CRI)

The Programme d'amélioration environnementale dans les communautés inuites (PAECI – Environmental improvement program in Inuit communities), established by CRI, involves projects carried out in replacement of offset plans for losses for wetlands and water environments established for projects in southern Québec. Although it is the result of an obligation, this innovative program remains an excellent example of partnership among CRI,

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the regional government (Kativik Regional Government (KRG)) and the local member communities of the Nunavik Nickel Agreement. This partnership allows the KRG and the communities to propose environmental improvement projects that will benefit the residents of the Inuit villages. These projects will be funded, in the majority, by CRI. By its involvement in PAECI, CRI shows that its development in Nunavik can contribute harmoniously to the sustainable development of Inuit communities.

Green energy production (TUGLIQ)

Since its beginnings, TUGLIQ has committed to the development of renewable energy projects to limit greenhouse gas emissions in the environments most at risk. While extreme conditions did not seem suitable for installation of wind turbines, TUGLIQ showed that the Arctic could be a suitable environment for the conversion of wind energy into electricity.

In 2014, TUGLIQ installed a first 3 M wind on the Raglan mining complex, a success that lead to the installation of a second wind turbine in 2018. Since then, these two wind turbines have generated energy and avoided the use of 23.7 million litres or diesel, or 66,100 tonnes of CO_2 equivalent. The installation of these two structures is a technological feat opening the door to installation of green energy projects under Arctic conditions, north of the 55th parallel.

Moreover, TUGLIQ Energy is currently testing the possibility of generating energy from the sun with solar panels adapted to the Arctic climate. The objective is to provide access to green energy in the most remote and inaccessible regions.

For Tugliq, the projects cannot be developed in the Arctic without acting in concert with the Inuit communities concerned. Communicating with them is therefore a priority and TUGLIQ implements various means to share maximum information (creation of website, internet, broadcasting information on local radio, sharing information with local elected officers, etc.). In addition, TUGLIQ prioritizes hiring and training of employees from the local communities.

Assistance in the energy transition for mining companies (TUGLIQ)

Québec mining companies are among the province’s leading GHG emitters. The origin of these emissions largely comes from their great consumption of electricity generated by diesel generators. To help these companies reduce their use of fossil fuels, TUGLIQ Energy has developed a consulting branch with the goal of supporting them in their priority decision-making. For this purpose, TUGLIQ develops more efficient energy strategies with them to limit use of fossil fuels and incorporate the use of green energy, such as solar energy, wind energy or biomass.

3.11.3.2 Future Initiatives

Complete carbon footprint (CRI)

In addition to this project for installation of two wind turbines, CRI understands hte importance of accounting for GHG emissions throughout its value chain and its product portfolio for overall management of the risks and opportunities related to GHGs. For this purpose, the company plans to initiate voluntary reporting of indirect GHG emissions (*Scope 3*) starting in 2022. *Scope 3* emissions include, among others, upstream and downstream emissions from administration, materials and travel. This exhaustive exercise will allow CRI to better assess the carbon footprint of its products, nickel and copper concentrates, and to identify new opportunities for GHG emission reduction, involve its partners in GHG management, and improve information for the stakeholders and the company’s reputation through public reporting.

Strategy for management of environmental, social and governance (ESG) issues (CRI)

CRI is working to perfect its sustainable development strategy by deploying objectives and practices to demonstrate progress and responsibility on the issues that count most for the stakeholders, and that will help CRI better understand and manage its social and environmental risks and opportunities.

Specifically, CRI intends to produce a consistent ESG report according to recognized international standards to increase transparency and responsibility concerning questions of importance by the end of 2023.

In addition to addressing the risks of climate change more by reporting *Scope 3* emissions, CRI intends to produce a lifecycle assessment of the products of its activities. This study will strengthen its ability to manage risks well, better define its sustainable development objectives, and meet the highest international environmental standards.

Green mobility (TUGLIQ)

Diesel consumption in the mines is not only related to generation of electricity. It is also related to the use of vehicles, which also consume appreciable quantities of fossil fuels. To limit this consumption, TUGLIQ Energy proposes electric vehicles for the mining industry. These are conventional pickups converted to electric power.

Thus, two electric pickups are currently used by two major mining companies in Northern Québec. To carry out this project, TUGLIQ particularly had to account for the difficult conditions these vehicles would have to face. They are therefore equipped with thermal protection allowing their use in very cold periods, while maintain performance similar to conventional vehicles. New projects are also being developed by TUGLIQ in partnership with mining companies to develop their use of electric vehicles further. Projects seeking to convert bigger vehicles, such as trucks or buses, to electric power, are currently in progress. TUGLIQ ultimately is seeking to develop a full line of vehicles adapted to the needs of mining companies operating in a northern environment.

3.12 Climate Resilience Assessment and Adaptation

The climate change is important to take in consideration in the environmental authorization regime for projects in Québec according to sections 24, 25, 31.1.1 and 31.9 of the *Environment Quality Act* (chapter Q-2) (EQA) and sections 1, 3 and 5 of the *Regulation respecting the environmental impacts assessment and review of certain projects* (REEIE) (chapter Q-2, r. 23.1). Indeed, the project and its components must be located, designed, and operated considering the risks generated by the current and anticipated effects of climate change. Otherwise, the integrity or efficiency of the infrastructures under study could be affected, environmental risks could be amplified, new environmental risks could arise, or human well-being safety could be in danger.

It is in this context, the general objective of this study is to identify and assess possible risks in order to make recommendations for various components, activities, and operations in the face of climate change and extreme weather conditions. The scope of this analysis will be the installation of two wind turbines with a battery energy storage system at the Nunavik Nickel mine by TUGLIQ Energy co., in partnership with Canadian Royalties Inc. The installation of the two wind turbines is planned for the summer and autumn of 2023, with the start of energy production in December 2023. Using the manufacturer guaranteed lifespan of the wind turbines of 25 years, the assessment has been carried out using the climate projections for 2040 to 2060.

Appendix F presents a short glossary about climate change vocabulary.

3.12.1 Objectives

The main objective of this study is to assess the risks and vulnerabilities related to climate change for regarding the installation of two wind turbines with a battery energy storage system at the Nunavik Nickel mine. This assessment must meet the requirements related to the adaptation to climate change described in the guide for MELCC project initiators (MELCC, 2021).

More specifically, this study aims to:

- Establish the context and identify the hazards likely to have repercussions on the project or modify its impacts on the environment.
- Identify the components of the project likely to be affected by the hazards.
- Identify the consequences of these hazards for the project or its environment.
- Identify and assess the risks associated with climate change on all project components throughout the lifespan of the operations phase.
- Propose adaptation measures to be implemented in order to reduce the identified risks.

3.12.2 Methodology for the Assessment of Risks and Vulnerabilities to Climate Change

To design a project and properly assess its impacts, it is essential to take into account the effects attributable to climate change. Indeed, the hazards are likely to be amplified by the effects of climate change and in return, they will amplify the impacts of the project on the natural and built environments during its lifecycle. These hazards must be identified through an **Assessment of Risks and Vulnerabilities to Climate Change** (ARVCC) so that the appropriate adaptation measures can be proposed at the end of the analysis. An ARVCC generally involves adopting a risk management approach to:

- Anticipate the risks related to climate change that could have an impact on the assets or activities that are the subject of the study; and
- Identify design features or potential actions to help prevent, resist, respond, restore, and adapt to these risks.

The ARVCC carried out for this project is based on the design details provided by TUGLIQ Energy and follow-up discussions with the TUGLIQ Energy team.

The resilience and adaptation to climate change for this project has been assessed by respecting the ISO 31000 standard (Canadian Standards Association, 2018) in risk management to ensure that the requirements described in the Guide for project initiators of the *Ministère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC, 2021). The ARVCC was carried out by following the five steps described in the guide of the MELCC project initiators (MELCC, 2021). These steps are described below.

- Step 1 - Establishing the context and identifying the hazards likely to have repercussions on the project or modify its impacts on the environment
  - Stage 1 of the ARVCC contains the following activities:
    - Describe the environment in which the project will be carried out and identify the hazards resulting from climatic phenomena likely to affect the project that could occur during its lifespan.
    - Describe past and recent climate, the history of extreme events and hazards that have affected, in the recent past, the realization of similar projects located in the same region, that is to say in Nunavik.
    - Examine the climate projections for the future horizon 2040-2064 for the RCP4.5 and8.5 scenarios.
    - Determine areas in natural and built environments that could be affected by current and projected climatic conditions and may in turn produce or accentuate a hazard.
    - Step 2 - Identification of project components likely to be affected by hazards
  - Stage 2 of the ARVCC contains the following activities:
    - Identify the components vulnerable to the effects of the hazards identified in the previous step.
    - Identify the project components whose impact on the environment may be amplified by the identified hazards.

- Step 3 - Identification of the consequences for the project or its environment
  - Step 3 of the ARVCC contains the following activities:
    - List the possible interactions between the hazards identified in step 1 and the project components identified in step 2.
    - Determine the potential consequences of these interactions for the project.
    - Describe the potential consequences of these interactions for the environment.
- Step 4 - Assessing the impacts and risks for the project or its environment
  - The fourth step of the ARVCC constitutes a single activity, namely the following:
    - Assess and describe the impacts and risks generated by the effects of climate change for the project and for the surrounding environment.
- Step 5 - Climate Change Adaptation Measures
  - The final step of the ARVCC contains the following activities:
    - Identify risk treatment and adaptation measures.
    - Recommend a set of adaptation measures for each project component.

3.12.3 Description of the project implementation environment and identification of hazards

3.12.3.1 Description of past and recent climate

3.12.3.1.1 Climate normals

The climate data analysis was carried out using weather and climate data obtained and analysed by Ouranos in their *Élaboration du portrait bioclimatique futur du Nunavik* (Mailhot and Chaumont, 2017) in alignment with the Direction Générale de l'Évaluation Environnementale et Stratégique (Ministère de l'Environnement et de la Lutte contre les changements climatiques, 2022). In the report, the historical climate information was derived from a combination of the Global Meteorological Forcing Dataset for Land Surface Modeling (GMFD) for temperature and precipitation related indicators and historical regional climate simulations for solid precipitation and snow cover. The GMFD data set was validated using the weather stations in Nunavik and Labrador north of the 50th parallel, and an overall good agreement was found. As discussed in the report, the historical reference period was selected to be 1980 to 2004 (Mailhot and Chaumont, 2017).

The Project site is located in or near the polar climate zone, which is characterized by all monthly averaged temperature being below 10°C. For said climate reference period, the monthly averages of daily mean temperature (T) in °C and total precipitation (P) as well as snow (S), both measured in mm, are shown in Figure 3-6. The maximum monthly temperature is reached in July with 11°C, while the coldest month with -24.2°C is January. The precipitation between 1980 and 2004 shows an annual cycle with larger amounts in the summer months.

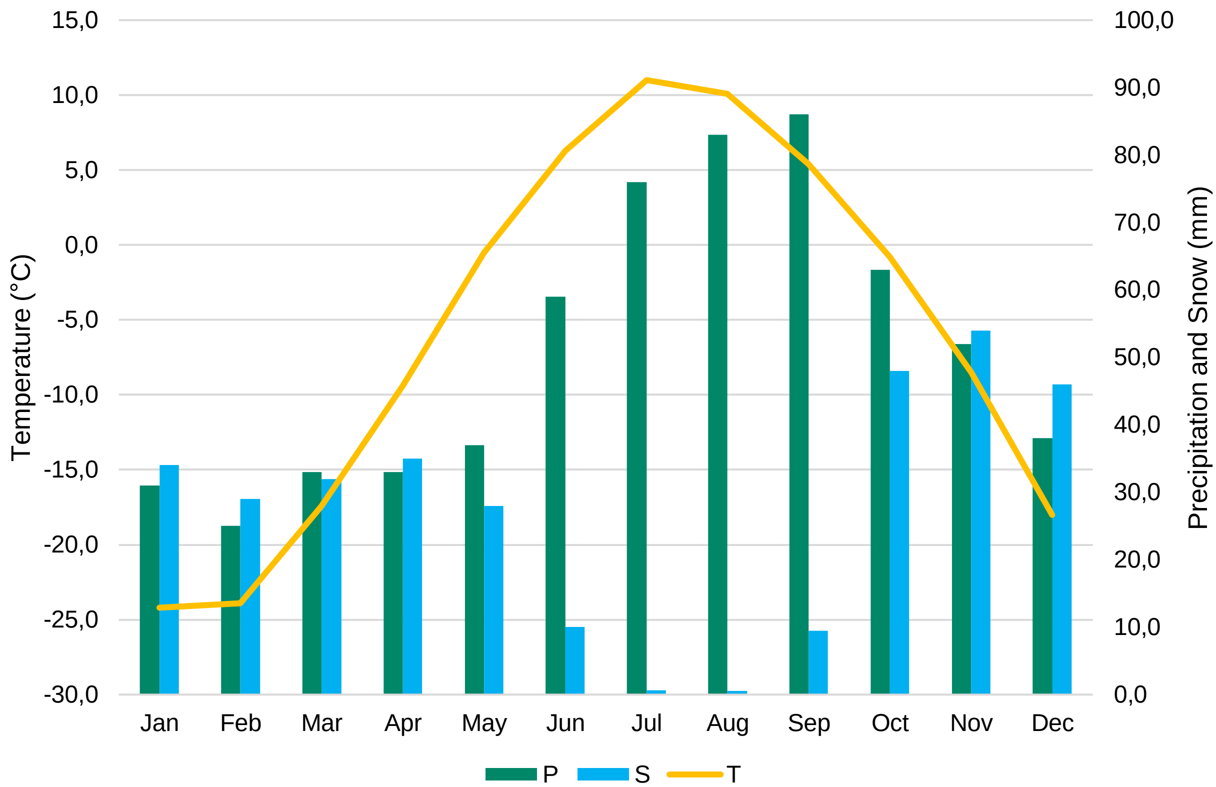


Figure 3-6: Climate normal for the Nunavik region for the reference period 1981-2004 based on the climate portrait by Ouranos

3.12.3.1.2 Permafrost

<u>Historical State</u>

The study area is located in a zone of continuous permafrost. In this zone, the drainage capacity is limited to mollisol, the superficial layer of the ground, which freezes in winter and melts in summer, also called active layer. The amount of energy transmitted into the ground and the thermal diffusivity of the ground (ability to conduct and store heat) depends on the thickness of this layer, which is delimited by the maximum progression of the thaw at the end of the summer season (GENIVAR, 2007). Mollisol can reach thicknesses varying between 0.25 and 5.0 m depending on the thermal characteristics of the soil (thermal conductivity, thermal diffusivity, and specific heat), the geomorphological characteristics of the site (exposure, drainage, thickness of the material surface organic material), and the latitude of the site.

Gray *et al.* (1988) demonstrated that the depth of active layer is proportional to the thermal diffusivity of the soil. According to the temperatures measured at Salluit in different types of unconsolidated deposits, the thickness of mollisol reaches depths of around 1 m on average in fine-textured marine sediments, while coarser-grained soils, such as sands and gravels, display a greater thaw depth, approximately 1.5 to 2 m (Allard *et al.*, 2002). In a larger, regional context, the historical thickness of the mollisol reaches a depth of 2.2 m in Salluit while it reaches a thickness of up to 5 m in Kangiqsualujjuaq (Lévesque *et al.*, 1990).

Warming Effect

With the warming temperatures observed in northern Québec since the mid-1990s, the permafrost has warmed as well. Observations from 1993 to 2007 show a temperature increase of 1.8 to 2.7°C at 4 m depth in Salluit, while in Kangiqsualujjuaq the temperature increase at the same depth is up to 3.4°C. Even at lower depth (20 m), the soil is warming by 1 to 1.3°C in Salluit and by up to 1.2°C in Kangiqsualujjuaq (Allard et al., 2012). This temperature increase has led to advances the mollisol limit in the soils. For example, in Salluit, for the period from 1987 to 2004, the thickness of the mollisol went from 2.2 m to about 3.05 m in the rock and from 1.30 m to more than 1.40 m in the till (L'Hérault, 2005). Newer observations show that active layer depth in the Narsajuaq river valley has increase significantly between 1991 and 2017 (Gagnon and Allard, 2020). In a follow-up study, Gagnon and Allard (2021) show that the active layer thickness increase will continue with climate change. Depending on the emission scenario and soil type, the layer thickness will be 2 to 3.4 times greater by the end of the century compared to 1992.

The melting of the permafrost and the transformation of the continuous permafrost zone into a non-continuous zone in several places can lead to the following risks:

- risks to the structural integrity and stability of the works;
- problems in finding suitable places to build;
- increase in road infrastructure maintenance costs;
- risks of road or railway closures (subsidence and settling of land) and isolation of sites.

However, these risks are not applicable in the context of the wind farm project since the potential consequences of climate change on mollisol are taken into account from the design stage.

3.12.3.1.3 Climatic extremes and natural hazards

The territory of Nunavik is an environment affected by natural and catastrophic events such as river floods, coastal flooding, ice jams, ice break-ups, floods, slope movements (landslides, gelifluctions, avalanches, etc.), periglacial phenomena and extreme meteorological phenomena (windstorms, blizzards, droughts, etc.). Many events have occurred since 1935, including the avalanche in Kangiqsualujjuaq (in 1981, 1982, 1986, 1993 and 1999), the wet snow avalanche in Deception Bay (2005), landslides in Salluit (2005), as well as the 1989 earthquake (L'Hérault, 2005). In 2003, a blizzard affected the Salluit community due to high wind speed and heavy snowfall. As a consequence, telephone lines and power were cut off and flights were suspended (Allard et al., 2010; L’Hérault et al., 2016). In the following year, another two violent winter storms paralyzed the area (Allard et al., 2020).

Hazards that have affected similar projects in Nunavik

Mass movements

Detachments of the active layer are likely to occur on slopes characterized by unconsolidated ice-rich deposits with slopes as low as 4° (L'Hérault, 2009). The particular meteorological conditions (several hot days in a row) that occurred during the years 1998, 2005 and 2010 increased the instability of the slopes and favoured the triggering of several detachments of the active layer in the Salluit valley.

The Deception Bay site has experienced three wet snow avalanche episodes over the past fifty years. The first occurred between June 6 and 7, 1970 and would have been caused by the rapid melting of the snow causing the fall of the snowpack saturated with water.

Hydrological Hazards

On May 23, 1979, a major ice jam occurred in the Kuujjuaq region. Twelve hours before the occurrence, precipitation in the form of freezing rain and wet snow fell heavily (19 cm) .

During the period from October 8 to 11, 2010, a storm surge was felt along Hudson Strait and the north coast of Ungava. The passage of an atmospheric depression coinciding with the high seas of the high tides forced the exceptional rise in the water level.

On November 19, 2015, particular weather conditions (abnormally hot temperatures combined with a long period of precipitation and strong winds) led to the overflow of the Innuksuak River in Inukjuak.

Hazards associated with permafrost

Several cases of thermokarstic subsidence (or settlement associated with permafrost thaw) have been noted on the territory of Nunavik. A few sectors affected by coastal and fluvial erosion were observed by photo-interpretation using geolocated photos obtained during the overflight of the coastline for coastal classification purposes.

3.12.3.2 Climate Projections

To understand the exposure of the proposed infrastructure to climate change and assess the associated risks, it is essential to establish potential climatic changes at the location and over the lifespan of the infrastructure. This CCRA is based on the regional climate projections obtained from downscaled multi-model ensembles constructed from several Coupled Model Intercomparison Project Phase 5 (CMIP5) global climate models (GCM) (Mailhot et Chaumont, 2017). The CMIP5 simulations build the bases of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate change (IPCC).

As future global emissions of greenhouse gases (GHG) and other pollutants are uncertain, four realizations with different greenhouse gas concentration trajectories have been conducted. These Representative Concentration Pathways (RCP) are named after their associated level of radiative forcing (i.e., the change in the atmosphere's energy balance) in 2100 relative to the pre-industrial levels in 1750. Hence, as an example, the RCP2.6 corresponds to 2.6 W/m^2 of radiative forcing and a surplus of energy of 2.6 W/m^2 in Earth's atmosphere. Projected GHG concentration levels (including carbon dioxide (CO_2) and methane (CH_4)) depend on the anticipated population growth, changes in economic activity and energy consumption, shifts in land use, and climate policies (IPCC, 2014). A high-level description of the RCPs can be found in Table 3-13.

While the global temperature increase is likely to exceed the limit of 2°C set in the Paris Climate Agreement (UNFCCC, 2015) for all RCP scenarios but the RCP2.6 scenario (IPCC, 2014), the corresponding levels of decarbonization necessary to achieve the RCP2.6 scenario are beyond most ambitious decarbonization plans. On the other hand, the RCP8.5 represents the high end of possible GHG emissions over the course of this century and is sometimes referred to as the business-as-usual scenario. Although countries have outlined various climate actions in their Intended Nationally Determined Contributions (INDCs), the GHG emissions keep increasing (UNFCCC, 2022; Hook and Campbell, 2020), and a good agreement between the RCP8.5 scenario and historical cumulative CO_2 emission has been found (Schwalm et al, 2020). To capture both a future with somewhat limited GHG emission due to some successful mitigation measures as well as a future without any significant reductions in GHG emission, both the RCP4.5 and RCP8.5 scenarios were chosen for his CCRA to allow for a conservative assessment of the risks due to climate change. The climate change projections used come from the Bioclimatic Portrait of Nunavik (Mailhot et Chaumont, 2017).

Table 3-13: Description of the different Representative Concentration Pathways (RCPs)

RCP	Description
RCP 2.6	**Stringent Mitigation Scenario**: representative of a scenario that aims to keep probable global warming below a 2°C increase above pre-industrial temperatures. Ambitious reduction in GHGs emissions, which peak around 2020, then decline and become significantly negative before 2100.
RCP 4.5	**Intermediate mitigation scenario:** compatible with relatively ambitious emission reductions and a slight increase in GHG emissions before starting to decline between 2040 and 2050. This scenario will likely fall short of the 2°C limit agreed upon in the Paris Agreement.
RCP 6.0	**Emissions scenario ranging from intermediate to high** with emissions peaking in 2080 and declining for the rest of the century.
RCP 8.5	**Very high GHG emissions**: corresponds to the absence of policy change to reduce emissions (current policies or maintaining the status quo).

Source: IPCC, 2014.

3.12.3.3 Areas of natural and built environments that could be affected by current and projected climate conditions

The entire ecosystem is dependent on fine-tuned balance of environmental factors. Precipitation and availability of water are an intrinsic part for the balance of terrestrial and wet flora and fauna. Plants and animals further depend on the seasonal cycle of temperature. Anthropogenic climate change and its fast pace threaten the balance and put at risk flora and fauna as they cannot adapt fast enough. For example, deep thawing of the soil may cause peat to dry out and thereby transform wetlands into terrestrial environments (Woo *et al*., 2006).

Built-up areas and roads are vulnerable. It should be noted that the consulting engineering firm recruited for the design of the wind farm took climate change into account in its design. For example, the wind turbines will be erected on piles and are anchored in solid rock. This way, ground movements due to changes in the permafrost will not affect the wind turbines. Furthermore, to the northeast of the Expo pit, buildings will rest on piles, which will speed up construction and help avoid the spread of heat through the permafrost and the risk of differential settlement.

3.12.4 Components of the Project likely to be Affected by Hazards

3.12.4.1 Identification of components vulnerable to the effects of identified Hazards

Reports and scientific studies were consulted to determine the components potentially likely to present a reaction to an extreme weather event and climate change. Based on these documents, the following components are to be considered for the design as well as future operation and maintenance of the two wind turbines and should be considered when assessing climate change resilience (Table 3-14).

Table 3-14: List of project components and elements

Components	Elements
Wind Turbines	• Tower (steel painted with protective paint), including the transformer • Hub (steel) • Blades (heated, re-enforced plastic, protective paint) • Outside staircase (steel)
Wind Turbine Foundations	• Foundation (concrete and steel)
Electrical Cables	• Electric cables (underground) • Batteries • Geotextile membrane
Environment	• Roads (gravel)
Human Well-Being	• Construction workers • Maintenance workers

3.12.4.2 Project components whose impact on the environment may be amplified by the identified hazards

During the construction phase of the project, the gradual evolution of climate change is not a major concern. However, weather extremes and how they are intensified can cause problems during the installation of the wind turbines, leading to delays. For example, a severe storm with high wind speed and heavy rain could hold the erections of the tower or the installation of the blades.

Over the course of the operation of the wind turbines, both extreme weather events and more gradual climate change can pose a risk to the project. Examples for risks to project components are a heat wave that can lead to excess heat gain in the tower, increasing the temperature beyond the normal operating temperature of the transformer or the melting of permafrost that can destabilize the foundation of the outer staircase. Similar to the construction phase, during the decommission phase, weather extremes are of greatest concern.

Overall, the adequate consideration of the effects of climate change is important for the success of the project. The lack of precautions in the engineering design of the infrastructure in this permafrost region can have serious consequences, potentially leading to the failure and abandonment of the project. However, it is important to note that in the present project, the wind farm infrastructure is designed according to the best current standards to limit climate risks.

3.12.4.3 Identification of Climate Indicators

Climate conditions or events that can cause loss of productivity, damage to the infrastructure, harm to employees, etc., can be represented by climate indicators. Such indicators are defined by thresholds (e.g., a hot day can be defined as instances at which the maximum temperatures reach above 15°C). The probability associated with an indicator is obtained from the Climate Portrait for Nunavik (Mailhot and Chaumont, 2017), using the assumption of the Public Infrastructure Engineering Vulnerability Committee (PIEVC) High Level Screening Guide (HLSG) (PIEVC, 2021).

To determine the climate-related risks to the project, climate indicators and their probabilities were analyzed for both the climate reference period (1980-2004) and in the context of a changing climate. To this end, the averaged climate data for the Nunavik region for both the reference climate and the future climate have been extracted from the Climate Portrait. The climate projections for Nunavik indicate an increase in annual mean temperature of 3.3°C by 2040-2064 in the RCP4.5 scenario and 4.5°C by 2040-2064 in the RCP8.5 one. For the same period, the annual precipitation amount is predicted to increase significantly by about 120 mm and 140 mm for the RCP4.5 and RCP8.5 scenarios, respectively.

Based on the Climate Portrait for Nunavik, 37 climate indicators (21 related to temperature, 8 related to precipitation, and 8 related to solid forms of precipitation) were considered, in addition to two further climate indicators – freezing rain and high wind speed occurrences –, which are included based on a literature review. Recent scientific publications indicate an increase in freezing rain for Nunavik in a warming climate (Jeong et al. 2019; McCray et al., 2022). For a global mean temperature change of +2°C, which is to be expected for the mid-century, the zonal mean (60-70°N) of the annual freezing precipitation amount is projected increase by 50% (Jeong et al. 2019). From the perspective of annual number of hours of freezing rain, the effects of climate change are less pronounced. McCray et al. (2022) found no significant change in median annual hours of freezing rain for a 2°C warmer world.

While Inuit observations point toward more frequent and more severe fall storms (Ashford and Castleden, 2001), climate projections of (high) wind speeds are uncertain. The average surface wind speed is not projected to change significantly (Table 3-15). However, the projection of high wind speed events is less certain. According to one theory, the faster warming of the Arctic will divert of low-pressure systems and fall storms further towards the north, which will lead to an increase in heavy wind events. In a contradictory theory, the faster warming Arctic results in a reduced pole-equator temperature gradient, which will reduce the speed of the polar jet and will lead to overall weaker storms. The mechanisms and the complex interactions of the different aspects of climate changes are not yet fully understood (e.g., Doblas-Reyes et al. 2021). Hence, trends in high wind speeds (i.e., heavy winds) for Nunavik remains uncertain.

Table 3-15: Changes in surface wind speeds obtained from Climate data viewer (2022)

Scenario	Spring	Summer	Fall	Winter	Annual
RCP4.5	-1,8 %	-2,3 %	0,4 %	-0,5 %	+0,3 %
RCP8.5	-0,8 %	0,0 %	+0,7 %	0,8 %	+0,4 %

In total, 39 climate indicators were reviewed at a high-level to assess the risk to the project due to climate change. As a result of this initial review, 29 climate indicators were removed from the analysis as they did not change significantly with climate change, their impacts on the project were deemed low or nonexistent, or their impact/risk is similar to the impact/risk of another climate indicator and they are assessed together (Table 3-16). The remaining ten indicators were selected as:

- the climate indicators identified past extreme weather conditions (past extreme weather events were researched as they provide insights into the potential relevance of certain climate indicators for the future infrastructure);
- historical and future annual and seasonal variation of both temperature and precipitation provide insights on future trends;
- applicable climate indicators show significant increases in probability during the project's timeframe;
- the local reality mandates the inclusion of the climate indicator;
- potential interactions of a certain climate condition with a project component carry non-negligible risks.
- Table 3-17 presents the variation of each climate indicator between historical data and the period from 2040 to 2064 for the RCP4.5 and RCP8.5 scenario as well as the rate of change of each indicator.
- Climate projections from Mailhot and Chaumont (2017) indicate that there will be an increase in annual average temperatures of 57% for the RCP4.5 scenario and 78% for the RCP8.5 scenario. There will also be an increase in hot days of 43% for RCP4.5 and 71% for RCP8.5. Rising temperatures will influence the frost-free season, which will be longer and longer.
- Precipitation will increase by 19% for the RCP4.5 scenario and by 23% for the RCP8.5 scenario. There will also be an increase in the number of very intense precipitation days. Projected solid precipitation will not change significantly with climate change. Finally, due to the increase in temperatures, the duration of the projected snow cover would decrease by 9% for the RCP4.5 scenario and by 13% for the RCP8.5 scenario, indicating that the snow will remain on the ground for a shorter period of time during the year in the future.

3.12.4.4 Vulnerability to Climate Change

Climate vulnerability analyzes the exposure of an asset, community, ecosystem or region to a particular climate hazard or extreme weather event, their sensitivity to the hazard or extreme weather event, and their ability to adapt. Assets and operations that are sensitive and have low inherent adaptive capacity proceed to the next stage of risk analysis. As part of this study, vulnerability to climate change was first assessed to determine the exposure, sensitivity and adaptive capacity of each component (Figure 3-7) to the ten climate indicators listed above (see Table 3-17).

Table 3-16: Description of hazards and climate indicators according to Mailhot and Chaumont (2017)

Climatic hazards	Climate Indicators	Definition
Ambient temperature	Mean temperature (° C)	Annual average of daily average temperatures.
	Duration of frost-free season (days)	Number of days between the first and last day of the frost-free season, where the first (last) days are defined as the first day when the moving average of daily minimum temperatures over the 10-day period centered on this day is greater (smaller) than or equal to 0°C.
	Freeze-Thaw (days)	Annual number of days on which, for the same day, the daily minimum temperature is below 0°C and the daily maximum temperature above 0°C.
	Hot days (days)	Annual number of days with a maximum daily temperature above 15 ° C.
Precipitation	Total annual precipitation (mm)	Annual total precipitation.
	Days with extreme precipitation (days)	Annual number of days with precipitation more intense than the 95th percentile of the wet day precipitation distribution (more than 1 mm) over the reference period.
Solid precipitation	Freezing rain (mm)	Occurrence of freezing rain
	Annual solid precipitation (mm)	Annual total precipitation in solid form.
Wind	Duration of continuous snow cover (days)	Number of days in a year between the beginning and the end of the snow cover (first day when the thickness of the snow accumulated on the ground is below a given threshold after March 1) where the thickness of the accumulated snow on the ground is greater than or equal to 2 cm.

Table 3-17: Variation and rate of Change for the ten climate indicators and future projections

	Climate Indicators	Historic	Futur eRCP4.5	Future RCP8.5	Future RCP4.5	Future RCP8.5
		1980 - 2004	2040 - 2064			
		Absolute values	Rate of change		Rate of change	
Temperature	Mean temperature	-5.8°C	+3.3	+4.5	+56.9%	+77.6%
	Duration of frost-free season	111 days	+22	+32	+19.8%	+28.8%
	Freeze-thaw cycle	63 days	-2	-5	-3.2%	-7.9%
	Hot days	42 days	+18	+30	+42.9%	+71.4%
Peécipitation	Total precipitation	616.0 mm	+120	+140	+19.5%	+22.7%
	Days with extreme precipitation	5.5 days	+2.3	+3.4	+41.8%	+61.8%
	Freezing rain*	-	increasing	increasing	increasing	increasing
Solid precipitations	Solid precipitation	350.0 mm	+1	-5	0.3%	-1.4%
	Duration of continuous snow cover	244 days	+1	-5	-8.6%	-12.7%
Wind	Heavy wind*	-	uncertain	uncertain	uncertain	uncertain

* no localized observations and calculations were available.

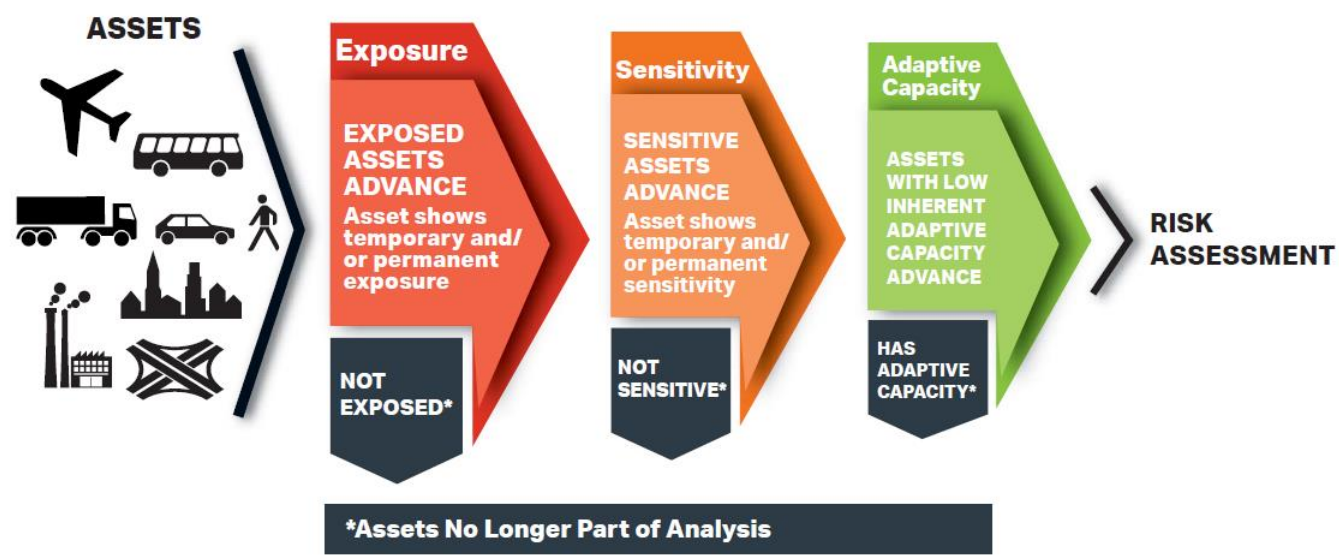


Figure 3-7: Schematic of the climate vulnerability assessment approach

3.12.4.5 Description of the potential consequences of the interactions for the environment

Table 3-23 and section 2.5 describe the consequences on the environment concerning the interactions between the identified climatic hazards and the project components.

3.12.4.6 Identification of Risks that may affect the project

The identification of the risks likely to have impacts on the project is detailed in Table 3-23, as well as in section 2.5.

3.12.5 Identification of the consequences for the project or its environment

A risk is defined as the product of the probability of an event occurring or likelihood and its consequence or severity on an asset (e.g., wind turbines) should the event occur. A risk assessment was carried out to estimate the impacts of the eight climate indicators on each of the project components listed above (see Table 2-2), using an impact ranking matrix. The latter classifies the severity consequence levels from very low to very high.

3.12.5.1 Estimation of the Probability of an Occurring Event or Likelihood

In order to determine the climate-related risks for the project, the relevant climate indicators were examined for the reference period/baseline conditions (1980-2004) and in the context of climate change for the period 2040-2064. The probability of occurrence rating used is described in Table 3-18.

Table 3-18: Description of the Probability of Occurrence rating according *to the High Level Screening Guide* from the Committee for the Committee on Public Infrastructure Engineering Vulnerability (PIEVC, 2021)

Probability of Occurrence Rating	Tendency	Likelihood/Occurrence	Definition
1	⬆	Likely to occur less frequently than current climate	50-100% reduction in frequency or intensity with reference to baseline mean
2			10-50% reduction in frequency or intensity with reference to baseline mean
3	Current climate reference by parameter	Likely to occur as frequently as in current climate	Baseline average conditions or +/- 10% change in frequency or intensity with reference to baseline mean
4	⬇	Likely to occur more frequently than in current climate	10-50% increase in frequency or intensity with reference to baseline mean
5			50-100% increase in frequency or intensity with reference to baseline mean

First, using variation, the rate of change for each climate indicator was calculated for the RCP4.5 and RCP8.5 scenarios as described in Table 3-17. Subsequently, the rate of change was used to determine a probability of occurrence rating varying between 1 and 5 using Table 3-18. These ratings are based on a scale ranging from 1 to 5, where 3 represents baseline climatic conditions and a stable frequency of occurrence relative to baseline conditions. For example, the average temperature shows a 57% increase for RCP4.5 (Table 3-17). Using Table 3-18, a probability rating of 5 can be assigned to this climate indicator, as the increase is between 50% and 100%. This logic applies to all climate indicators, to one future time horizon (2040-2064), and to the two RCPs (4.5 and 8.5).

Table 3-19 presents the probability of occurrence ratings that can be assigned for each climate indicator considered for the baseline conditions and the RCP4.5 and RCP8.5 climate scenarios for the 2040–2064-time horizon.

Table 3-19: Likelihood rating for climate indicators

Climatic hazards	Climate indicators	Probability of occurrence		
		Current basic conditions	RCP4.5	RCP8.5
Ambient temperature	Mean temperature	3	5	5
	Duration of frost-free season	3	4	4
	Freeze-thaw cycle	3	3	3
	Hot days	3	4	5
Precipitation	Total precipitation	3	4	4
	Days with extreme precipitation	3	4	5
	Freezing rain*	-	4	4
Solid precipitation	Solid precipitation	3	3	3
	Duration of continuous snow cover	3	3	2
Wind	Heavy wind*	3	3	3

* Based on literature review, no localized observations and calculations were available.

3.12.5.1.1 Consequence Severity Estimates

To estimate the level of consequences, four impact categories were identified based on the most relevant aspects regarding the risk management for the project. These four impact categories are defined as

1. **Impact on health and safety**, including occupational illness and injury to staff or the public because of incidents for which the owner may be liable,
2. **Infrastructure integrity**, including damages or deterioration of essential components and materials,
3. **Operational impact**, including operational delays, process slowdowns, or interruption of services,
4. **Financial impact**, including losses due to additional cost/expense directly attributed to the event, damages to asset to be repaired immediately to maintain operations, or failure to maintain operations.

The severity rating (1- very low to 5 - very high) and impact categories which were used to guide the risk analysis are detailed in Table 3-20.

Table 3-20: Impact Severity Index and Impact Categories

		Impact category			
Impact Severity Index	***Consequences***	**Health and security**	**Infrastructure health**	**Operational impact**	**Costs**
1	**Very low**	First aid in case of injury	Very low damage; immediately repairable maintenance cost	Operation halted for less than 6 hours (loss of service)	Minor increase in costs (< $5 000)
2	**Low**	Medical treatment for a minor injury	Slight increase in infrastructure construction efforts, low investments required preventively	Operation halted for 6 to 24 hours (loss of service)	Investments required to adapt/repair the wind turbines (between $5 000 and $15 000)
3	**Moderate**	Bodily injury / Illness with work restrictions	Moderate damage to the materials making up the structure; slow deterioration of the materials of certain essential components; investments required to maintain infrastructure stability	Operation halted for 24 hours to 1 week (loss of service)	Minor investments required for corrective work and possible work stoppage (between $15 000 and $100 000)
4	**High**	Permanent disabling injury or accident affecting several people	Causes additional costs and high logistical difficulties leading to difficulties in finding suitable sites for construction	Operation halted for between 1 week and 1 month (loss of service), interruptions of operations at the mine	Major investments required for corrective work and possible work stoppage (between $100 000 and $500 000)
5	**Very high**	Death or significant irreversible disability	Significant increase in construction and maintenance costs; risks to infrastructure stability	Operation halted for more than 1 month (loss of service), interruptions of operations and significant increase of costs at the mine	Significant additional coast leading to the abandonment of the project (>$3 000 000 – cost of a wind turbine)

3.12.6 Assessment of risks and impacts for the project or its environment

3.12.6.1 Risk Assessment

A risk (R) is defined as the product of the likelihood of occurrence (L) and the severity of the consequences (G). The table below presents the scoring of the risk assessment matrix for the different likelihood and severity (or gravity) of consequence ratings.

Table 3-21: Risk matrix

			Severity of consequences				
			Very weak	**Weak**	**Moderate**	**High**	**Very high**
		Ratomg	**1**	**2**	**3**	**4**	**5**
Likelihood	Very high	5	5	10	15	20	25
	High	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Weak	2	2	4	6	8	10
	Very weak	1	1	2	3	4	5

Thus, the risk matrix (L x G) was divided into four main categories according to the treatment associated with these risks (table 3-22).

Table 3-22: Description of risk treatment

Risk (R) = Likelihood (L) x Severity or Gravity of Consequences (G)	Risk treatment
Low risk: ≤ 9	Risk controls probably not required.
Moderate risk: 10 ≤ R ≤ 16	Some controls will need to be put in place to reduce the risks to lower levels.
High risk: R ≥ 17	Mandatory control or risk management measures to be put in place.
Risk = 5	Special cases: interactions giving rise to a risk rated " 5 " are considered special cases and are considered in the risk evaluation, as these can either be interactions with very low likelihood but very high severity or interactions with high likelihood and very low severity. While the former case may have very severe impacts, the latter case can trigger a slow deterioration of project components due to the high likelihood of the climate condition.

3.12.6.2 List of Possible Interactions Between Hazards and Project Components

Using the equation above, the risk level for all 50 interactions between the ten climate indicators and the five project components have been calculated. Twenty interactions were assessed to not be impacted by the selected climate indicators and hence were excluded from the risk analysis. The remaining 30 interactions show a low or moderate risk (including special cases; figure 3-8).

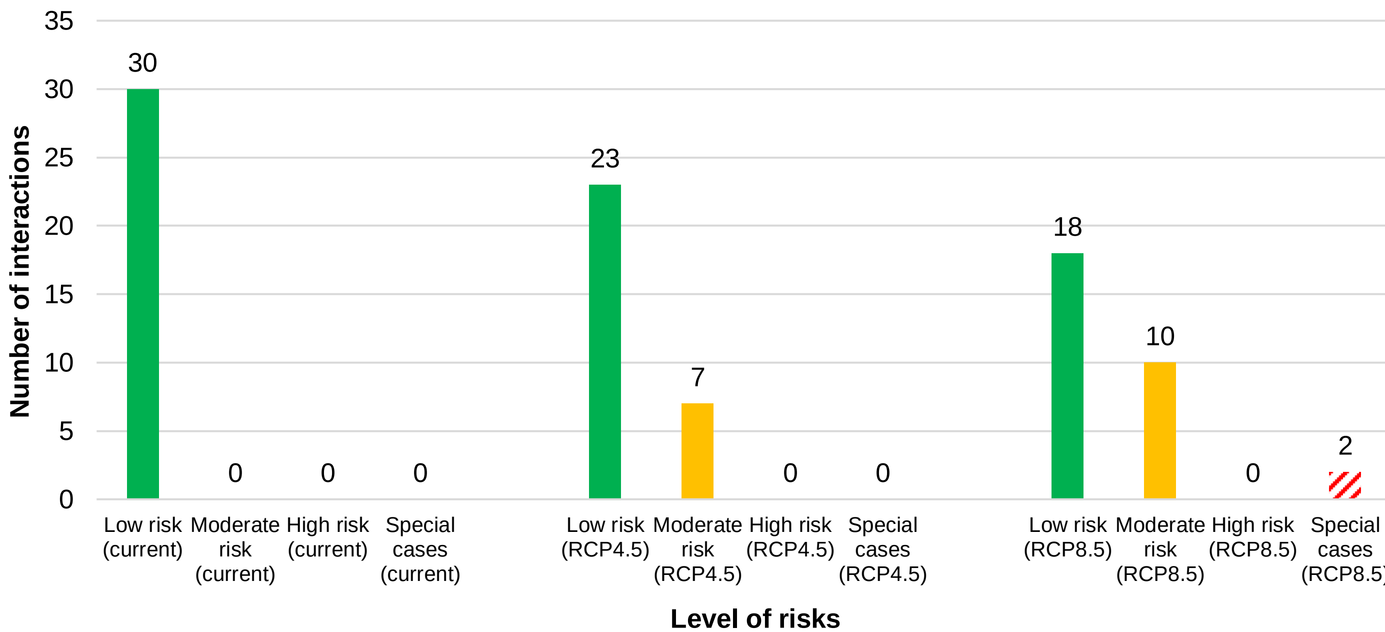


Figure 3-8: Level or risks of current and projected interactions between weather events and project components/elements

For the climate reference period (1980-2004),

- all interactions result in a low risk.

For the 2040-2064 timeframe, the assessment indicated using the RCP4.5

- 23 interactions with a low risk and
- 7 interactions with a moderate risk.

For the same period, the risk assessment using the RCP8.5 shows that

- 18 interactions with a low risk,
- 10 interactions with a moderate risk, and
- 2 special cases.

A break-down of the risk scoring for the individual interactions of weather/climate events and project components is provided in Appendix G. The risk assessment for both the climate reference period (1980-2004) and the 2040-2064 timeframe with the both the RCP4.5 and RCP8.5 climate projections show in most cases comparable risk for both projections and an increased risk due to the temperature increase (both mean temperature and hot days) and days with extreme precipitation.

Of the 30 interactions with at least a low-risk assessment, only moderate-risk and special cases[16] were considered for the subsequent part of the analysis. No high-risk interaction was found during the assessment.

Table 3-23 presents the summary of the risk analysis by climate indicators (hazards) and by project component for each RCP (4.5 and 8.5) of the future period, keeping in mind that the current period is based on the historical climate data from 1980 to 2004 and that the future period is defined from 2040 to 2064.

3.12.6.3 Presence of Potential Impacts

The potential impacts of climatic hazards on each project component have been described when present in the following table. The consequence levels were established using relevant literature (Ward, 2013; CSA Group, 2019; Allard et al. 2012).

3.12.7 Climate Change Adaptation Measures

3.12.7.1 Identification of Risk Treatment and Adaptation Measures

Adaptation measures already implemented by CRI have been identified for most of the 12 interactions that result in a moderate risk for RCP 8.5 (worst-case scenario) between the 10 climate indicators and the 5 project components. According to the literature and the guide CSA PLUS 4011:19, adaptation measures have been identified based on the following three types of measures:

- Design: measures to be integrated into the design of assets so that they are resilient to future climate risks.
- Operation and maintenance (O&M): measures to be incorporated so that the facilities achieve resilience in its operations and maintenance.
- Policy: measures to ensure and maintain safe and healthy working conditions.

[16] Interactions resulting in a risk rated 5 are considered special cases and are assessed in the risk evaluation, as these can either be interactions with very low likelihood but very high severity or interactions with very high likelihood and very low severity. While the former case may have very severe impacts, the latter case can trigger a slow deterioration of project components due to the high likelihood of the climate condition.

Table 3-23: Summary of risk analysis by climate indicators and by project component for two RCPs scenarios for the future period, as well as the potential impacts

Project component	Climatic hazards	Climate indicators	RCP4.5			RCP8.5			Potential impacts
			Probability of occurrence	Severity of consequences	RISK	Probability of occurrence	Severity of consequences	RISK	
Tower	Temperature	Mean Temperature	5	3	15	5	3	15	An increase in mean and maximum temperature (as well as the number of hot days) will increase indoor temperature (tower) and reduce the loading rate (maximum power rate) of transformers and other (electrical) equipment. When the normal operating temperatures are exceeded, the life span of the transformer is reduced.
		Hot Days	4	3	12	5	3	15	Warmer temperature can lead to a thawing of the permafrost and consequently thaw settlement and, hence, affect the outside staircase.
	Precipitation	Days with Extreme Precipitation	4	2	8	5	2	10	Extreme precipitation may result in premature deterioration of exterior wind turbine elements (e.g., tower, hub, blades) due to water infiltration, resulting in increased inspections and maintenance costs.
Foundation	Precipitation	Days with Extreme Precipitation	4	2	8	5	2	10	The increase in precipitation and the increase in days with intense precipitation can lead to water flows along the icy permafrost, leading to thermal erosion (subsidence of the ground). If it happens in close vicinity to the foundations, they can be weakened.
Electrical Cables	Temperature	Mean Temperature	5	3	15	5	3	15	The cables buried close to the surface might be affected by the increase in air and, therefore, soil temperature, leading to a reduction in network capacity (increased resistivity) and decrease in life expectancy cables. Even the underground cables might be indirectly affected by an increase in soil temperature (as a consequence of higher ambient temperatures).
		Hot Days	4	3	12	5	3	15	Warmer temperature can lead to a thawing of the permafrost and consequently thaw settlement and, hence, affect the foundation of the battery storage
Environment	Temperature	Mean Temperature	5	3	15	5	3	15	The increase in temperature (hot days and lengthening duration of frost-free season) will lead to a thawing of the permafrost and ground subsidence or settlement, leading to damages to the roads (e.g., potholes, larger sunk segments).
		Duration of frost-free season	4	3	12	4	3	12	
		Hot Days	4	3	12	5	3	15	
	Precipitation	Days with Extreme Precipitation	4	2	8	5	2	10	The increase in precipitation and the increase in days with intense precipitation could create an increase in the risk of water accumulation on the access roads, and the possibility of runoff. Affects infrastructure integrity.
Human Well-Being	Temperature	Hot Days	4	1	4	5	1	5	Hot days (high temperatures) can lead to increased indoor temperatures (tower) and to deteriorating working conditions for maintenance staff.
	Precipitation	Days with Extreme Precipitation	4	2	8	5	1	5	Extreme precipitation can leave the outside (including the staircase) slippery leading to unsafe working conditions for the maintenance workers in case of urgent repairs during extreme precipitation events.

Note:
All special cases in this analysis result in interactions were the product of very high probability crossed with very low severity. This is characterized by a likelihood score of 5 and a severity score of 1. The risk score is 5, which indicate low risk. However, these interactions may indicate a situation where the infrastructure could experience weathering resulting in higher maintenance demand, increased costs or reduced overall capacity. The response of this risk outcome should be reviewed in the context of a changing climate.

3.12.7.2 Recommendation of Adaptation Measures for each Project Component

It has been established that all interactions presenting a moderate risk must be mitigated by adaptation measures for a project to be considered resilient to climate change. To this end, below are some of the design measures already implemented by TUGLIQ Energy and recommended operation and maintenance measures, which contribute to the resilience of wind farm project:

Design measures:

- Design of the facilities by the firm TUGLIQ Energy, considering the impacts of climate change. Examples include the following actions:
  - Install cooling system to control the operating temperature and prevent the overheating of the transformer. Ensure that transformers with sufficiently high ambient temperature rating is selected.
  - Consider pre-thawing of permafrost to prevent ground settlement and damages to staircase (very costly).
  - Select cables with appropriate temperature ratings and, if required, increase the depth at which cables are buried to reduce the temperature fluctuations.
  - Consider pre-thawing of permafrost to prevent ground settlement under battery storage.
  - Ensure sufficient drainage (sloped roads natural drainage) to prevent water accumulation on road.

Measures related to operations and maintenance (O&M):

- Conduct regular monitoring of the tower, foundation, battery (and its storage) and roads to ensure that deteriorations/damage are addressed in a timely manner.
- Reschedule maintenance work and delay repair work until after the heavy wind event and/or the extreme precipitation event.

Policy-related measures:

- Implement worker safety measures to protect the health and safety of staff from potential climate events.

3.12.8 Conclusion and recommendations

This study made it possible to draw a portrait of the potential impacts of climate change on the installation of two wind turbines with a battery energy storage system and for all of these components, for the entire operating life (25 years).

The study was carried out in accordance with the requirements concerning adaptation to climate change described in the guide for MELCC project initiators. Two greenhouse gas (GHG) emission scenarios were chosen (RCP 4.5 and 8.5) and climate change projections were also extracted from the CCSC.

The analysis of climate-related risks for the historical (1980 to 2004) and future (2040 to 2064) periods has made it possible to retain ten climate indicators (mean temperature, duration of frost-free season, freeze-thaw cycle, hot days, total precipitation, days with extreme precipitation, freezing rain, solid precipitation, duration of continuous snow cover and heavy wind) based on past extreme weather events, future trends and a probability of significant increase over the life of the project. The relevance of these meteorological events to the local reality was also taken into account.

The risk analysis was carried out on five distinct components of the wind farm project, namely the wind turbines, foundations, electrical cables, environment, and personnel working at the wind farm.

For each RCP, the final risk assessment revealed 50 possible interactions between the ten climate indicators and the five project components. For the period from 2040 to 2064, the 50 interactions resulted in the following levels of risk:

RCP 4.5:

- 23 interactions result in low risk;
- 7 interactions result in moderate risk;
- 0 interaction results in high risk;
- 0 special case

RCP 8.5:

- 18 interactions result in low risk;
- 10 interactions carry a moderate risk;
- 0 interaction results in high risk;
- 2 special cases.

Considering that the risk assessment did not identify any interactions resulting in a higher than moderate risk, and that the interactions resulting in a moderate risk are mitigated, for the most part, by measures already implemented by TUGLIQ Energy, the main recommendation of the evaluation of the resilience to climate change of the wind farm project consists of the development of a plan for adaptation to climate change. This plan will enhance the measures already implemented by TUGLIQ Energy and thus rigorously address all the moderate risks encountered in this study.

4 Local Consultation

In the context of this project, different forms of consultations were held with various local stakeholders, i.e. the Inuit villages of Kangiqsujuaq and Salluit, the neighbouring mining companies (Canadian Royalties Inc. and Glencore Canada), Kattiniq-Donaldson Airport, and Pingualuit National Park. This section presents the summary of these various consultation activities. The interview grids used during consultations are presented in Appendix H.

4.1 Inuit villages of Kangiqsujuaq and Salluit

The Inuit villages of Kangiqsujuaq and Salluit are the closest to the site planned for installation of the wind turbines, located approximately 75 km to the east and a little under 140 km to the northwest. The land concerned by the project (the area proposed for the development of the two wind turbines, the access roads leading to them, and the neighbouring territory) is therefore located in the territory traditionally used by the populations of these two villages. Thus, from the outset, it appeared important for TUGLIQ Energy to inform the people of these communities about this project and gather their expectations and concerns regarding it.

The first contacts were made with representatives of the two villages and their landholding corporations in spring and summer 2022. This made it possible to present the project to them and discuss the consultation process to be deployed. It then was established that public consultations would be held in the two communities in September 2022. Their goal was to inform the population of the two villages about the different aspects of the project and present the highlights of the inventories conducted in summer 2022 in the context of this impact assessment. The public consultations also had the goal of gathering information from the populations of the two Inuit villages, particularly concerning the current use of the territory concerned by the project, and the additional knowledge relating to this territory. The public consultations were also meant to be discussion forums allowing the population and the local authorities to ask questions to TUGLIQ Energy and share their expectations, fears and apprehensions in relation to the wind turbine development project.

4.1.1 Village of Kangiqsujuaq

A visit was made to the village of Kangiqsujuaq on September 20 and 21, 2022 in order to hold public consultation sessions, but also to meet representatives of the northern village and the landholding corporation (Nunaturlik Landholding Corporation of Kangiqsujuaq). Three representatives of TUGLIQ and an AECOM anthropologist participated.

4.1.1.1 Public consultation sessions

A first public consultation session was held in the village's community in the evening of September 20. Although this meeting was organized in concert with the authorities of the northern village, nobody from the community attended (Photo 4-1). A radio message translated into Inuktitut was also shared with the managers of the local radio station.[17] According to certain village inhabitants encountered during the stay, the local population has been hesitant to attend community events since the start of the COVID-19 pandemic. This reluctance would be even greater when people from outside were present at these events. This possibly explains the absence of participants during the evening. Moreover, although the village authorities had collaborated in organizing the session upstream of the session, no elected officer attended this session. The little interest shown by the local authorities thus also may have played a role in the absence of participants for the evening.

[17] It was impossible to know how many times the message was aired, or even if it had been aired.

Photo 4-1: Public consultation session held in the Kangiqsujuaq community room on September 20, 2022

A second public consultation was held on air on the local radio station at noon on September 21 (Photo 4-2). During this consultation, a TUGLIQ representative presented the project, as well as the results of certain inventories conducted in summer 2022. The village population then was invited to phone the radio show to ask questions or express comments, expectations or apprehensions concerning the project. Throughout the session, a person from the community acted as translator, thus allowing the TUGLIQ presenter and the community members to express themselves in English or Inuktitut. The local radio station only had one hour of air time to devote to the public consultation session. All this time was used to present the project and answer as many questions as possible from Kangiqsujuaq inhabitants.

During the session, eight people from the community expressed their views on different subjects. Some questions were asked particularly concerning the impact of the presence of the proposed wind turbines on wildlife. More specifically, people wanted to know if the presence of wind turbines could alter the caribou migration routes or result in mortality in bird populations visiting the sectors concerned. Since the TUGLIQ presentation mentioned that wind turbines similar to those proposed are currently operated at the Raglan Mine, some participants particularly wanted to know the impacts of this infrastructure on wildlife to date. Moreover, one person asked TUGLIQ to speak about the benefits that could be obtained by the community in the event of construction and operation of the proposed wind turbines. This same person also wanted to know how long the wind turbines would be present in the territory if they were constructed.

Photo 4-2: Public consultation session held on air on Kangiqsujuaq community radio on September 21, 2022

During the session, Ms. Mary Pilurtuut, Director of Pingualuit National Park, took the floor to ask what noise level would be produced during operation of the two proposed wind turbines. She said she was particularly concerned about the effect the noise produced might have on the animals present in the sector concerned. She also mentioned that the lights of the mining complexes operated by CRI and Glencore Canada are visible from the park in periods of darkness. She associates this situation with electric power generation at the different sites concerned and wanted to know if the use of wind turbines at the Expo site could reduce this “light pollution”.

Some people also expressed positive comments concerning the wind turbines. One of them pointed out that they would enable CRI to reduce its diesel consumption and thus limit its polluting emissions, which will be beneficial for the environment and the resources of the territory used by the people of Kangiqsujuaq. Another appreciates the presence of the wind turbines located at the Raglan Mine, because these two large structures serve as reference points when travelling by snowmobile in the territory. This person considers that the two proposed wind turbines will also allow people from the community to find their way more easily in the territory and suggests that TUGLIQ make them more visible by painting them in bright colours. One participant said he was also happy to see that TUGLIQ took time to inform the population of the community and listen to what they had to say about its project, before it was carried out.

4.1.1.2 Meeting with the village authorities and the members of the landholding corporation

During the day of September 20, representatives of TUGLIQ Energy and the AECOM anthropologist also met the Mayor of the northern village of Kangiqsujuaq (Ms. Qiallak Nappaaluk), two councillors (Messrs. Charlie Arngak and Daniel Nappaaluk), and the President and the General Manager of Nunaturlik Landholding Corporation of Kangiqsujuaq (Messrs. Lukasi Pilurtuut and Charlie Alaku). This meeting allowed a detailed presentation of the different aspects of the project and discussion of the results of the inventories conducted in the context of the impact assessment in summer 2022.

During the meeting, a councillor mentioned that the use of wind turbines will allow CRI to reduce the use of diesel. He considers this is a good thing, becomes it happens that he personally smells diesel odours when he goes into sectors located near the company's mining complexes, which he does not appreciate. He therefore believes that the use of wind turbines may possibly mitigate this situation. The same councillor wanted to know if other wind turbines could be installed at the Expo site or at CRI's other mining complexes in the next few years. He also indicated that the caribou seem to accommodate well to the presence of the two wind turbines already operated by TUGLIQ at the Raglan Mine. He therefore believes that the same will apply with the two proposed wind turbines.

The councillor and the Mayor of the village pointed out that they have been invited on a few occasions to the Raglan Mine, which gave them the opportunity to see the two wind turbines operated by TUGLIQ. The councillor also mentioned that Glencore Canada, which operates the Raglan Mine, presents plenty of information to the community concerning the different environmental follow-ups done in the course of the mine's operations. This is how it knew that the caribou seemed to accommodate well to the presence of the two wind turbines already installed at this location.

The Mayor of the village indicated that the work area planned for this project is a sector where ptarmigan are often found. She was therefore surprised to see that the inventories conducted in summer 2022 did not mention this bird. She also indicated that she would like environmental follow-up studies to be conducted during construction and operation of the proposed wind turbines. She added that these studies should be conducted at different times of the year and not only during the summer period. The General Manager of the landholding corporation also argued that it is important to have a good understanding of the use of the territory concerned by the animal species. He points out that caribou, Canada geese and snow geese are found there at different times of the year. He therefore believes it is important to know when these species will be present near the wind turbines so as to avoid affecting them.

The President of the landholding corporation also pointed out that the wind turbines will enable CRI to limit greenhouse gas emissions, which is inherently a good thing. However, he added that there should not be too many wind turbines in the territory and that he wants to avoid their implementation at the different mine sites operated by CRI in the years ahead. In a similar vein, the General Manager of the corporation indicated that, in his opinion, the wind turbines produce noises and vibrations that can be perceived by animals. He therefore believes this could frighten them and drive them away from sectors where wind turbines are implemented. Thus, he also hopes that there will not be too many wind turbines in the territory, because he believes this could induce game to abandon several locations. Contrary to the Mayor and the councillors, the two representatives of the landholding corporation doubt that the caribou accommodate well to the presence of the two wind turbines already in operation at the Raglan Mine. The two men reiterated that the presence of wind turbines is not inherently a bad thing, but they do not want several wind turbines to be installed in the territory.

The General Manager of the landholding corporation also mentioned that TUGLIQ and the community of Kangiqsujuaq will have to work together so that the community benefits from the project. To this effect, he pointed out that TUGLIQ will earn income by operating infrastructure that will be found in the community's traditional territory. He therefore estimates that a portion of this revenue should come back to the community, which would allow it to pay for the deployment or maintenance of infrastructure or to fund various projects.

The President of the landholding corporation mentioned that he would like representatives of the northern village and the landholding corporation to be invited to visit the work area planned for this project, before, during and after construction of the wind turbines.

The President of the landholding corporation pointed out that it is often difficult for people from the community to understand the effects of mining development on their territory. He therefore believes that the results of the follow-up studies conducted under this project should be shared with the community.

4.1.1.3 Discussion with the President of the landholding corporation

The additional discussion was conducted by the AECOM anthropologist with Mr. Lukasi Pilurtuut in the afternoon of September 20, in order to document the current use by the people of Kangiqsujuaq of the territory concerned by this project. The information thus gathered is presented in section 5.4 of this report. The discussion also made it possible to question Mr. Pilurtuut regarding certain animal species present in the territory concerned to see if he had noticed changes in their distribution, the size of their population or their behaviour over the past few years. This information complemented the data gathered during the field inventories for the natural environment conducted by AECOM in summer and was integrated into section 5.3 of this report.

4.1.2 Village of Salluit

Following the public consultations held in Kangiqsujuaq, it was planned that a visit would be made to the village of Salluit on September 21 and 22, 2022, to hold a public consultation session and meet representatives of the northern village. Unfortunately, the poor weather conditions prevailing at that time prevented any air travel to the village of Salluit.

The representative of the northern village of Salluit who was acting as the point of contact with TUGLIQ then proposed to hold a conference call with representatives of the landholding corporation to present the project and the results of the inventories conducted to date in the context of the impact assessment. He also proposed to hold a public information session on the project, accompanied by the President of the landholding corporation, following the conference call. The two men thus could present the project to the village population and gather the questions, the comments, and the expectations and concerns expressed.

A videoconference meeting was finally held on October 14, 2022 between the TUGLIQ representatives, a representative of the northern village of Salluit (Willie Keatainak), and a representative of the Qaqqalik Landholding Corporation (Adamie Sariadjuk). An AECOM anthropologist also attended the meeting to document the questions, comments, expectations and concerns expressed by the two representatives of the Inuit community.

At the outset, the representative of the northern village of Salluit said he was happy that the meeting could finally be held. He would have liked it to be held in person, in the community, but he understood very well that the circumstances did not allow this.

The two Inuit representatives know that wind turbines similar to those proposed are already in operation at the Raglan Mine. They were informed of the stands conducted in relation to these two infrastructures (impact assessment and subsequent follow-up studies) and thus are aware of the type of impact that may result from such a project.

The representative of the northern village asked if this project would be conducted in collaboration with Tarquti Energy, a Makivik Corporation subsidiary operating in the renewable energy field. He also wanted to know if TUGLIQ was associated with other Inuit companies in the context of its different wind energy projects. He also asked if there are plans to employ local companies during the construction phase of the proposed wind turbines. To this effect, he explained that the community has developed a joint venture[18] in partnership with outside companies, pointing out that it is active in various fields that will be in demand during the construction phase. He therefore believes this joint venture could be employed by TUGLIQ to carry out certain contracts.

The two Inuit representatives wanted to know how long the construction phase of the current project will last and how long the two proposed wind turbines will be operated. Given that the project only concerns the construction of two wind turbines, and that it is possible two additional wind turbines may be constructed in a subsequent phase, the two Salluit representatives also wanted to know how long it could take to implement these other two infrastructures.

[18] The name of this joint venture was not mentioned in the discussion.

The representative of the landholding corporation wanted to know how many kilometres will be covered by the road that will be developed to access the wind turbines from the Expo mining complex. He also wanted to have information on the line that will allow the wind turbines to be connected to the electric power grid of the CRI mining complex. In particular, he wanted to know its projected length and whether it is planned to be underground. He explained that foxes often chew the lines that are too close to the ground, which damages them. He believes this type of situation must be taken into account under this project. He thus wanted to know if this problem had been anticipated and if measures had been taken to avoid it.

The representative of the northern village wanted a little more detail concerning the operation of the bird protection system that must be deployed on the proposed wind turbines. He points out that snow geese are probably present in the vicinity of the Expo site during their spring and fall migrations, because there are many around Deception Bay during these same periods. He pointed out that the presence of these birds must be taken into account under this project and said he is pleased to know that a system will allow the wind turbines to be stopped if the need arises. However, he adds that snow geese sometimes fly by night during their seasonal migrations. He therefore wanted to ensure that the shutdown system can be activated in a period of darkness if necessary. The same representative also pointed out that snow geese will only risk being struck by the wind turbine blades if they fly at low altitude. He considers that snow geese only fly at low altitude when they are taking off or landing, generally near large bodies of water or on plains. He noted that the work area does not contain any of these environments and that the limited study area has few of them (only two significant lakes are present in the eastern part). He therefore believes that most of the snow geese entering the sector concerned by this project fly at high altitude, as they are accustomed to do when they travel long distances.

Finally, the representative of the northern village asked TUGLIQ to send him paper documentation regarding the project (brochure, posters, etc.). He proposes to post it in certain public places in Salluit, so that the public can consult it. The representative of the landholding corporation indicates that he will speak about the TUGLIQ project on the local radio station. The two representatives mentioned that they then can contact the TUGLIQ representatives again to provide them with the questions, comments, expectations and concerns that will be expressed to them by people in the community.

4.1.3 Website

Parallel to the consultations held with the Kangiqsujuaq population and the representatives of the two Inuit villages concerned, a website presenting the project (https://www.tugliq-expowindproject.com) also went live to make the information accessible to as many people as possible. People consulting this site were also invited to contact TUGLIQ to ask questions, or to share their expectations and apprehensions related to the project. The go live announcement and the address of this website were shared with the people contacted in Kangiqsujuaq and Salluit starting the deployment on June 15, 2022. They were invited to consult the website and tell their respective communities about it. A reminder of the website's existence was also made during the public consultation session held on air on Kangiqsujuaq community radio in September 2022. In addition, a message translated into Inuktitut was broadcast on local radio during the previous week to invite community people to visit the website. The content of this website is presented in Appendix I.

The website was consulted 320 times between its go live in June 2022 and the end of September 2022.[19] The website visitors came from different places in Québec (Greater Montréal region, Capitale-Nationale region, Nunavik), other provinces (Ontario, British Columbia), and other countries (United States, China and France). From Nunavik, the website was consulted on 28 occasions, 4 times by people from Kangiqsujuaq, 10 times by people from Salluit and 14 times by people from Kuujjuaq. Consultation of the website by people from Nunavik increased in the week of September 20, 2022, when the public consultations and meetings with various local representatives were held in Kangiqsujuaq and were supposed to be held in Salluit. During these few days (September 20 to 23), the website was consulted 11 times from Kuujjuaq and 6 times from Salluit. No visitor to the website asked questions, made comments or expressed expectations or apprehensions in relation to this project.

[19] The website is still online. The consultation statistics presented here are those that prevailed at the time of production of this report at the beginning of October 2022.

4.2 Glencore Canada and Canadian Royalties Inc.

Glencore Canada and Canadian Royalties Inc. (CRI) both operate mining complexes near the area planned for development of the two proposed wind turbines.[20] These two mining companies are the main users of the access roads connecting the Deception Bay port facilities and Kattiniq-Donaldson Airport to the site planned for development of the wind turbines. It was therefore important to consult them.

Telephone conversations were held with representatives of the two mining companies in summer 2022. Thus, the Supervisor, Security and Emergency Reponses at Canadian Royalties Inc. and the Superintendant, Surface Services at the Raglan Mine (Glencore Canada) were contacted, which allowed them to describe the current and proposed use of the access roads concerned by the two companies, describe the wildlife resource harvesting activities practised by the employees of the two companies and obtain some information concerning land use by the Inuit users from Salluit and Kangiqsujuaq. This information is presented in section 5.4 regarding the description of the human environment.

The conversations also allowed the expectations and concerns of the two representatives to be obtained concerning the deployment and operation of the two proposed wind turbines. The Canadian Royalties Supervisor, Security and Emergency Response (Expo site) and the Glencore Canada Superintendant, Surface Services (Raglan Mine) both consider that the slight increase in heavy traffic on the access road leading to the Expo site for the purpose of transporting the materials and machinery necessary for installation to the two proposed wind turbines will not result in any notable impact on the current use of these roads. They indicate that the few additional trips made during the construction phase will possibly require a temporary reorganization of the traffic habits on the roads concerned. However, they add that the communication structure in place between the two companies is very good, which will greatly facilitate the planning, coordination and execution of the necessary road trips. In addition, they indicate that the access roads are in good condition and have several widenings that will allow vehicles to park outside the lane to allow oversized flatbeds to pass.

4.3 Kattiniq-Donaldson Airport

Kattiniq-Donaldson Airport is located about 10 km north of the site planned for development of the two proposed wind turbines. A discussion was therefore held in August 2022 with a Glencore Canada employee working at the airport (an air traffic controller, in charge of aircraft communications and logistics), so that it would be possible to gather information on the current and projected use of the airport (see section 5.4 of this report) and obtain eventual expectations and concerns in relation to the project.

The employee interviewed pointed out that the site planned for development of the two proposed wind turbines is located less than 24 km southwest of the airport runway, which normally requires specific assessments by Transport Canada and NAV Canada. He therefore asked to consult the documents issued by the two organizations concerning this project. They were sent to him on August 16, 2022. After receiving these documents, the airport authorities did not issue additional comments.

4.4 Pingualuit National Park

The northern limit of Pingualuit National Park is less than 15 km south of the area planned for development of the two proposed wind turbines. Contact was established by email in July 2022 with a representative of Nunavik Parks, the park's management body, and a short discussion then was held with him by videoconference. It was then agreed that the representative would consult various members of his team to provide us with a written document presenting the park's current and proposed activities, in particular. This information is presented in section 5.4 on the description of the human environment.

[20] The Expo, Méquillon, Mesamax, Allamaq and Puimajuq mineral deposits in the case of CRI, and the Raglan Mine in the case of Glencore Canada.

The document submitted by the Nunavik Parks representative also presented that body's expectations concerning the deployment and operation of the proposed wind turbines. In particular, there is the question of the visual impact caused by the addition of the two wind turbines in the park's neighbouring landscape. The Nunavik Parks authorities particularly fear that the two structures will not be perceptible from the park's sites of tourist and traditional use, and that they therefore will contrast with the natural landscape characterizing these locations. To this effect, the document mentions the perimeter of the Lac Pingualuk Crater, the park's main attraction, which is located about thirty kilometres southwest of the proposed work area. The document also refers to the Puvirnituq River Canyon, particularly the Sangummaaluk and Paarutivik camps (Map 5-4), which respectively are located about 30 and 45 km southwest of the work area, as well as the park's reception building and main camps, located on the south shore of Lac Manarsulik, about 30 km southwest of the work area. The document also indicates that Nunavik Parks is currently working to obtain recognition of the territory of Pingualuit National Park as a Dark-Sky Preserve.[21] Nunavik Parks thus is concerned about the sources of "light pollution" that may affect visibility and thus hinder certification. The document submitted mentions that the mine infrastructure currently in operation north of the park already generates "light pollution". The Nunavik Parks authorities fear that the addition of new infrastructure at the Expo site, such as the two proposed wind turbines, may increase this "light pollution" and thus contribute to the deterioration of a situation that is not already ideal.

Another concern expressed by Nunavik Parks concerns the impact the operation of the proposed wind turbines will have on wildlife, particularly regarding habitat modification, disturbance and possible mortality increases for the various species concerned. The document submitted identifies mammals as species that potentially may be affected, but also and especially birds of prey. The document further suggests that the Proponent determine the main wildlife mobility corridors in the sectors affected, particularly concerning birds of prey. It also proposes follow-ups concerning the wildlife species that potentially could be affected, before, during and after the work, to assess the disturbance caused and identify eventual mortality increases. Mitigation measures to be deployed in the operating phase are also proposed:

- the determination of a minimum wind turbine startup speed (e.g. startup limit set at about 5.0 – 6.5 m/s);
- the shutdown of operations during fledging periods and the migration period;
- frightening birds with noise signals at the approaches to the proposed wind turbines.

The Nunavik Parks authorities also suggest consulting the *Guide d'intégration des éoliennes au territoire*, published by the Gouvernement du Québec, to identify good practices to be deployed during construction and operation of the proposed wind turbines.

The Nunavik Parks authorities would like the data gathered during the various inventories conducted in the context of this assessment to be shared with them (whether concerning the natural, physical and human environment).

[21] Dark-Sky Preserves are protected areas where a special commitment is made to protect and preserve the night sky and reduce or eliminate all forms of light pollution. In Canada, the Royal Astronomical Society of Canada determines what protected areas can be Dark-Sky Preserves

5 Description of the Receiving Environment

5.1 Study Areas

The description of the receiving environment and the assessment of the project's impacts are based on four distinct study areas (Map 1-1). These study areas were delineated to encompass all the components of the environment that could be affected during the different stages of the project.

5.1.1 Work Area

The work area is formed by an irregular polygon with an area of about 4 km^2 located east of the mining and industrial facilities of the Expo site. All the infrastructure that will be deployed specifically to carry out the wind farm project is located within the work area. The project's direct footprint on the receiving environment, associated with the presence of the works, will thus be limited to this work area.

5.1.2 Limited Study Area

The limited study area encompasses the territory that could suffer the project's direct impacts, which could extend beyond the work area, such as the impacts associated with noise. This 100 km^2 (10 X 10 km) area is centred on the site projected for the implementation of two wind turbines and allows documentation of most of the components of the physical and biological environment.

The mining facilities of the Expo site belonging to Canadian Royalties Inc. (CRI) are included in the limited study area, as well as Lac du Bombardier located in the northeast portion of this area. This lake serves as a water reserve for the mine's operations.

5.1.3 Local Study Area

The local study area covers 2,500 km^2 (50 X 50 km). This area allows documentation of the components of the biological environment with a greater home range or whose movements largely extend beyond the limited study area, as in the case of avian fauna. This study area also allows documentation of the components of the human environment necessitating a more extensive spatial scale, such as Inuit land use or study of the landscape.

The northern portion of the local study area encompasses Kattiniq-Donaldson Airport, the Raglan mining facilities (Glencore Canada), and the two wind turbines installed on the Raglan Mine site and operated by TUGLIQ Energy for the past few years. The southern portion of the local study area overlaps part of Pingaluit National Park, while excluding the Lac Pingaluk crater, this park's main tourist attraction. This study area also includes several other CRI mineral deposits, currently operated (Méquillon, Mésamax, Allamaq, Puimajuq deposits) or projected (Nanaujaq deposit).

The local study area corresponds to the region better known locally as "Kattiniq".

5.1.4 Extended Study Area

The extended study area is used to describe the administrative entities and the socioeconomic characteristics of the human environment, as well as the migratory movements of caribou, a sensitive species occupying a very large home range. This area encompasses the Inuit communities most likely to use the study area, namely those of the village of Salluit, in the northwest, and the village of Kangiqsujuaq, in the east. The extended study area also encompasses Deception Bay, the location of the port facilities through which the equipment and materials required to carry out this project pass. All the access roads that will be used to transport this equipment and these materials to the work area are also located in the extended study area.

5.2 Physical Environment

The information presented in this section mainly comes from studies produced by Genivar (2007), WSP (2015), and AECOM and CRI (2022). Several passages of these studies are therefore recapitulated in full, followed by the source.

5.2.1 Climate

The components of the climate that are addressed in this section concern the air temperature, the precipitation regime, winds, solar radiation and the associated visibility in fog.

Overall, the climate associated with the region in which the extended study area is inserted is Arctic. Indeed, the most northern portion of Nunavik is characterized by polar mean annual temperatures (-9.4 to -6.0°C), a semi-arid precipitation regime (250 to 469 mm per year) and a very short growing season (90 to 119 days per year) (Charron, 2015).

5.2.1.1 Temperature

The growth season for the vegetation in the extended study area is contained between the end of June and the beginning of September. The temperature remains at or above 0°C for only 20 days during this period, which defines the *frost-free* period (FAPAQ, 2000 in Genivar 2007). According to Mailhot and Chaumont (2017), the Nunavik region encompassing the extended study area could change from polar to subpolar temperatures by 2040, according to the climate change predictions on the average scenario. However, these temperatures are unlikely to lengthen the growing season, which would remain essentially the same as today.

The data from different weather stations was consulted to obtain an overall but representative picture of the extended study area (and incidentally, the limited study area). The results are described below.

Figure 5-1 presents the mean, minimum and maximum monthly temperatures measured at the Orion weather station (located on the site of the Expo mining camp, at the coordinates 583,763 m E, 6,825,870 m N (UTM, NAD83, zone 18)) between January 1, 2017 and December 31, 2021. According to the data collected at the Orion station, the mean temperature recorded during that period is -8.7ºC and the mean depth of precipitation accumulated in the course of one year is 240.5 mm. The minimum and maximum air temperatures recorded during this period were -42.9°C and 23.0°C, respectively.

Table 5-1 presents the climate normals available regarding the temperature for the period from 1981 to 2010, associated with the nearest *Environment and Climate Change Canada* weather station, the one in Iqaluit (63°45’N; 68°33’W) (located on Baffin Island, across Hudson Strait). According to the Iqaluit results, in general, February is the coldest month (-27.5°C) and July is the warmest month (8.2°C).

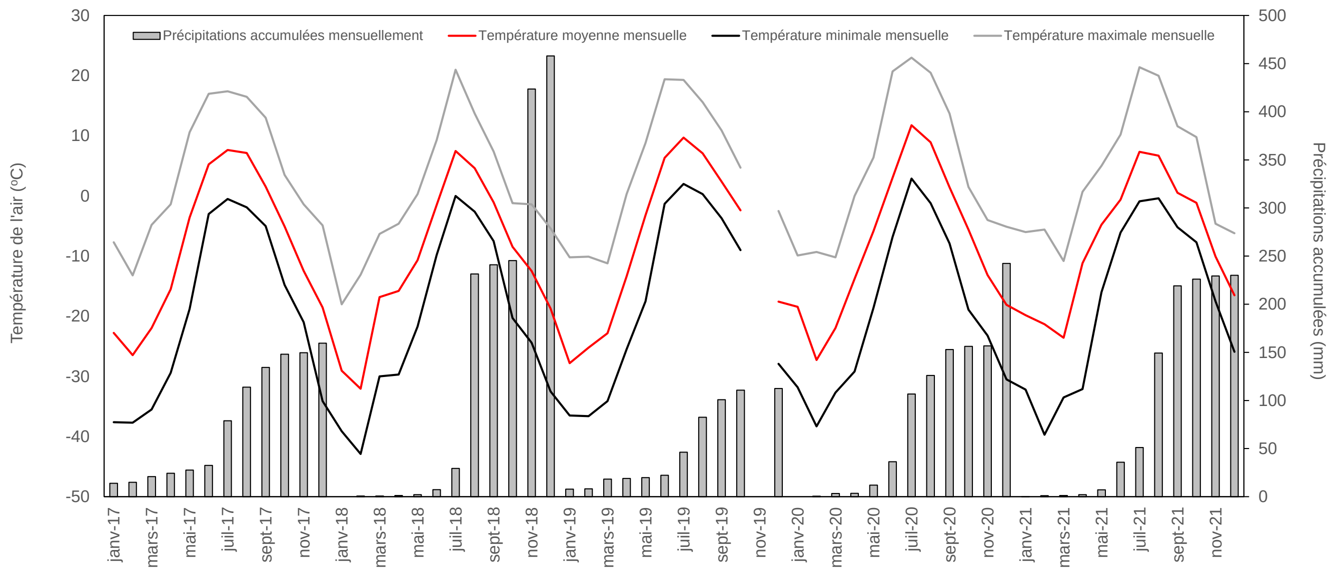


Figure 5-1: Monitoring of air temperature and accumulated annual precipitation at the weather station of the Expo site (Orion weather station)

Table 5-1: Temperature normals of the Iqaluit weather station – 1981 to 2010

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	year
Mean daily (°C)	-26,9	-27,5	-23,2	-14,2	-4,4	3,6	8,2	7,1	2,6	-3,7	-12	-21,3	-9,3
Standard deviation	4,3	4,4	3,8	2,8	2,2	1,2	1	0,9	1,1	2,5	3,1	4,8	3,7
Maximum daily (°C)	-22,8	-23,3	-18,3	-9,4	-1,2	6,8	12,3	10,5	5,2	-1	-8,3	-17	-5,6
Minimum daily (°C)	-30,9	-31,7	-28,1	-18,9	-7,6	0,5	4,1	3,6	-0,1	-6,4	-15,8	-25,5	-13,1

Source: Government of Canada (2022a).

Between 2000 and 2005, mean monthly and annual temperatures were calculated at the Raglan South mine site based on the minimum, maximum and mean daily values measured in Katinniq. This analysis revealed substantial variations over the year, with January identified as the coldest month and July as the warmest month. The mean temperature is above zero for the period from July to September only, which is a good reflection of the harsh climate (Genivar, 2007). These results essentially agree with the climate data indicated in Table 5-1.

A wind study was conducted by Hatch (2015) on the scale of the limited study area, from June 23, 2014 to June 22, 2015. Temperature data was collected on the anemometer mast, installed less than 1 km south of the Expo site, and indicated mean monthly temperatures ranging from -33.6°C in February to 8.1°C in August, with a mean annual temperature of -12.1°C for the analysis period (Hatch, 2015).

5.2.1.2 Precipitation

The cold temperatures characteristic of Nunavik contribute to the maintenance of a low moisture content in the air, which does not favour the formation of precipitation. Indeed, rain is infrequent compared to southern Québec, where it is generally two to three times greater. Precipitation is observed mainly in summer, when the insolation period is longer (Genivar, 2007).

In Katinniq (local study area), the recorded annual rainfall ranges between 197 and 287 mm, with a mean of 241 mm (Genivar, 2007). Since the period when precipitation tends to form is short, this assessment is not necessarily representative from year to year.

Table 5-2 reports the data of the climate normals available regarding precipitation for the period from 1981 to 2010, associated with the nearest *Environment and Climate Change Canada* weather station, the one in Iqaluit (across Hudson Strait). According to this data, rain tends to fall more between June and September (> 20 mm/month). The snow cover is generally predominant between November and May (> 10 cm) and snowfalls may occur year round, except in July.

Table 5-2: Precipitation normals of the *Environment and Climate Change Canada* weather station in Iqaluit – 1981 to 2010

	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	year
Rainfall (mm)	0	0	0	0,2	3,1	23,8	51,9	68,6	42,2	6,8	0,6	0	197,2
Snowfall (cm)	21,7	21	21,6	31,5	27,6	9,3	0	0,9	13,2	29,4	29,7	23,4	229,3
Precipitation (mm)	19,7	18,7	18,7	27,5	29,2	33	51,9	69,5	55,2	33,3	27,2	19,9	403,7
Mean snow cover (cm)	22	25	26	31	22	3	0	0	0	5	15	19	14
Median snow cover (cm)	21	25	26	30	20	1	0	0	0	5	14	18	13
Snow cover, Month end (cm)	24	28	30	29	12	0	0	0	1	9	20	21	14

Source: Government of Canada (2022a).

The rainfall level seems to be slightly higher on the Raglan plateau than in Iqaluit. However, the monthly trends are comparable (Genivar, 2007). Between 2000 and 2005, at the Raglan South mine site (local study area), it was estimated that liquid precipitation fell essentially between June and October, with more rain in August (mean of 85.4 mm). The greatest quantities of rain recorded for one-hour and 24-hour periods were respectively 14.2 mm and 64.8 mm on August 31, 2002. Daily precipitation exceeded 10 mm only 10% of the time during the period from 2002 to 2005 (Genivar, 2007).

In 2011, it had been reported that mean precipitation was 520 mm per year (local study area), with about 50% falling in the form of snow (KRG, 2011 in WSP, 2015).

In the tundra, the snow generally takes the form of drifting snow and forms compact dunes which, in the absence of trees and obstacles, moves under wind action. The snow accumulated on the exposed banks and the crests thus is blown to the sheltered areas. The maximum thickness of the snow cover on the ground does not exceed an average of one metre (FAPAQ, 2000 in Genivar 2007).

In Katinniq (local study area), for the period from 2000 to 2004, snow cover was generally present between the end of September and mid-June. In spring, snowmelt and sublimation gradually reduce the snow cover. The maximum thickness of the snow cover reached 0.67 m in winter 2003-2004, for a mean maximum thickness of 0.52 m. The mean thickness of the snow cover was only 0.34 m (Genivar 2007).

According to a mean temperature increase scenario for northern Québec (beyond 50°N), mean precipitation in summer (June to August) and winter (December to February) would increase respectively by 10% to 20% and 10% to 25% for the 2080-2100 period in relation to the 1960-1990 period. The pessimistic scenarios forecast additional increases of 15% (Ouranos, 2004 in Genivar 2007).

Figure 5-1 reports the precipitation accumulated monthly between January 1, 2017 and December 31, 2021 at the weather station of the Expo site (limited study area), the Orion weather station. Generally between June and July, precipitation becomes relatively more frequent and more abundant, after which it tends to decrease and stabilize. In the past five years, however, two exceptions were noted, in 2018 and 2020, where the accumulated precipitation increased around November and December (Figure 5-1).

5.2.1.3 Winds

In Katinniq, on an annual basis (local study area), only 2% of winds are considered calm (< 1.8 km/h). The mean annual wind speed is relatively high, up to 20 km/h. The strongest wind measured during the 2000-2005 period was 79.6 km/h, on September 22, 2002 (Genivar, 2007).

The Orion weather station of the Expo site (limited study area) records mean annual speeds of 20.5 km/h. The maximum speed was measured at 108.9 km/h. The lowest and highest winds at the Expo site are recorded respectively in January and April.

The variation of the mean wind speed (Orion station) between seasons is not very great. The lowest mean wind speed is observed in summer (7.55 m/s) and the highest mean wind speed in fall (8.63 m/s) (AECOM and CRI, 2022).

Figure 5-2 presents the wind roses on an annual basis and for the four seasons at the Expo site. This figure indicates that the prevailing winds in the limited study area mainly comes from the west, northwest and southwest, regardless of the season.

A wind study was conducted by Hatch (2015) near the Expo site over a one-year period (June 23, 2014 to June 22, 2015). This study indicates that the mean annual wind speed is 7.5 m/s (27 km/h), with peaks that could exceed 20 m/s (> 70 km/h, Figure 5-3), and that the prevailing winds come from the southwest, west and northwest. The month of February records the lowest mean wind speeds (> 4 and < 5.5 m/s) and the month of October records the highest (> 8.5 and < 10.5 m/s). The wind turbulence at the highest measuring point is qualified as moderate (10.8%). The wind shear exponent is equal to 0.07 (Hatch, 2015).

The density of the air was calculated on the anemometer mast according to the altitude and the local temperature. The annual value was established at 1.24 kg/m^3 (Hatch, 2015).

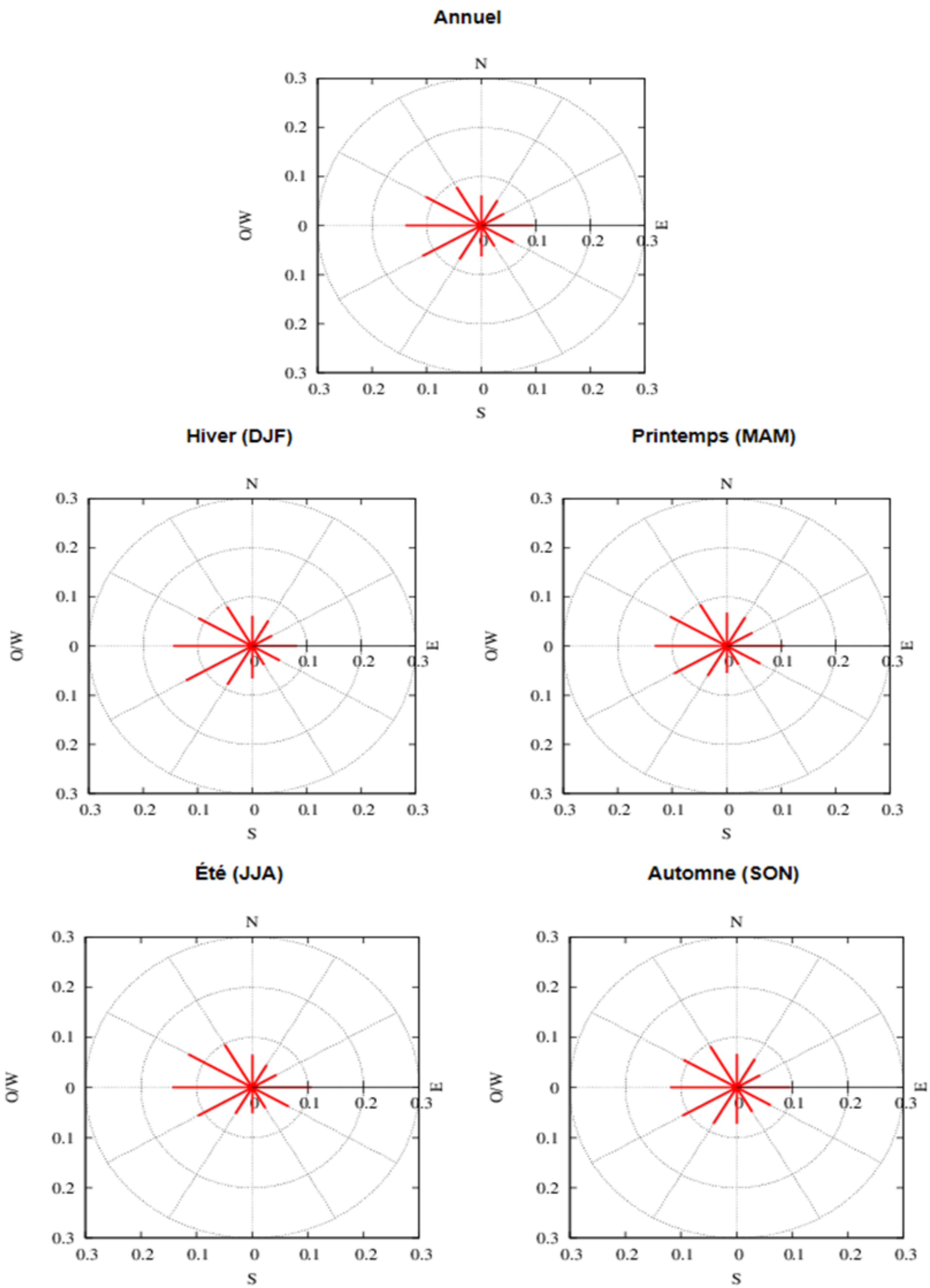


Figure 5-2: Wind rose at the site of the Expo industrial complex (taken from Government of Canada, 2022b)

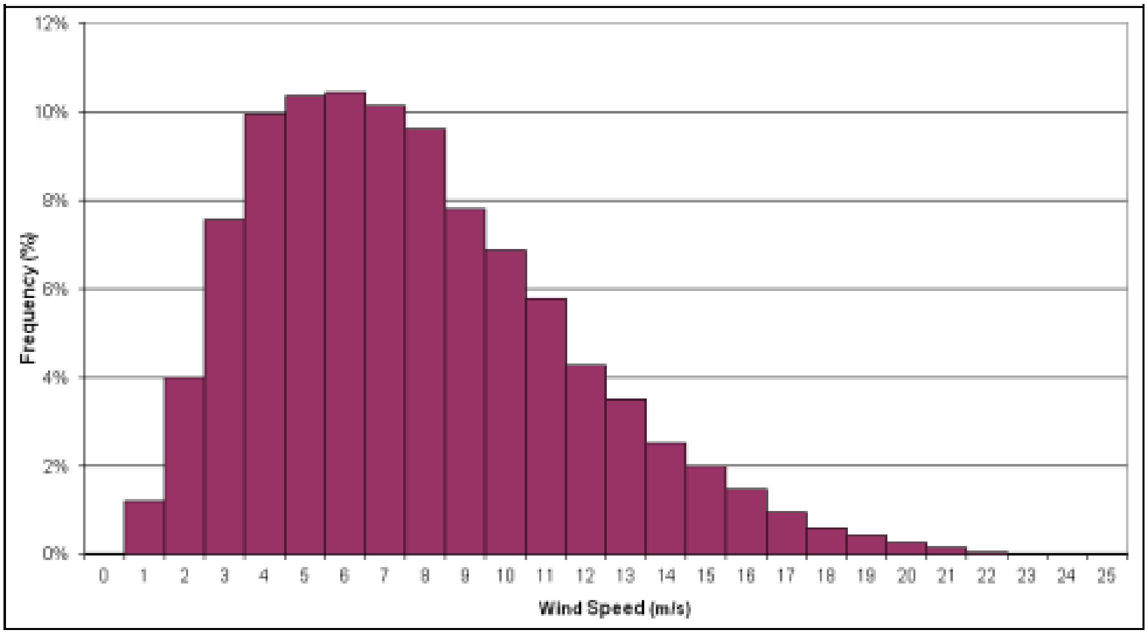


Figure 5-3: Frequency of wind speeds measured south of the Expo site from June 23, 2014 to June 22, 2015 (taken from Hatch, 2015)

5.2.1.4 Solar Radiation and Insolation

The solar radiation period is important in summer in Nunavik, when the length of the day can reach a maximum of 20 hours at the summer solstice. In winter, the opposite situation is observed, when incident radiation may last a minimum of 5 hours at the winter solstice. The sunniest month is July, with a length of 236 hours, and the least sunny month is December, with only 25 hours (Genivar, 2007).

According to the Environment Canada data for the period from 1951 to 1980 (climate normals), the mean overall radiation in Iqaluit is 9.47 MJ/m²/d. The mean annual insolation time in Québec's far north is 1,476 hours (Genivar, 2007).

5.2.1.5 Visibility and Fog

Visibility is mainly affected at the beginning of the summer, with the arrival of warmer air that circulates above the snow cover, which usually triggers sublimation and fog formation (Genivar, 2007).

During the winter, visibility is influenced by snow squalls and blizzards, which are very frequent (Genivar, 2007).

5.2.2 Air Quality

Fine particles, which have a diameter smaller than 2.5 µm, contribute to the formation of SMOG episodes and are considered in the calculation of the Air Quality Index in cities. When the value of this index (without a unit) is between 0 and 25, it corresponds to an air quality level qualified as "good" (Genivar, 2007).

In summer 2006, the first air quality measurements taken near the Expo and Berbegamo exploration camps, during the Raglan South Nickel Project, showed that the ambient concentrations of atmospheric contaminants were low, and thus that air quality was considered "good". Indeed, the mean concentration of airborne particles smaller than 2.5 µm, measured every 30 minutes, was 5.4 ± 8.3 µg/m³. In reporting this data for a one-hour and 24-hour period, the mean concentrations for these periods (1 h and 24 h) were assessed at 3.7 and 2.5 µg/m³ respectively (Genivar, 2007).

Since the start of operations for the CRI NNiP, air quality has been altered slightly near the mining infrastructure. Indeed, the data collected on fine particles indicates that 97% of the time, air quality is considered "good". This finding is established from the calculation of the Air Quality Index (AQI) established according to the formula defined by Environment Canada. This reality reflects the isolation of the study area and the very small number of polluting atmospheric emission points. However, 3% of the time, air quality is qualified as "acceptable", primarily due to the dust raised during high wind periods, as well as the sparse ground vegetation and the absence of tree and shrub vegetation (Genivar, 2007).

For the metals analyzed, none exceeds the ambient air quality standards and criteria defined in Schedule K of the *Clean Air Regulation* (CAR) (Genivar, 2007). These results confirmed the fact that the NNiP was isolated and not affected by the polluting atmospheric emission sources.

Following the deployment of the NNiP's first activities, annual air quality monitoring is performed to analyze the influence of construction and operating activities on the ambient air. Table 5-3 presents the results obtained over the past three years.

Table 5-3: Ambient air concentrations of atmospheric contaminants - 2019 to 2021 period

Contaminant	Period	Standard/Criterion	Unit	2019		2020		2021	
				Mean	Maximum	Mean	Maximum	Mean	Maximum
TSS	24 h	**1,20E+02**	µg/m³	1,65E+01	8,16E+01	1,38E+01	3,60E+01	8,70E+00	4,29E+01
$PM_{2.5}$	24 h	**3,00E+01**	µg/m³	4,35E+00	1,76E+01	3,60E+00	1,09E+01	3,70E+00	1,49E+01
Arsenic	1 year	**3,00E-03**	µg/m³	2,62E-04	5,71E-04	2,07E-04	2,33E-04	2,23E-04	3,55E-04
Beryllium	1 year	**4,00E-04**	µg/m³	1,68E-04	1,77E-04	1,55E-04	1,75E-04	1,65E-04	2,67E-04
Cadmium	1 year	**3,60E-03**	µg/m³	1,12E-04	1,18E-04	1,03E-04	1,16E-04	1,10E-04	1,78E-04
Chromium	1 year	**4,00E-03**	µg/m³	**4,61E-03**	1,94E-02	**5,17E-03**	2,69E-02	3,39E-03	9,67E-03
Copper	24 h	**2,50E+00**	µg/m³	8,99E-02	4,62E-01	4,19E-02	1,03E-01	4,60E-02	2,64E-01
Nickel	24 h	**1,40E-02**[A]	µg/m³	**3,95E-02**	2,28E-01	**2,49E-02**	7,13E-02	1,12E-02	4,97E-02
Lead	1 year	**1,00E-01**	µg/m³	6,50E-04	6,55E-03	2,10E-04	2,73E-04	2,89E-04	5,10E-04
Vanadium	1 year	**1,00E+00**	µg/m³	1,51E-03	4,17E-03	1,14E-03	1,84E-03	1,07E-03	2,15E-03
Zinc	24 h	**2,50E+00**	µg/m³	7,38E-03	1,65E-02	5,14E-03	1,20E-02	6,58E-03	2,04E-02

Source: AECOM and CRI (2022).

Note: **A grey background in bold** indicates an exceedance of the standard/criterion according to the CAR.
A: Since April 28, 2022, the new daily standard is 7.00E-02 µg/m³

Total suspended solids (TSS) are monitored between the months of May and September with a high-flow sampler. Given the extreme weather conditions encountered for the rest of the year, meaning October to April, no TSS monitoring was done. For all the samples collected, no exceedance of the CAR standard (120 µg/m³) was detected (AECOM and CRI, 2022).

For fine particles with an aerodynamic diameter less than or equal to 2.5 µm ($PN_{2.5}$), the samples were collected continuously with a BAM-1020 device. As in the case of TSS, no exceedance of the CAR standard (30 µg/m³) was measured (AECOM and CRI, 2022).

Concerning metals, exceedances are measured for chromium and nickel (Table 5-3). For chromium, the mean annual concentration measured in the samples collected exceeded the standard in 2019 and 2020, but not in 2021. However, it is important to note that the limit value used as a standard was the one for hexavalent chromium

(0.004 µg/m^3) and not the one for trivalent chromium (0.1 µg/m^3). However, the concentration obtained during the laboratory analysis is that of total chromium, which can lead to an overestimate of the result. In the case of nickel, the sampling results show an exceedance of the daily standard in 2019 and 2020, but not in 2021 (Table 5-3) (AECOM and CRI, 2022).

The activities performed during the first phase of the NNiP, such as ore loading and crushing and ore storage on dry stockpiles, are identified as the main sources of dust emissions that contain these metals (AECOM and CRI, 2022).

Since 2021, investigations have been conducted by CRI to deploy mitigation measures allowing reduction of these emission sources (AECOM and CRI, 2022).

5.2.3 Geology

Some of the information presented in this section are from a sectoral soil and rock characterization study conducted in the context of the Environmental and Social Impact Statement of the Raglan South Nickel Project (Levasseur et al., 2007 in Genivar 2007). The study area used in this impact statement is more extensive than the local study area of the current project and corresponds to the Raglan South sector. This area, from west to east, encompasses the Ivakkak, Méquillon, Expo and Mesamax sites of the NNiP. The local study area of this project encompasses the Expo site and borders the Mesamax site to the east.

The local study area is located in the Ungava Trough geological region, commonly known as the Cape Smith Belt, which is part of the Canadian Shield. This geological region corresponds to a suture zone between the tectonic Superior Province, in the south, and Hearne Province, in the north. The Ungava Trough consists of a major zone of folds and overlaps, established during the Ungava orogenesis, which occurred in the Paleoproterozoic between 2.04 and 1.83 Ga (billions of years) ago. This crosses the entire peninsula of Nouveau-Québec over a width of about 50 km (Genivar, 2007).

Mafic volcanic rocks and sedimentary rocks dominate the limited study area, covering almost the entire area. These stratigraphic units are aligned in a southwest-northeast axis. The mafic volcanic rocks are located in the north, centre and south of the limited study area, while the sedimentary rocks are located on each side of the central axis of the mafic volcanic rocks. The mafic volcanic rocks are mainly composed of basalt, olivine basalt and volcanoclastite (Genivar, 2007).

At several locations in these mafic volcanic and sedimentary rock masses, gabbro and peridotite intrusions are inserted. These intrusive rocks, of basic composition, are poor in silica and rich in iron and magnesium. These are sills, which have been interpreted as part of the magmatic system at the origin of the establishment of the region's basalts. These seams form alignments of parallel hills, resulting in differential erosion (Genivar, 2007).

More specifically, in the limited study area characterizing the Expo site, the lithology is composed of magmatic rocks (peridotite and gabbro), all belted by sedimentary rocks (sandstone, quartzite, conglomerate, limestone).

Boreholes were drilled by Tugliq Energy between June 20 and 29, 2022 on two potential wind turbine implementation sites (sites A and B) (WSP, 2022). A total of 7 boreholes were drilled during this geotechnical study. The results of the boreholes showed that the thickness of the overburden before hitting rock varied between 2.34 m and 4.50 m. The boreholes hit rock at thicknesses ranging from 6.0 m to 9.65 m. The bedrock was composed of homogeneous greenish grey basalt, weakly altered to unaltered, massive and aphanitic, with some calcite venules and quartz veins (WSP, 2022).

The RQD values ("Rock Quality Designation" or calculated indices allowing grading of rock quality) mostly vary between 83% and 100% and grade the rock as good to excellent quality. The only exception is a surface portion of the bedrock on one of the site B boreholes, which was medium quality (WSP, 2022).

5.2.4 Physiography

The local study is located in the James physiographic region in the vast natural region of the Ungava Plateau. This region's terrain generally is not rugged and the altitude ranges between 300 and 600 m (Genivar, 2007).

The physiographic subunit concerned on the scale of the local study area is that of the Puvirnituq Hills, with folded terrain dominated by the presence of rock crests oriented in an east-west axis that are relatively long (0.5 to 7 km) and wide (0.25 to 1 km) and that vary in height from 20 to 60 m. The slopes are generally gentle, less than 5% for the local study area. The rock crests mainly correspond to gabbro and peridotite sills and, in most cases, are covered with a thin discontinuous layer of till (less than 1 m) (Genivar, 2007).

More specifically, in the limited study area, the elevation generally ranges between 500 and 600 m. The altitude is higher in the northeast sector of the limited study area and decreases in the direction of the southwest sector. The highest site is that of Expo South, where the altitude is about 565 m. These findings come from the topographic maps presented in the impact statement of the Raglan South Nickel Project (Genivar, 2007).

Because of high winds, considerable snow accumulations form where there are slope changes and natural or anthropogenic obstacles (WSP, 2015).

No soil erosion zone is apparent, except concerning the passage of site vehicles, which created ruts on the Expo South site, thus altering the appearance of the soil (AECOM and CRI, 2022).

5.2.5 Geomorphology

The surface deposits of the limited study area are mainly characterized by till from the last glaciation. This type of deposit is composed of a mix of rock debris of various sizes, ranging from fine particles (clay) to coarse (metre-sized boulders) (Genivar, 2007).

On the scale of the local study area, it is possible to find deposits and forms of erosion generated deglaciation, which may have occurred in two types of environments, fluvioglacial or glaciolacustrine. Forms of fluvioglacial origin are present, particularly numerous eskers and some meltwater channels (Genivar, 2007).

The surface deposits associated with deglaciation are the main sources of granular material for construction of roads and other mine infrastructure. Several eskers are located near project infrastructures of the NNiP, particularly between the Mesamax and Expo deposits, between Expo and Mequillon, and between Expo and the Raglan Mine (Genivar, 2007).

Organic deposits, less than 0.5 m thick, are also present in the study area. The biggest ones, at large scale, are located northwest of the Expo deposit. In general, they are found in sectors where the till is thick (Genivar, 2007).

The landscapes may also be altered by rivers and winds. However, as shown by the few alluvial deposits in the area, surface water movement is very limited. Indeed, the relatively flat terrain and the low streamflows limit the capacity of the watercourse to erode and transport fine sediments. Moreover, the climate conditions characterizing the study area are unfavourable to these processes. On the other hand, winds may be very active and very efficient, particularly due to a relatively flat terrain, sparse and low plant cover, and soils mostly composed of unconsolidated sediments. In the local study area, the prevailing high winds do not encounter any obstacle and thus can easily carry away, displace accumulated sediments not fixed to the soil, or simply act as abrasion agents (Genivar, 2007).

In the impact statement of the Raglan South Nickel Project (Genivar 2007), for which the documented area was relatively extensive (while encompassing the limited study area of this project), it had been assessed that there were generally few or no risks of erosion and sediment transport where the roads cross the watercourses. The sites that were documented concerned the crossing points of the preliminary route of the roads. The available information indicated that the shores of the watercourses are currently not subject to erosion because they are mostly characterized by gentle slopes (< 5%), composed of coarse sediments (i.e. boulders and pebbles) and colonized by vegetation. On the other hand, because the study area is subject to a harsh climate, the soil disturbed by the road is protected most of the time from the erosion and sediment transport processes, because the soil is frozen and/or covered with snow (Genivar, 2007).

The risks of sediment inputs to watercourses and sediment transport had been assessed for the Raglan South Nickel Project, accounting for the reworking of the watercourse shores and slopes necessary for construction of roads and the existence of drainage ditches in the operating phase of these same roads. It is then likely that, during snowmelt and heavy rain, the runoff will carry and transport fine sediments to the drainage ditches, eventually reaching the watercourses. This phenomenon is more likely to appear at crossing points where the terrain is accentuated (Genivar, 2007).

5.2.6 Permafrost

In the permafrost sectors, the active layer corresponds to the surface soil zone subject to the freeze-thaw effects accompanying the seasons. The thickness of the active layer depends on the maximum progression of the thaw observed at the end of the summer. The thickness is assessed at 2.2 m in Salluit and 5 m in Kangiqsualujjuaq (Genivar, 2007).

As mentioned in WSP (2015), the local study area is found in a continuous permafrost sector with a mean temperature below -5°C, which reaches thicknesses of about 500 m. In the context of climate change, climate warming may lead to degradation of the permafrost and reduce its bearing capacity, which could present risks for the stability of mine and road infrastructure (WSP, 2015).

The soil temperature values measured in summer 2006 in the Expo and Mesamax sectors (limited study area) ranged between -5 and -7°C and indicated active layer thicknesses between 1.7 and 2.2 m. The maximum depth of the active layer is observed at the end of the summer season, once the air temperatures fall below 0°C, around September (Genivar, 2007).

The risks associated with permafrost degradation consist of differential settling of soils, which may lead to problems of subsidence, local flood, drainage network diversions and erosion. Moreover, permafrost degradation increases the risk of land instability (reptation, slumps, landslides, rockslides). All these changes can result in damage to the structures in place. Relief sectors, such as hillocks, are generally better drained than flat or depressed sectors (Genivar, 2013).

5.2.7 Hydrography and Hydrology

The local study area is located at the head of the Puvirnituq River watershed. The mean unit summer flow of this river is estimated at 3.6 m^3/s at the outlet of Lac du Bombardier (limited study area). After a westward course of about 260 km, the waters of the Puvirnituq River flow into Hudson Bay at the Inuit village of Puvirnituq, where the watershed reaches about 28,600 km^2 (Genivar, 2007; WSP, 2015). The Expo South site (limited study area) is part of a subwatershed of 153.8 km^2, which flows to the Puvirnituq River (AECOM and CRI, 2022) (Map 5-1).

Two permanent watercourses and five intermittent watercourses were identified in the limited study area during the inventories conducted in summer 2022, but they are not hydrologically connected with a larger body of water (lake or river). A more detailed description of these watercourses is provided in section 5.3.2.

The snow cover in the region generally melts between the beginning of June and mid-July. Given the very gentle terrain, the increase in flows related to snowmelt translates more into a widening of the flow than a rising water level. Finally, the summer low water level (occurring in August) and the winter low water level are very severe. In winter, the flows become mostly non-existent, given the harsh season and the absence of groundwater input (permafrost) (Genivar, 2007; WSP, 2015).

Due to the harsh winters and the low snow cover on the soil, the ice may thicken over two metres or more. Given that the winter flows are not sustained by groundwater inputs, several small tributaries dry up quickly at the beginning of the winter. Even during the summer, several small watercourses dry up almost completely, a phenomenon observed during previous inventories (WSP, 2015).

The village of Puvirnituq, located over 250 km west of the local study area, takes its drinking water supply from the Puvirnituq River (WSP, 2015). The sector is regionally composed of wide watercourses and shallow bodies of water.

Concerning groundwater, its flow within the permafrost is different from what can be observed in place where the soil is not permanently frozen. Indeed, the permafrost acts as an impervious barrier that restricts the flow of groundwater to the talik zones (unfrozen soil thicknesses, such as the zones under the watercourse) and within the active layer during the summer. During the summer season, the water flows in the active layer in the direction of the slope. More water will then flow during rapid melting of the active layer or following a precipitation episode and will mainly flow on the surface in the form of a sheet of water depending on the topography of the soil. On many occasions, these sheets of water follow the trails traced by terrestrial wildlife, such as caribou. It is therefore frequent to see intermittent watercourses form among several wetlands. These intermittent watercourses do not constitute any fish habitat (Genivar, 2007).

Underground flow is limited to a depth of two to three metres, where the soil is permeable, because it is not frozen (WSP, 2015). It should be noted that the limited study area does not contain any aquifer that can be considered a source of drinking water for the Inuit communities of Nunavik (Genivar, 2007).

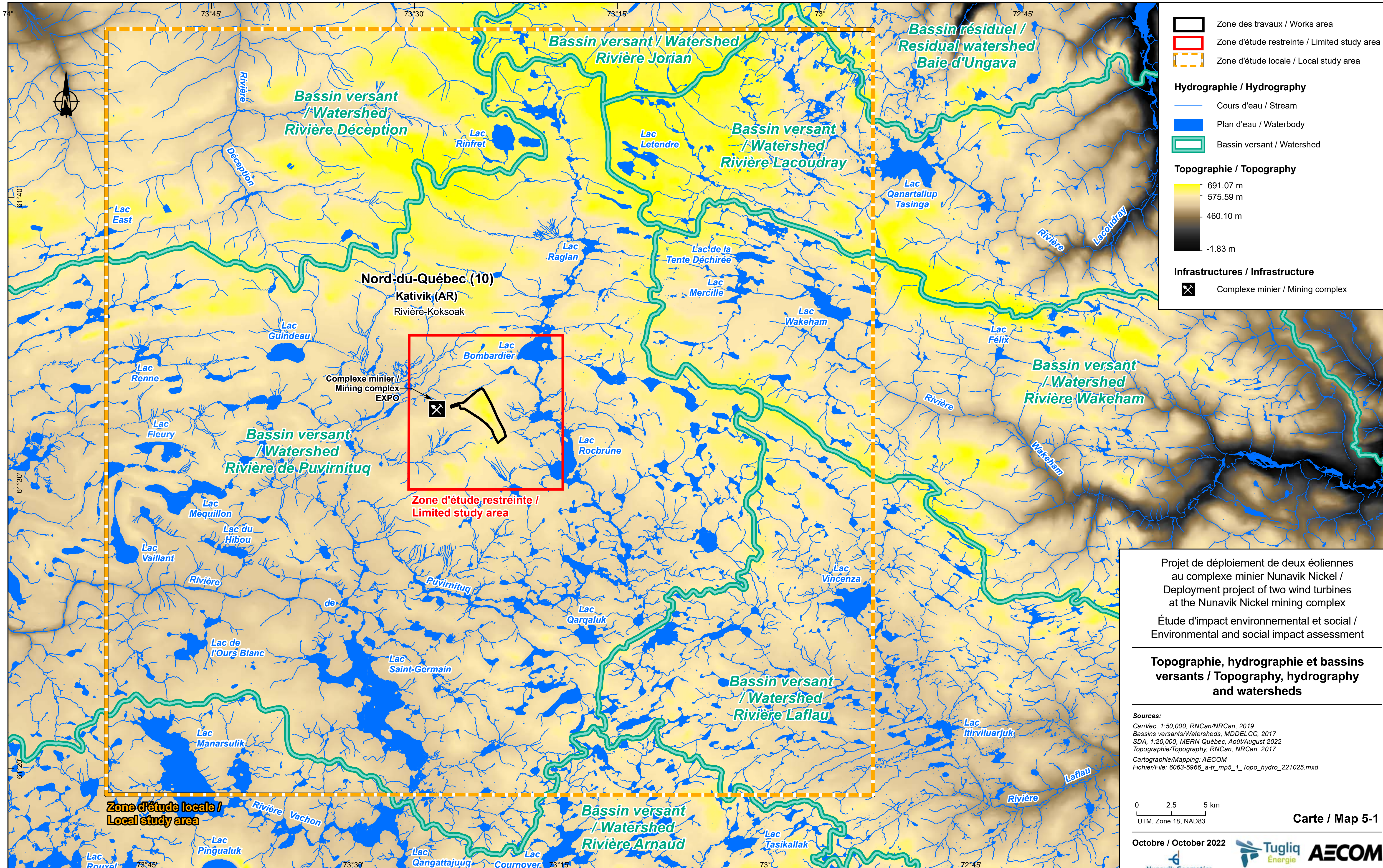
5.2.8 Surface Water Quality

The final mine effluent of the Expo industrial complex of the NNiP discharges into a tributary of the Puvirnituq River about 250 km upstream of the water intake of the village of Puvirnituq (AECOM and CRI, 2022).

The water quality is documented during annual environmental monitoring performed at the Expo industrial complex. In 2021, 1,078,400 m³ of treated mine effluent from the Expo mine complex was discharged into the receiving tributary of the Puvirnituq River. The quality analyses of the Expo effluent in 2021 showed that no exceedance of the requirements of Directive 019 and Schedule 4 of the MDMER occurred (AECOM and CRI, 2022).

Since 2010, the surface water quality of the Puvirnituq River has been monitored by CRI. It is part of the many environmental monitoring operations with which CRI complies annually for the NNiP. The surface water quality is therefore monitored in the receiving environment of the Expo effluent and the parameters measured are compared with the MELCC criteria for the chronic effects (CVAC) and acute effects (CVAA). During this monitoring the total phosphorus showed ACCE exceedances (criterion of 0.03 mg/L) in 8 samples (concentrations ranging between 0.04 and 0.18 mg/L) among the 15 samples for the stations located near the effluent and those outside the effluent's area of influence (baseline area). The phosphorus is of anthropogenic origin and is probably natural. Indeed, phosphorus sources of anthropogenic origin are absent in the studied systems, and the variations that may appear are attributed to the presence of birds on the bodies of water and in the neighbouring wetlands (arrival of large numbers of Canada geese and snow geese on the bodies of water) and to erosion of the soil and rocks in presence (AECOM and CRI, 2022). Indeed, the natural phosphorus concentration in the water largely results from the quantity and types of rocks and the type of soil in the region (Government of Canada, 2022 in AECOM and CRI, 2022).

The mercury concentration exceeded the CVAC criterion (0.0016 mg/L) in September 2021 in the baseline area (0.0024 mg/L in the area not impacted by mining activities), while in the area exposed to mining activities, the mercury concentrations for September 2021 also exceeded the CVAA, but less significantly: only at two monitoring stations out of four (values between 0.0011 and 0.0012 mg/L). Mercury therefore seems to be present in the natural state in the region's waters according to the data collected in the areas not impacted by the project. However, it is noted that climate change could have an impact on the mercury concentration in the waters of the study area, because the mining projects are located within the permafrost. Indeed, the permafrost is a considerable mercury reservoir and its deep thaw could considerably increase the mercury concentration in the aquatic environment (Louvet, 2018), regardless of the mining activity (AECOM and CRI, 2022).



Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex

Étude d'impact environnemental et social / Environmental and social impact assessment

Topographie, hydrographie et bassins versants / Topography, hydrography and watersheds

Sources:
CanVec, 1:50,000, RNCan/NRCan, 2019
Bassins versants/Watersheds, MDDELCC, 2017
SDA, 1:20,000, MERN Québec, Août/August 2022
Topographie/Topography, RNCan, NRCan, 2017
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp5_1_Topo_hydro_221025.mxd

0 2.5 5 km
UTM, Zone 18, NAD83

Carte / Map 5-1

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Nunavik Geomatics Tugliq Énergie AECOM

The copper concentrations exceeded the ACCE for 11 of the 12 samples from the area exposed to mine effluent (values between 0.002 and 0.007 mg/L), and for the three samples located in the baseline area (values between 0.002 and 0.007 mg/L) on the three sampling dates. These values indicate heterogeneous copper concentrations in the study area and that the presence of mining activities does not seem to have a marked effect on the metal content in the aquatic environment. Moreover, in the baseline, the copper value measured was 0.003 mg/L (AECOM and CRI, 2022).

Finally, 7 of the 12 water samples collected exceeded the CVAC for nickel (criteria established according to hardness) in an exposed area (values ranging between 0.015 and 0.077 mg/L), while only one sample out of three in the baseline area showed an exceedance of the ACCE (values of 0.030 mg/L). The CVAA criteria were exceeded only once for nickel in September at one station of the exposure area (values of 0.077 mg/L). The results indicate high values for nickel both in the natural environment and the exposure area. However, the exposure area seems to present higher nickel values (AECOM and CRI, 2022).

CRI monitors all the required regulations regarding the discharge objectives set for the NNiP. As an effluent quality indicator, ecotoxicological tests are performed several times a year on rainbow trout. These tests show that effluent quality does not cause fish mortality (AECOM and CRI, 2022).

In short, all of these reasons indicate that metals concentrations in the water of the study area of the Expo industrial complex is naturally high in 2021, but that some exceedances could be of anthropogenic origin, such as the ones noted for nickel. The pH generally remains in the interval from 6.5 to 9.0 and the water is well oxygenated (>9 mg/L) (AECOM and CRI, 2022).

5.2.9 Sediment Quality

On the scale of the limited study area, no sediment quality data is available.

5.3 Biological environment

5.3.1 Terrestrial environment and wetlands

The natural environment characterization and delineation inventory was produced in the work area from July 27 to 31, 2022 by AECOM. The natural environments identified in the work area vary according to three types of terrestrial environments and two types of wetlands. The terrestrial environment and wetland inventory method is presented in Appendix J.

The terrestrial environments are composed of boulder fields, felsenmeers and tundra ostiole polygonal soils. The boulder fields are composed of coarse-grained boulders with blunted or rounded edges. They are generally found at lower altitudes and are the result of the passage of a glacier during the last glaciation. These environments are generally barren of vegetation. The felsenmeer is a boulder field formed by frost wedging, the alteration of the rock by the action of the freeze-thaw process. Due to the excessive drainage caused by the coarseness of the substrate, these boulder fields are practically free of vegetation. The exposed surfaces of the boulders are essentially colonized by crustose lichens. Occasionally, small moss pads (especially *Racomitrium lanuginosum*) may be present in the hollows where a little fine substrate is found. A gradual transition from felsenmeers to tundra ostiole polygonal soils is often observed. Tundra ostioles thus may be found sporadically in the felsenmeers. In these areas, it is possible to find sparse vascular vegetation. The tundra ostiole polygonal soils are generally located on lands characterized by a fine or very fine grain size due to till deposits, a shallowly sloping and very subdued topography located at medium altitude. The environments cover a vast surface over the entire study area, particularly on the summit and the slopes of rocky crests. The plant diversity found in the tundra ostiole polygonal soils is relatively wide, but usually there is no clear dominance.

The wetlands are composed of lowland polygonal fens and snowbed fens. Lowland polygonal fens are found at the bottom of valleys well supplied with water. The plant cover is therefore almost continuous and generally composed of grasses and mosses. The peat accumulation is significant, but generally is less than 50 cm thick, particularly in the northern lands. The snowbed fen is a wetland found at the foot of snowbeds and in delayed snowmelt areas. There is little accumulation of organic matter in these environments and they are limited to drainage areas, giving the appearance of furrows in the landscape. This fen is characterized by a discontinuous appearance, especially upstream. The plant cover is relatively low (<50%) and dominated by grasses, carex and cottongrass (genus *Eriophorum*).

Terrestrial environments are preponderant in the work area and correspond to 90.1% of this area. Wetlands occupy 9.8% of the work area (Table 5-4). The northern environments occupy a very small surface of the work area (0.1%) and are discussed in more detail in section 5.3.3.

Table 5-4: Area of each type of environment found in the work area

Environment	Environment category	Total area (ha)[1]	Total number of characterization stations
Terrestrial	Anthropogenic	20,79	1
	Felsenmeer	53,19	5
	Boulder field	68,56	7
	Tundra ostiole polygonal soil	224,81	4
Wetland	Lowland polygonal fen	38,24	8
	Snowbed fen	1,57	8
Water	Watercourse	0,44	-
Total		**407,59**	**33**

[1] The areas of each type of environment were determined from the photointerpretation and land validation results. The land validation was performed in the sectors that will be directly impacted by the project, namely the projected right of way of the road, the cable and the wind turbine platforms.

5.3.2 Vegetation

The vegetation of the study area is typically Arctic. The vascular plant families best represented in the local study area are generally represented by Cyperaceae, Poaceae, Caryophyllaceae, Ericaceae, Brassicaceae and Saxifragaceae. During sector studies produced for the Nunavik Nickel Project (NNiP) and pertaining to the inventory of vascular flora, vegetation and rare plants, it was determined that the Expo site contained up to 49 taxa and the Mesamax site contained up to 43 (Genivar 2007).

The poverty of plant life is explained, at least partially, by a series of edaphic, topographic and climatic factors that act concomitantly. Among these factors, we should mention a relatively high mean altitude, the relatively homogeneous topography, a very harsh and highly contrasting climate, the absence of acid granite rocks and the flora associated with them, and the low diversity of habitats, at least in the environments visited (Genivar 2007).

The Expo South site (limited study area) was characterized on August 6, 2021 with the goal of delineating the different environments present and producing the vegetation inventory. During all the inventories and the movements in the study area, an active search for plant species at risk was conducted (Table 5-5) and any spot observation of wildlife was noted and georeferenced (AECOM, 2022). The Expo South site is composed only of a terrestrial environment. The vegetation present on the site essentially consists of Arctic white heather with a 1% to 10% percentage cover depending on the station. Species such as genus *Racomitrium* moss and northern wood rush (*Luzula confusa*) are also present on the site, with a 5% to 20% cover. A total of 20 different plant species were identified at the four characterization stations (Appendix J) (AECOM, 2022).

Table 5-5 presents the list of plant species at risk potentially present in the local study area according to the information obtained from the Centre de données sur le patrimoine naturel du Québec (CDPNQ). In 2010, the CDPNQ mentioned the presence of milky whitlow grass (*Draba subcapitata*), classified as a species likely to be designated threatened or vulnerable in Québec, northeast of the Expo mining camp, i.e. 3.7 km from the Expo

South Study areas. Two subpopulations were found, one in the tundra ostiole and the second in the snowbed fen. No plant species at risk was observed on the Expo South site during the 2021 characterization (AECOM, 2022).

Table 5-5: Plant species at risk potentially present in the local study area (CDPNQ, 2021)

Scientific name	Vernacular name	Status
Cephaloziella uncinata	Hooked Threadwort	Likely
Draba arctica	Arctic Whitlow-grass	Likely
Draba cayouettei	Cayouette's Draba	Likely
Draba corymbosa	Flat-top Draba	Likely
Draba micropetala	Small-flowered Draba	Likely
Draba pilosa	Pilose Draba	Likely
Draba puvirnituqii	Puvirnituq Mountain Draba	Likely
Draba subcapitata	Ellesmereland Draba	Likely
Grimmia sessitana	Alpine Grimmia	Likely
Ranunculus sulphureus	Sulphur Buttercup	Likely
Sabulina rossii	Ross' Stitchwort	Likely

Inventories were produced in summer 2022 in the environments likely to be influenced by the work according to the detailed method indicated in Appendix J. In the work area are the five types of environments stated previously (section 5.3.1), in addition to a station characterized as an anthropogenic terrestrial environment. In all, 46 plant species were identified in the 33 stations inventoried. The shrub species present in the majority are snowbed willow (*Salix herbacea*) and Arctic white heather (*Cassiope tetragona*), with an absolute percentage cover ranging from 1% to 20%. For herbaceous plants, membranous sedge (*Carex membranacea*) is the species with the highest absolute cover, between 1% and 80%. Mosses (*Racomitrium* and the sphagnums) have a large percentage cover, between 10% and 95%. In parallel, some species are found in more than 50% of the stations. This is the case, in particular, for Arctic bluegrass (*Poa arctica*), membranous sedge, Arctic white heather, polar grass (*Arctagrostis latifolia*) and mosses. No plant species at risk was inventoried in the work area.

The plant species inventoried in the work area are listed in Table 5-6 according to the type of environment in which they were observed the species presented in this table account for at least 5% of the mean absolute cover of the site. No species in the anthropogenic terrestrial environment (one station) complied with this criterion, which is why this type of environment is not represented in Table 5-6.

<u>Wetlands</u>

The wetlands are mostly composed of membranous sedge and mosses (Table 5-6). These species have a 100% occurrence and cover ranging between 41% and 65%. Fisher's tundra grass and polar grass are also very present, although their cover is less. Indeed, polar grass is present on all the inventoried sites, while Fisher's tundra grass is present on over 50% of the sites. In all, 41 plant species were inventoried at the 16 wetland stations.

<u>Terrestrial environments</u>

Racomitrium is present in the three types of terrestrial environments, with cover ranging between 8% and 13% and an occurrence of over 70% in all cases (Table 5-6). Moreover, Arctic white heather has a high occurrence in the boulder fields and in the tundra ostiole polygonal soils (occurrence of 86% and 100% respectively). In the tundra ostiole polygonal soils, Arctic hare's foot sedge has the highest cover (20%), followed by membranous sedge (15%), although their occurrence is 25%. In all, 34 plant species were inventoried at the 17 terrestrial environment stations (including one anthropogenic terrestrial environment station).

Table 5-6: Plant species present in the work area depending on the types of environment

Type of environment	Plant species	Latin name	Number of stations with occurrence	Mean absolute cover	Occurrence
Boulder field	Racomitrium sp.	*Racomitrium sp.*	5	8 %	71 %
	Arctic White Heather	*Cassiope tetragona*	6	7%	86%
		Total number of stations			
Felsenmeer	Racomitrium sp.	*Racomitrium sp.*	3	10 %	75 %
		Total number of stations			
Tundra ostiole polygonal soil	Arctic Hare's Foot Sedge	*Carex lachenalii*	1	20 %	25 %
	Membranous Sedge	*Carex membranacea*	1	15%	25%
	Racomitrium	*Racomitrium sp.*	4	13%	100%
	Tufted Hairgrass	*Deschampsia cespitosa*	2	12%	50%
	Bryophyte	*Bryophyta sp.*	1	10%	25%
	Bigelow's Sedge	*Carex bigelowii*	2	9%	50%
	Arctic Cinquefoil	*Potentilla hyparctica*	2	8%	50%
	Arctic White Heather	*Cassiope tetragona*	4	7%	100%
		Total number of stations			
Snowbed fen	Membranous Sedge	*Carex membranacea*	8	49%	100%
	Bryophyte	*Bryophyta sp.*	8	41%	100%
	Sphagnum	*Sphagnum sp.*	3	23%	38%
	Bigelow's Sedge	*Carex bigelowii*	2	16 %	25 %
	Fisher's Tundra Grass	*Dupontia fisherii*	4	14 %	50 %
	Polar Grass	*Arctagrostis latifolia*	8	10%	100%
	Shortleaved Sedge	*Carex fuliginosa*	1	10%	13%
	False Semaphoregrass	*Pleuropogon sabinei*	1	10%	13%
	Common Cottongrass	*Eriophorum angustifolium*	8	6%	100%
		Total number of stations			
Lowland polygonal fen	Bryophyte	*Bryophyta sp.*	8	65%	100%
	Membranous Sedge	*Carex membranacea*	8	45%	100%
	Fisher's Tundra Grass	*Dupontia fisherii*	7	19%	88%
	Racomitrium	*Racomitrium sp.*	2	12 %	25 %
	Polar Grass	*Arctagrostis latifolia*	8	10%	100%
	Bigelow's Sedge	*Carex bigelowii*	3	9 %	38 %
	Snowbed Willow	*Salix herbacea*	8	9%	100%
	Arctic Hare's Foot Sedge	*Carex lachenalii*	3	8 %	38 %
	Alpine Bistort	*Bistorta vivipara*	8	7%	100%
	Short-leaved Hairgrass	*Deschampsia cespitosa subsp. Septentrionalis*	4	7%	50%
		Total number of stations	**8**		

5.3.3 Water environments

The water environments of the work area are composed of five intermittent watercourses and two permanent watercourses (Table 5-7). The permanent watercourses have the greatest mean widths. All the watercourses identified have a current speed of nil to slow and are considered impassable for the free circulation of fish. Indeed, the watercourses in the work area are not hydroconnected with a larger body of water (lake or river) and their fish habitat potential is therefore considered nil.

Considering that the route of the road was optimized to avoid all the watercourses present in the work area (see section 2), no impact on the water environments is expected in the context of this project.

Table 5-7: Characteristics of the watercourses crossing the work area

Caracteristics	CE1	CE2	CE3	CE4-1	CE4-2	CE5	CE6
Watercourse type (P=permanent; I=intermittent)	I	I	I	P	I	I	P
Mean width (m)	0.1	0.1	0.1	0.3	0	0	0.5
Mean width the shoreline (m)	1.5	1	1	1	0.6	1.5	1
Facies type (R= rectilinear; S= sinuous)	S	S	S	S	S	R	R
Dominant substrate (B=boulder; C=cobble; P=pebble; Gr=gravel; OM=organic matter)	MO	C	C	P	OM	OM	OM
Mean current speed (N=nil to slow; M=moderate; R=rapid)	N	N	N	N	N	N	N
Mean depth (m)	0.05	0.05	0.05	0.1	0	0	0.05
Maximum depth (m)	0.1	0.1	0.1	0.15	0	0	0.07
Obstacle to fish migration (P=passable; IMP=impassable; D=passable with difficulty)	IMP	IMP	IMP	IMP	IMP	IMP	IMP
Potential fish habitat (Salmonidae and Cottidae)	Nil	Nil	Nil	Nil	Nil	Nil	Nil

5.3.4 Aquatic fauna

Fishing was done in 2004 and 2006 in several watercourses and lakes of the local study area, in the context of sector studies produced for the Nunavik Nickel Project (NNiP), and showed little diversity of the ichthyic community. Indeed, the only species captured were Arctic char (*Salvelinus alpinus*), lake trout (*Salvelinus namaycush*), slimy sculpin (*Cottus cognatus*) and sticklebacks unidentifiable by species (observed in the stomachs of Arctic char and lake trout) (Genivar 2007).

As mentioned in section 5.3.3, two permanent watercourses were identified in the work areas, but they are not hydrologically connected to a larger body of water (lake or river), resulting in habitats with no potential for fish. Thus, no aquatic wildlife issue is expected in the context of this project.

5.3.5 Herpetofauna

According to the *Atlas des amphibiens et des reptiles du Québec,* no reptile species exists north of the 55th parallel, in Nunavik, and the only amphibian species living at this latitude are American toad (*Anaxyrus americanus*), mink frog (*Lithobates septentrionalis*) and wood frog (*Lithobates sylvatica*) (Genivar 2007). The distribution maps of the herpetofaunal species presented in Desroches and Rodrigue (2018) corroborate this reality.

No herpetofaunal species is currently identified in the limited study area because the latitudes are too far north. An inventory targeting herpetofauna conducted at the Raglan Mine also suggests the absence of herpetofaunal species at this latitude (Fortin, 2008). Moreover, no mention of amphibians or reptiles was reported by the Inuit communities (Fortin, 2008). No issue regarding herpetofauna is expected in the context of this project.

5.3.6 Avian fauna

5.3.6.1 Bird species identified in the study area

Various inventories relating to avifauna were conducted during previous studies, in 2006, 2008 and 2015, in the context of the Raglan and NNiP mining projects (Genivar, 2007; SNC-Lavalin, 2008; WSP, 2015). The inventories conducted in the local study area (including the Raglan South, Ivakkak, Expo and Méquillon sites) allowed identification of several bird species, which are listed in Table 5-8.

The breeding period of these species in the region extends from May/June to September, the spring migration period extends from the end of March to the end of April, while the fall migration period generally extends from mid-September to mid-October (Genivar, 2007). The accentuation of climate change could alter these periods during the lifecycle of mining operations. A recent study based on the migration data of 77 bird species between 1970 and 2020 tends to show that not all species have the same response to climate change. According to this study, the spring migration of species nesting in the Arctic would be moved ahead (Desrochers et al., 2021).

Among the birds presented in Table 5-8, two waterfowl species, Canada goose (*Branta canadensis*) and snow goose (*Chen caerulescens)*, and two land bird species, rock ptarmigan (*Lagopus mutus)* and willow ptarmigan (*Lagopus lagopus)*, occupy an important place in Inuit culture. Contrary to Canada geese and snow geese, which migrate over long distances, ptarmigans use the local study area year round. Canada goose and snow goose migrations render them more at risk of carrying *Toxoplasma gondii*, a protozoan parasite, which can cause risks to human health, especially for the fetus during pregnancy (Bachand et al. 2019).

Table 5-8: List of species confirmed and potentially present in the local study area

English name	Latin name	Special status	
Bird species whose presence is confirmed in the local study area		Provincial	Federal
Golden Eagle	*Aquila chrysaetos*	Vulnerable	
Horned Lark	*Eremophila alpestris*		
White-rumped Sandpiper	*Calidris fuscicollis*		
Pectoral Sandpiper	*Calidris melanotos*		
Wilson's Snipe	*Gallinago delicata*		
Canada Goose	*Branta canadensis*		
Snow Bunting	*Plectrophenax nivalis*		
Savannah Sparrow	*Passerculus sandwichensis*		
Lapland Longspur	*Calcarius lapponicus*		
Rough-legged Buzzard	*Buteo lagopus*		
Mallard	*Anas platyrhynchos*		

Table 5-8: List of species confirmed and potentially present in the local study area (cont'd)

English name	Latin name	Special status	
American Black Duck	*Anas rubripes*	Likely	Cause of concern
Tundra Swan	*Cygnus columbianus*		
Gyrfalcon	*Falco rusticolus*		
Peregrine Falcon	*Falco peregrinus tundrius*		
European Herring Gull	*Larus argentus*		
Common Raven	*Corvus Corax*		
Common Merganser	*Mergus merganser*		
Long-tailed Duck	*Clangula hyemalis*		
Snowy Owl	*Bubo scandiacus*		
Dark-eyed Junco	*Junco hyemalis*		
Rock Ptarmigan	*Lagopus mutus*		
Snow Goose	*Chen caerulescens*		
Red-necked Phalarope	*Phalaropus lobatus*		
Buff-bellied Pipit	*Arthus rubescens*		
Snow Bunting	*Plectrophenax nivalis*		
Lapland Longspur	*Calcarius lapponicus*		
Plongeon catmarin	*Gavia stellata*		
Plongeon huard	*Gavia immer*		
Pluvier argenté	*Pluvialis squatarola*		
Pluvier semipalmé	*Charadrius semipalmatus*		
Sizerin sp.	*Carduelis sp.*		
Bird species potentially present in the local study area			
Semipalmated Sandpiper	*Calidris pusilla*	Likely	Cause of concern
Brant	*Branta bernicla*		
White-crowned Sparrow	*Zonotrichia leucophrys*		
American Tree Sparrow	*Spizella arborea*		
Northern Pintail	*Anas acuta*		
King Eider	*Somateria spectabilis*		
Iceland Gull	*Larus glaucoides*		
Glaucous Gull	*Larus hyperboreus*		
Sandhill Crane	*Grus canadensis*		
Red-breasted Merganser	*Mergis serrator*		
Short-eared Owl	*Asio flammeus*		
Long-tailed Jaeger	*Stercorarius longicaudus*		
Parasitic Jaeger	*Stercorarius parasiticus*		
Pomarine Jaeger	*Stercorarius pomarinus*		
Willow Ptarmigan	*Lagopus lagopus*		
Red-necked Phalarope	*Phalaropus fulicaria*		
Common Redpoll	*Carduelis flammea*		
Arctic Tern	*Sterna paradisaea*		
Northern Wheatear	*Oenanthe oenanthe*		

Sources: Genivar, 2007; AECOM, 2020.

5.3.6.2 Raptors (birds of prey)

The inventories produced in the previous years confirmed the presence of golden eagles and peregrine falcons in the local study area, two species at risk (Table 5-8). These two species are migratory and use the study area in the nesting period. During the vegetation inventory on the Expo South site conducted in 2021, a rough-legged buzzard, a species without special status, was spotted about one kilometre east of the study site, in the limited study area. Snowy owls also used the work area, because regurgitated pellets were observed during the field campaign conducted in summer 2022. According to the information obtained during public consultations, the conditions observed in 2022 were conducive to the abundance of lemmings, the snowy owl's main prey. Lukasi Pilurtuut, President of the Nunaturlik Landholding Corporation of Kangiqsujuaq, points out that snowy owls are more abundant in the interior, particularly in the Kattiniq sector (which encompasses the Raglan Mine and the NNiP territory) than in the coastal sector, and that this situation has persisted for at least 10 years.

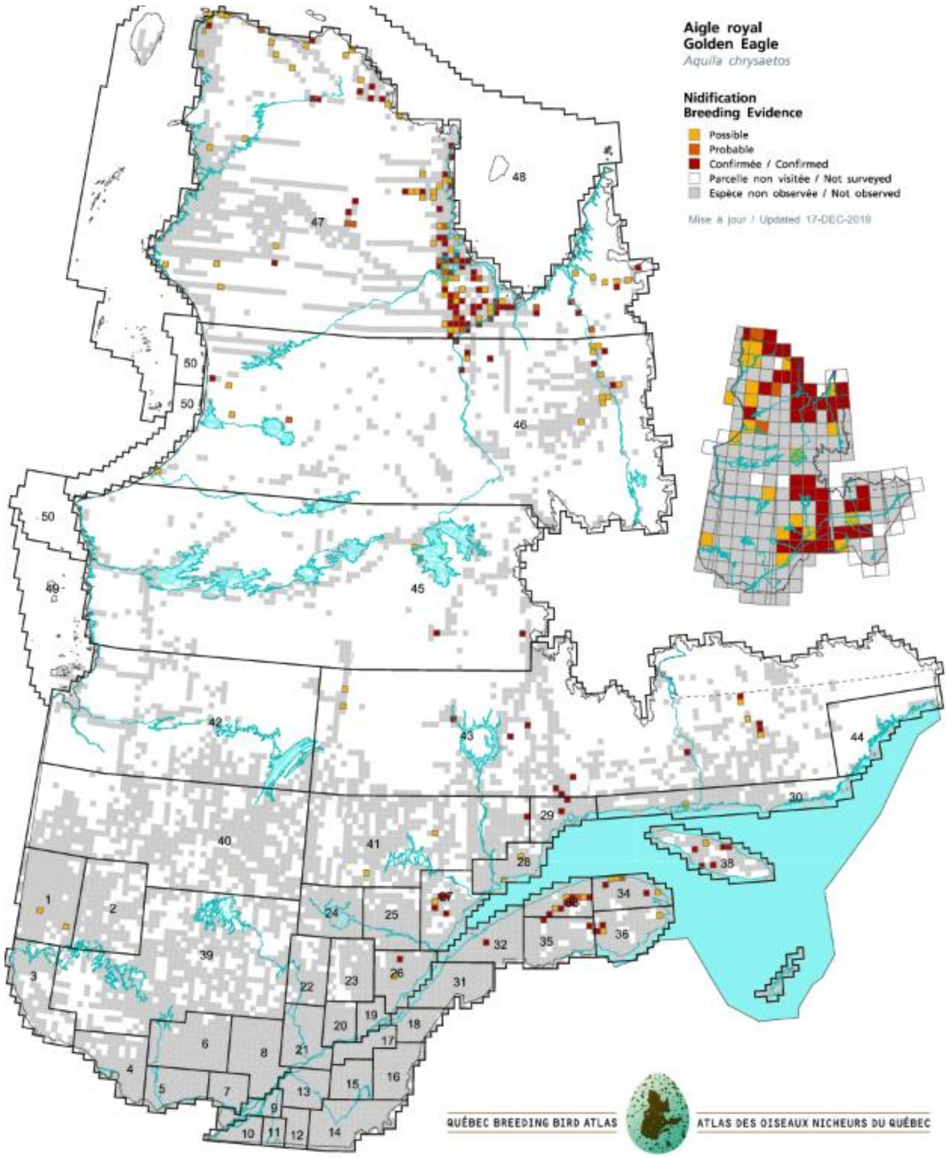
In Québec, birds of prey migrate along two main routes, the Atlantic Corridor and the Appalachian Corridor (Goodrich and Smith, 2008). These two migration routes go to the northern latitudes via Nunavik. In general, raptors follow their prey on their journeys.

A study of the peregrine falcon in Nunavut shows that they arrive in the north in May (Jaffré et al. 2015). According to the local Inuit knowledge of the Kattiniq sector, the spring migration of golden eagles, peregrine falcons and snowy owls instead occurs around the end of March, while the mile migration occurs in September and October (Lukasi Pulurtuut, pers. comm.). Mr. Pilurtuut mentions that he did not notice notable changes in the population sizes, behaviours or nesting areas of birds of prey over the past few years, except for the greater abundance of snowy owls in the Kattiniq sector, as mentioned previously.

<u>Golden eagle (*Aquila chrysaetos)*</u>

The golden eagle population is growing in Québec. The recovery plan for the species for the next decade seeks to maintain a self-sufficient population for northern Québec (EROP, 2020). According to the data from the second *Atlas des oiseaux nicheurs du Québec*, golden eagle nesting was confirmed west of Kangiqsujuaq and near Deception Bay, in the extended study area (Figure 5-4). Due to the poor quality of the habitat north of 52º of latitude, the home range of the golden eagle is very large (EROP, 2020). It was estimated at between 37 and 14,625 km^2 (Miller et al., 2017). During this period, golden eagles feed on a wide variety of prey, from young caribou to small mammals and birds, particularly waterfowl.

Telemetric tracking by the MFFP between 2007 and 2018 of 23 individuals showed that the fall migration of this species in Québec occurred between the end of September and the month of December. According to the MFFP, the spring migration varies according to the latitude of the wintering area and occurs between February and May. The duration of the migration varies from 26 to 58 days, depending on the distance travelled (Kochert et al. 2002 in EROP, 2020). The flying altitude of these birds during the migration period largely depends on the topography. Indeed, a telemetric study of eight golden eagles shows that they fly at lower altitudes near steep slopes or cliffs (about 150 metres of altitude) than above flat or rolling terrain, where the flying altitude is higher (about 300 metres; Katzner et al. 2012). Moreover, the mean flying altitude of golden eagles is higher during migratory movements (284 ± 7 metres) than their mean flying altitude during local movements (108 ± 5 metres). A sectorial study of the inventory of birds during the nesting and migration periods was carried out for the Raglan mine, located approximately 20 km north of the work area. The average flight altitude of the six golden eagles observed was 89 meters, with a minimum altitude of 40 meters and a maximum altitude of 300 meters. The latter were observed in the Deception Bay sector (see stations 11, 12 and 13 on the map in Appendix K).



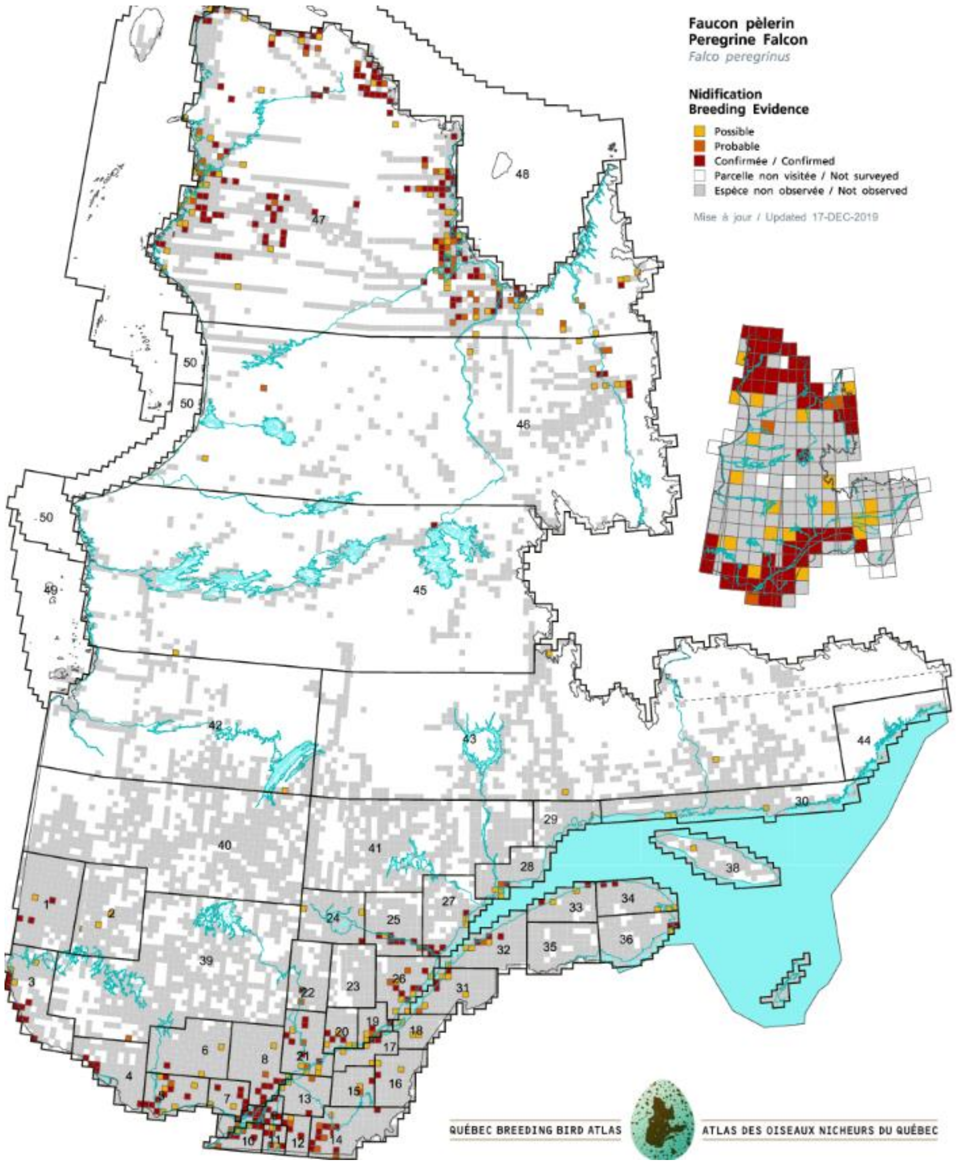
Source: Second *Atlas des oiseaux nicheurs du Québec*

Figure 5-4 : Golden eagle breeding area in Québec

<u>Peregrine falcon *(Falco peregrinus tundrius)*</u>

According to the peregrine falcon recovery plan (EROP, 2018), the population seems to be in remission in Québec. The main objective of this plan for northern Québec is to maintain a self-sufficient population. However, the lack of data in the northern regions does not allow establishment of the size and trend of the nesting population in northern Québec.

The data from the second Atlas des oiseaux nicheurs du Québec indicates that this species nests in the local study area (Figure 5-5). In Nunavik, cliffs and rocky escarpments with an abundance of prey are used as nesting sites. Although the peregrine falcon's preferred prey are birds (e.g. sparrows, waterfowl, etc.), other prey, such as micromammals, may be part of their diet (Bradley and Oliphant, 1991; COSEWIC, 2007). Given that they are predators rather than generalists, the abundance of the falcon population is relatively stable and not dependent on the demographics of a specific prey (Ratcliffe, 2010 in EROP, 2018).



Source: Second *Atlas des oiseaux nicheurs du Québec*

Figure 5-5: Peregrine falcon breeding area in Québec

The telemetry performed on three mature females in the context of a wind farm project in Montérégie shows that their home range varies between 13 and 250 km^2. However, this study shows that more than half of the time, falcons are found within a 16-km radius of their nest (Tremblay, 2011). A study by Lapointe et al. (2015) conducted on ten peregrine falcons also arrives at the finding that the majority of movements in the nesting period are concentrated within a 16-km radius around the next, but that this radius increases during the nesting season, whether in response to a change in food needs or the reduction of the need to defend a territory or care for nestlings (Newton, 1979 in Lapointe, 2012). The size of the home range of peregrine falcons living in northern Québec is unknown for now. This is subject to change according to the abundance of prey, which is cyclical in some cases (for example, for lemmings).

In the context of this study, a helicopter inventory was conducted in summer 2022 within a 20-km radius around the work area for the raptor inventory, in accordance with the birds of prey inventory protocol (MFFP, 2008). This inventory allowed a peregrine falcon nest to be identified at a distance of 15.81 km south of wind turbine No. 2

planned for this project (Map 5-2). However, the aggressive attitude of the two adults present on the site did not allow the number of eggs or young in the nest to be counted. A lone individual was also observed less than 10 km southwest of the work area (Map 5-2). No other bird of prey was identified during this helicopter inventory.

Peregrine falcons migrate over long distances, more than 8,000 km, travelling 198 km per day (Fuller et al. 1998). Contrary to other species, the peregrine falcon migration front is relatively broad and migration is considered to be dispersive in North America (Figure 5-6; Fuller et al. 1998). According to a study conducted in Nunavut between 1982 and 2008, peregrine falcons would be vulnerable to the climate conditions encountered during the fall migration (Franke et al. 2011).

An inventory during the fall migration period was conducted in the context of this study, between September 10 and October 3, 2022, to document the migration of birds near the work area. No bird of prey was observed during this period.

Source: Fuller et al., 1998

Figure 5-6: Spring and fall peregrine falcon migration

5.3.6.3 Waterfowl and other aquatic species

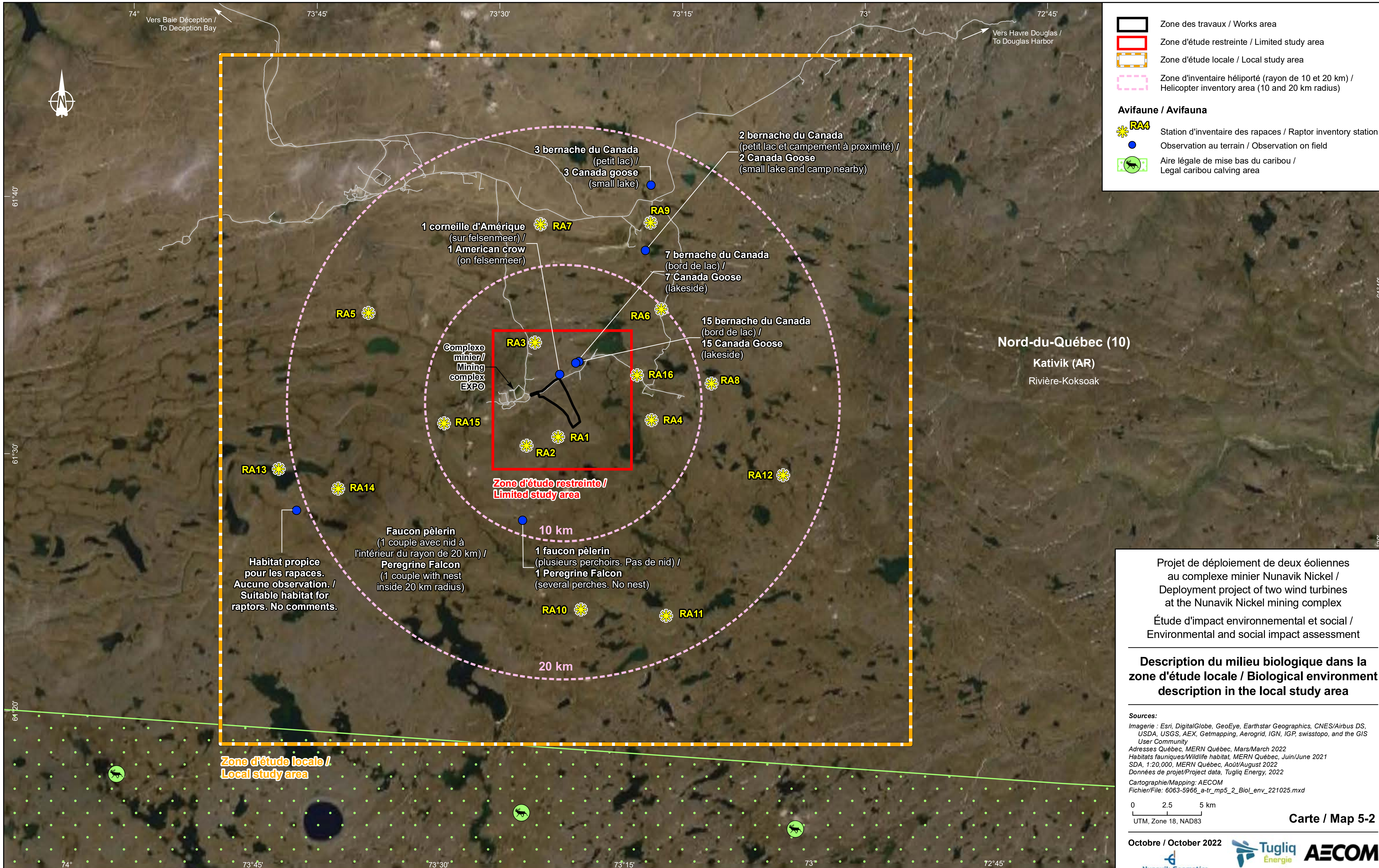
Several waterfowl species were observed in the extended study area during the initial NNiP impact statement (Genivar, 2007). Among them, we should mention mallard, American black duck, tundra swan, common merganser, long-tailed duck, red-throated loon and common loon (Table 5-8). Canada goose and snow goose are among the species frequently observed in the local study area. Although they do not have special status, these two species occupy a special place in Inuit culture.

Waterfowl were inventoried during a helicopter inventory conducted in summer 2022 within a 20-km radius of the work area.

Canada goose (*Branta canadensis*)

The Canada goose is one of the migratory species for which hunting is governed by the Canadian Migratory Birds Regulations (ECCC, 2022). The Atlantic population, which is found in Nunavik, has increased significantly since the 1970s and is currently in decline (Government of Canada, 2015a). The present estimate reports 164,000 breeding pairs, compared to approximately 200,000 breeding pairs in the 2010s (U.S. Fish and Wildlife Service, 2022). Canada geese breed in marshlands or near lakes and rivers. When the young can follow their parents, they occupy vaster territories (between 1.7 and 14 km^2) containing bodies of water (MFFP, 2019). Some populations are resident, meaning that they do little or no migration, while other populations do major migrations over thousands of kilometres.

The Canada geese observed in the study area migrate in the spring to return to their nesting territory in the Arctic tundra. When fall arrives, Canada geese migrate south with their brood. The data obtained from rings returned during the Canada goose hunt by the James Bay Cree communities indicate that the Atlantic population (AP) tends to migrate in the interior, contrary to the other populations (Figure 5-7; Giroux et al. 2022). Recent telemetric tracking of Canada geese nesting in the vicinity of the Pivurnituk River shows that all the marked birds migrated in the interior during their fall migration (J.F. Giroux, unpublished data in Giroux et al. 2022). Data obtained on six Canada geese indicate that the distance travelled during migration is about 3,000 to 4,000 km and that the individuals stop about every 400 km (Giles et al. 2013). In a migration period, their flying altitude is generally high, up to several kilometres. The sector study of the fall migration of birds near the Raglan Mine reports a mean flying altitude of 116 metres for Canada geese (SNC-Lavallin, 2008).



Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex

Étude d'impact environnemental et social / Environmental and social impact assessment

Description du milieu biologique dans la zone d'étude locale / Biological environment description in the local study area

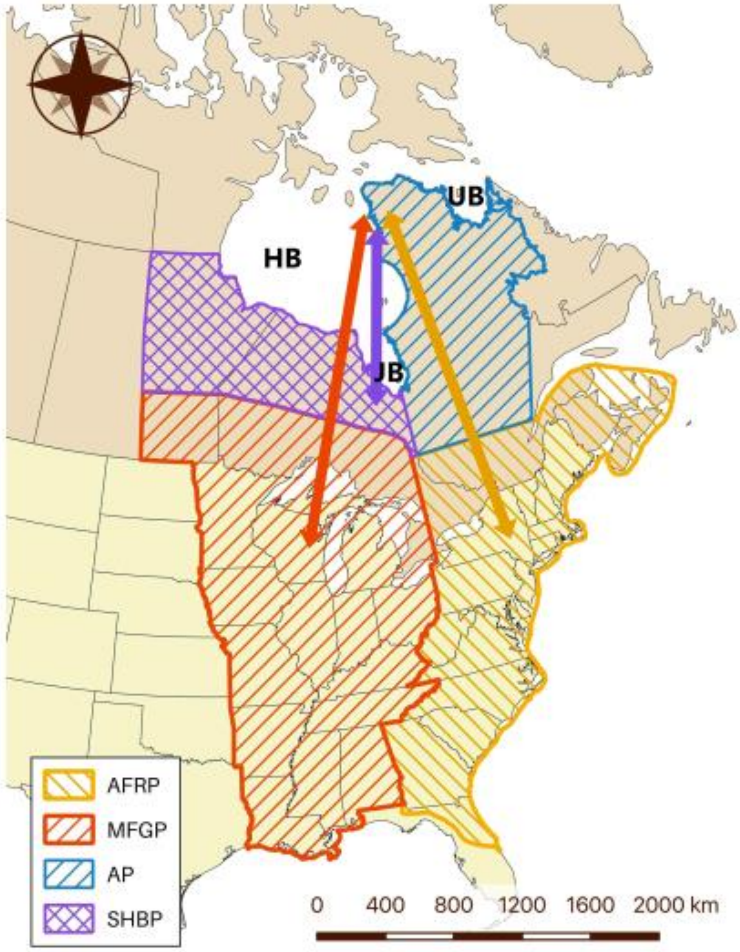
Sources:
Imagerie : Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Adresses Québec, MERN Québec, Mars/March 2022
Habitats fauniques/Wildlife habitat, MERN Québec, Juin/June 2021
SDA, 1:20,000, MERN Québec, Août/August 2022
Données de projet/Project data, Tugliq Energy, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp5_2_Biol_env_221025.mxd

Carte / Map 5-2

Octobre / October 2022

Nunavik Geomatics · Tugliq Énergie · AECOM



Source: Adapted from U.S. Fish and Wildlife Service 2021 in Giroux et al., 2022

Figure 5-7: Approximate breeding areas and migration routes for the Atlantic Flyway Resident Population (AFRP), the Mississippi Flyway Giant Population (MFGP), the Atlantic Population (AP) and the Southern Hudson Bay Population (SHBP)

According to the inventories conducted in summer 2022 by AECOM, during the nesting period, 27 Canada geese were observed within a 20-km radius around the work area, allocated near a lake or a body of water. Moreover, the inventories conducted during the fall migration period observed 75 Canada geese, but all the individuals observed passed over 1 km away from the work area. The data obtained in fall 2022 thus does not allow a decision on a flying altitude for Canada geese above the work area.

During the public consultations, Lukasi Pilurtuut, an Indigenous person using the territory for hunting, mentioned that he had not noticed significant changes in the behaviour or size of the Canada goose population over the past few years. He specified that Canada geese still migrate at the same times, arriving in the region around the end of March and the beginning of April to nest around Kangiqsujuaq before leaving for the south in September and October. He specified that at the end of October, all the Canada geese have left for the south. Mr. Pilurtuut also indicates that he has not noticed changes over the past few years concerning the location of the Canada goose nesting sites. Indeed, they essentially visit the same sectors year after year. Nor has he noted changes in the size of the broods he could observe.

Snow goose (*Chen caerulescens*)

Like the Canada goose population, the snow goose represents an important resource for the Inuit. The snow goose hunt is also regulated by the Government of Canada (ECCC, 2022). The snow goose population has increased significantly since the 1970s (Government of Canada, 2015b). In 1998, the greater snow goose was declared overabundant (Lefebvre et al. 2017). To avoid the degradation of the Arctic by overbrowsing by geese, concerted action between Canada and the United States were deployed to stabilize the population. It has generally been stable since 1999. The current population is declining, estimated at 753,000 individuals, compared to 1,000,000 individuals in the 2010s (U.S. Fish and Wildlife Service, 2022).

The greater snow goose uses the extended study area during its migrations; its breeding area is found in Canada's High Arctic (Figure 5-8). The spring and fall migration covers over 4,000 km, mainly in the interior. Snow geese arrive at their destination around the end of May. The fall migration occurs at the beginning of September, when the soil and the freshwater ponds start to freeze (ECCC, 2005). The sector study pertaining to the fall migration of the birds near the Raglan Mine reports a mean flying altitude of 145 metres for snow geese (SNC-Lavallin, 2008).

The inventories conducted in 2022 during the fall migration period allowed 221 snow geese to be counted (Table 5-10). All the individuals observed passed more than 1 km away from the work area.

Figure 5-8: Snow goose range

According to the local knowledge, snow geese are less abundant in the vicinity of Kangiqsujuaq in the past few years (about 7 or 8 years, according to Lukasi Pilurtuut). He indicates that some of them have changed their migration route, moving away from the coastal sector and circulating more in the interior, in the Kattiniq sector, west of Kangiqsujuaq and south of Salluit. He does not really know how to explain this situation. According to him, geese arriving from the north and flying by night could be attracted by the lights of the CRI and Glencore mining complexes, located in the interior, west of the community. These geese would then continue their migration southward while remaining in the interior, thus abandoning the coast and the vicinity of Kangiqsujuaq. Mr. Pilurtuut also points out that snow geese nonetheless continue to circulate near Kangiqsujuaq during their fall and spring migrations, but are less numerous than in the past in this sector. He adds that the goose migration dates have not changed over the past few years. Thus, in March and April, they sometimes land around the community (and sometimes in the interior) during their migration northward. They pass near the community again between mid-August and mid-October, when they return to the south.

5.3.6.4 Land birds

Several land bird species are likely to visit the local study area (Table 5-9). As mentioned during the public consultations (section 4), ptarmigans are species that are an integral part of Inuit culture. No ptarmigan was observed in the work area during the inventories conducted in summer 2022.

A standardized area count (CWS, 2007) was done in the work area for land birds in summer 2022. These standardized areas represent four quadrants of 10 hectares each, distributed in the work area (Appendix J). A small number of birds belonging to three different species were observed during these inventories. Indeed, only the snow bunting, the Lapland kingspur and the buff-bellied pipit were observed, for a total of 15 birds. The density observed in the work area thus was 0.38 birds/ha, which is relatively low compared to other sectors of the NNiP, where a density of 0.6 birds/ha was observed (Nanaujaq sector; AECOM, 2022), but comparable to other sectors, where 0.19 birds/ha were inventoried (Delta sector; AECOM, in preparation). The patches located in wetlands in the Delta sector were those with the greatest density, or 2.3 birds/ha (AECOM, in preparation).

In addition to the birds observed during the standardized inventories, fortuitous observations made it possible to inventory the presence of common ravens and American crows in the local study area.

Table 5-9 presents the inventory effort and the results obtained in the nesting period in summer 2022 (Maps 5-2 and 5-3).

An avian wildlife inventory was also conducted in the fall period to document the passage of birds in the sector of the work area. To cover the entire migration period, inventories by fixed observation station were conducted between September 10 and October 3, 2022, for a total of 99 hours of observation. In all, 337 individuals were observed, mainly including Canada geese and snow geese. Snow geese were observed up to September 20, 2022. Subsequently, only snow buntings, unidentified sparrows and common ravens were observed near the work area. The results are presented in Table 5-10.

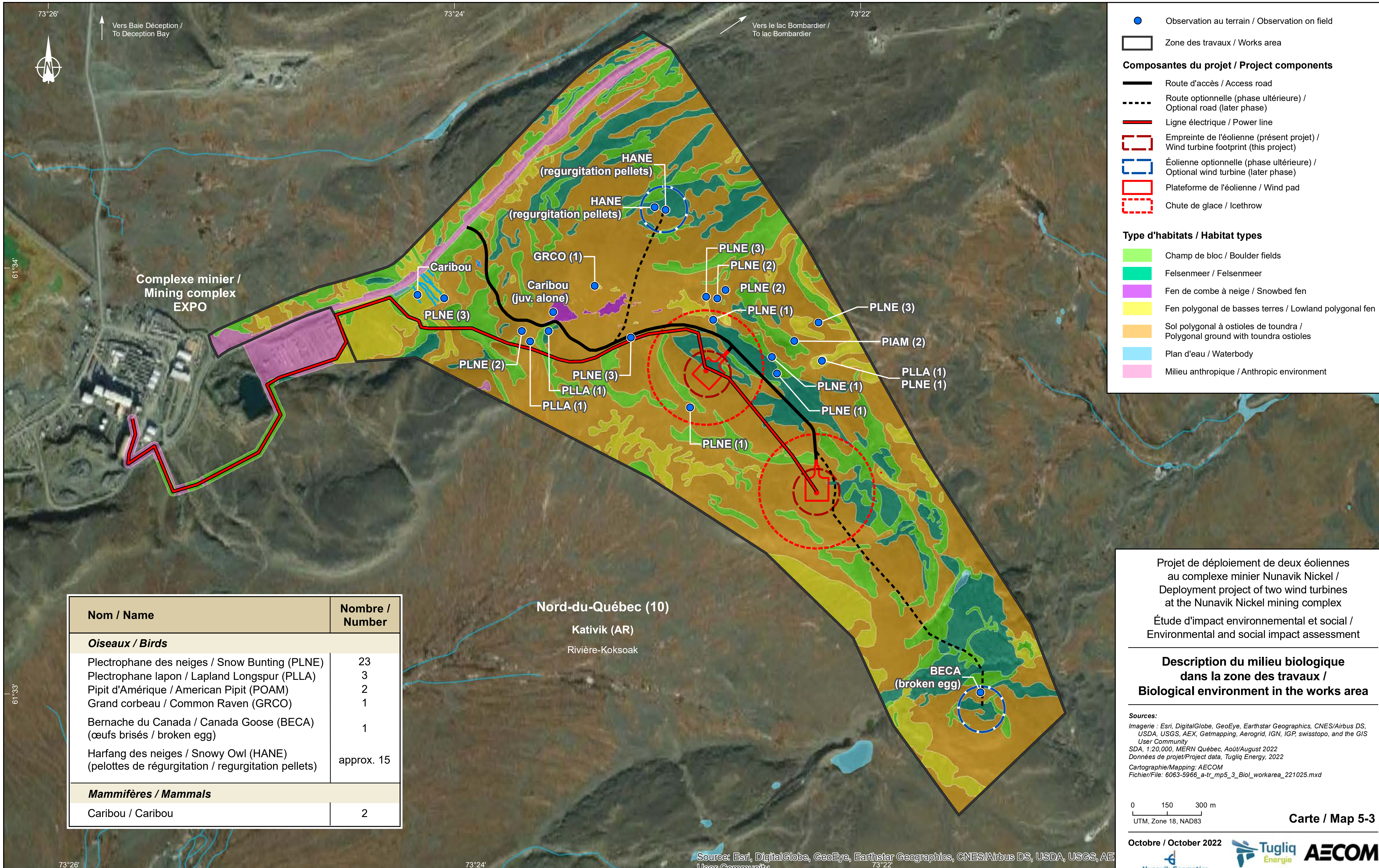
Table 5-9: Results of bird inventories during the 2022 nesting period, in the local study area or in the work area

Species	Male	Female	Indeterminate sex	Number of eggs	Total number	Observation	Habitat
Local study area (20-km radius around the wind turbines)							
Observations by helicopter flyover							
Canada Goose	-	-	27	-	27	-	Lakeside
American Crow	-	-	1	-	1	-	Felsenmeer
Peregrine Falcon	-	-	3	-	3	One pair with nest and one lone individual	Cliff
Work area							
Observations by standardized area (40 ha inventoried)							
Buff-bellied Pipit	1	1	-	-	2	In flight	-
Snow Bunting	7	4	-	-	11	-	-
Lapland Kingspur	2	-	-	-	2	-	Felsenmeer
Fortuitous observations							
Snow Bunting	-	-	12	-	12	-	-
Lapland Kingspur	-	-	1	-	1	-	-
Common Raven	-	-	1	-	1	-	-
Snowy Owl	-	-	-	-	NA	Regurgitated pellets	Felsenmeer
Canada Goose	-	-	-	-	1	Predated egg	Boulder field

Table 5-10: Result of bird inventories during the fall 2022 migration, near the work area

Species	Number	Mean flying altitude (m)
Raptor	No observation	
Waterfowl		
Canada Goose	75	100[A]
Snow Goose	221	100[A]
Sparrows and others		
Sparrow sp.	2	1.0
Snow Bunting	7	0.5
Common Raven	32	4.0
Total	**337**	**-**

[A]: The snow geese and Canada geese observed in the vicinity of the work area were engaged in feeding behaviour, passing from one wetland to another. The flying altitude observed thus is not representative of a typical migration flight.



Nom / Name	Nombre / Number
Oiseaux / Birds	
Plectrophane des neiges / Snow Bunting (PLNE)	23
Plectrophane lapon / Lapland Longspur (PLLA)	3
Pipit d'Amérique / American Pipit (POAM)	2
Grand corbeau / Common Raven (GRCO)	1
Bernache du Canada / Canada Goose (BECA) (œufs brisés / broken egg)	1
Harfang des neiges / Snowy Owl (HANE) (pelottes de régurgitation / regurgitation pellets)	approx. 15
Mammifères / Mammals	
Caribou / Caribou	2

Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex

Étude d'impact environnemental et social / Environmental and social impact assessment

Description du milieu biologique dans la zone des travaux / Biological environment in the works area

Sources:

Imagerie : Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
SDA, 1:20,000, MERN Québec, Août/August 2022
Données de projet/Project data, Tugliq Energy, 2022

Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp5_3_Biol_workarea_221025.mxd

Carte / Map 5-3

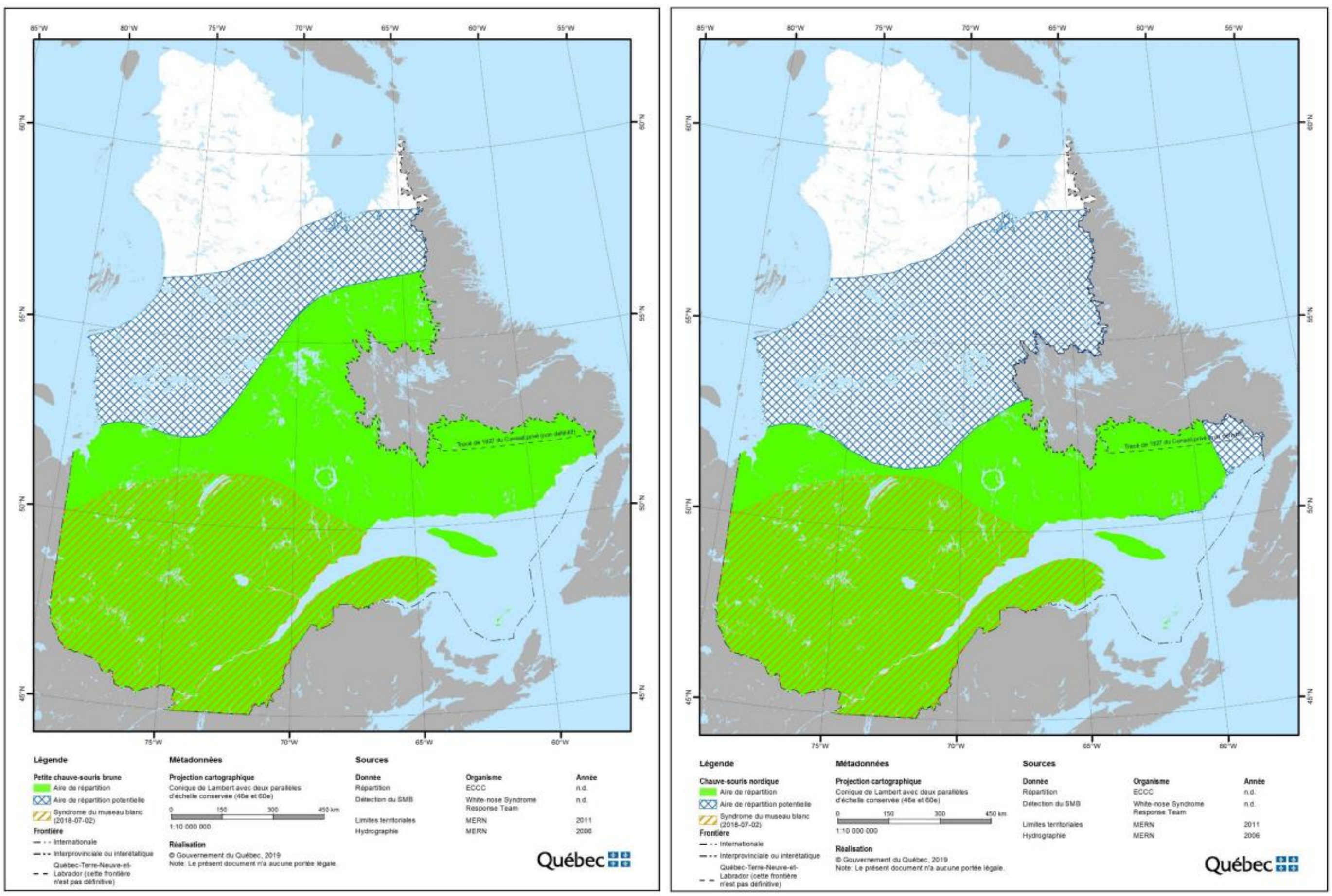
Octobre / October 2022

Nunavik Geomatics · Tugliq Énergie · AECOM

5.3.7 Chiroptera

In Québec, eight bat species are present, including five species classified as resident and three species classified as migratory. The resident species spend the winter in hibernacula, which may be mines or grottos, while the migratory species spend the winter farther south and return to Québec in summer. Among the five resident species, the northern myotis, little brown myotis and tri-coloured bat are classified as endangered species according to the federal government's *Species at Risk Act*. According to the recovery plan of these three species (Équipe de rétablissement des chauves-souris du Québec, 2019), their confirmed range is found south of the 54th parallel. Only the little brown myotis and the northern myotis, both part of the genus *Myotis*, have the potential to be found in Nunavik (Figure 5-9). However, according to Figure 5-9, the extended study area of the project would be north of the potential range of these two species (Équipe de rétablissement des chauves-souris du Québec, 2019).

According to the information gathered during public hearings in fall 2012, two people affirm they observed bats in Kuujjuaq and Quaqtaq (Genivar, 2013), respectively 473 km and 208 km from the work area. Mentions of bats in flight were also reported in Salluit (138 km north of the work area) and Kangiqsujuaq (75 km east of the work area; Équipe de rétablissement des chauves-souris du Québec, 2019).



Source: Équipe de rétablissement des chauves-souris du Québec, 2019

Figure 5-9: Range of the little brown myotis (left) and the northern myotis (right)

Note: The green shading in this figure represents the confirmed range for each species, while the squared shading farther north represents their potential range.

The range and use of the habitat by bats are still little known in Nunavik. In southern Québec, bats use grottos, rock crevices or sometimes tree bark as a hibernaculum or as a breeding habitat. Buildings can also be used as rest areas. Over the past few years, no direct bat sighting was made at the Expo site or in its vicinity by the mine employees (Marie-Ève Ratthé, CRI, pers. comm.).

In southern Québec, the feeding habitat for *Myotis* ssp. is mainly found under the forest cover, in openings, on the edge of woodlands or near or on the shore of bodies of water. A great abundance of insects is important in the selection of the feeding habitat (Équipe de rétablissement des chauves-souris du Québec, 2019). In the case of Nunavik, watering places and wetlands could serve as feeding sites. Genivar (2013) mentions the potential of the Deception River, Deception River East and Kangilllialuk River valleys to this effect.

The valleys of the watercourses could serve as natural corridors for chiroptera movements. In addition to offering protection against wind, these valleys represent a potential feeding habitat. In the local study area, only the Pivurnituq River valley could serve as a potential mobility and feeding habitat. The work area presents very little potential for the presence of chiroptera, given its topography in the form of plateaus and hills.

Chiroptera inventories were conducted in the work area in summer 2022. In all, three sound level meters specially designed for these inventories (Wildlife Acoustics, SM4BAT FS model) were positioned in the wetlands on both sides of the two projected wind turbines (Appendix J). The devices were programmed to inventory the summer period and the fall migration period (from July 21 to September 12, 2022). In all, 62 hours were recorded in the nocturnal period. The devices began recording one hour before sunset and ended at 6 a.m. the next morning. Figure 5-10 shows that all the data recorded was classified by the analysis software as noise largely caused by wind. A manual validation of 5% of the analyses allowed confirmation that no bats passed through the work area during the study period. Consequently, based on the results obtained and the habitats observed in the work area, the potential presence of chiroptera in this sector is considered practically nil.

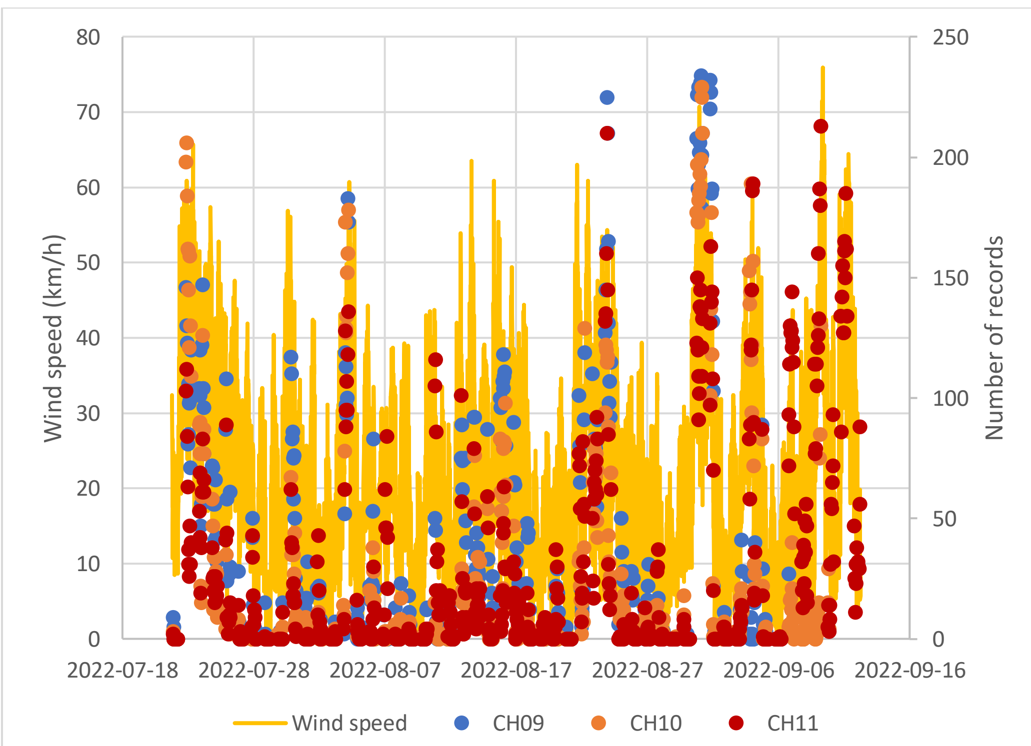


Figure 5-10: Number of recordings made by the three sound level meters depending on the wind conditions in the work area in 2022

5.3.8 Land mammals

According to the data of NNiP's initial impact statement (Genivar, 2007), a dozen land mammal species live on the Arctic tundra and are likely to use the local study area at some time of the year (Table 5-11). The homogeneity of the Arctic territory and the harsh winter conditions contribute to the low wildlife diversity of the environment.

Among the species listed, wolverine, least weasel and polar bear have a special status in Québec (Table 5-11).

Table 5-11: Land mammals likely to use the local study area (taken from Genivar, 2007)

French name	English name	Latin name	Relative abundance
Campagnol des champs	Meadow vole	*Microtus pennsylvanicus*	Low to high[B]
Lemming d'Ungava	Ungava lemming	*Dicrostonyx hudsonius*	Low to high[B]
Lièvre arctique	Arctic hare	*Lepus arcticus*	Low to medium
Caribou	Caribou	*Rangifer tarandus*	Low to high[C]
Boeuf musqué	Muskox	*Ovibos moschatus*	Low
Carcajou[A]	Wolverine	*Gulo gulo*	Rare
Hermine	Ermine	*Mustela erminea*	Medium
Belette pygmée[A]	Least weasel	*Mustela nivalis*	Low
Loutre de rivière	River otter	*Lutra canadensis*	Low
Renard arctique	Arctic fox	*Alopex lagopus*	Low to medium[B]
Renard roux[D]	Red fox	*Vulpes vulpes*	Low
Loup[E]	Wolf	*Canis lupus*	Low
Ours blanc[A]	Polar bear	*Ursus maritimus*	Low

[A] Species at risk
[B] The abundance of these species varies according to a cycle of about 3 to 5 years.
[C] The abundance of caribou varies according to the seasons.
[D] This species has extended its range considerably northward with climate warming.
[E] Lone wolf or wolf in pack.

In addition to the species identified in Table 5-11, four black bears were observed in 2022 near the Ivakkak site, a mother with two cubs and a lone individual (Marjorie Belzile, CRI, pers. comm.).

5.3.8.1 Caribou

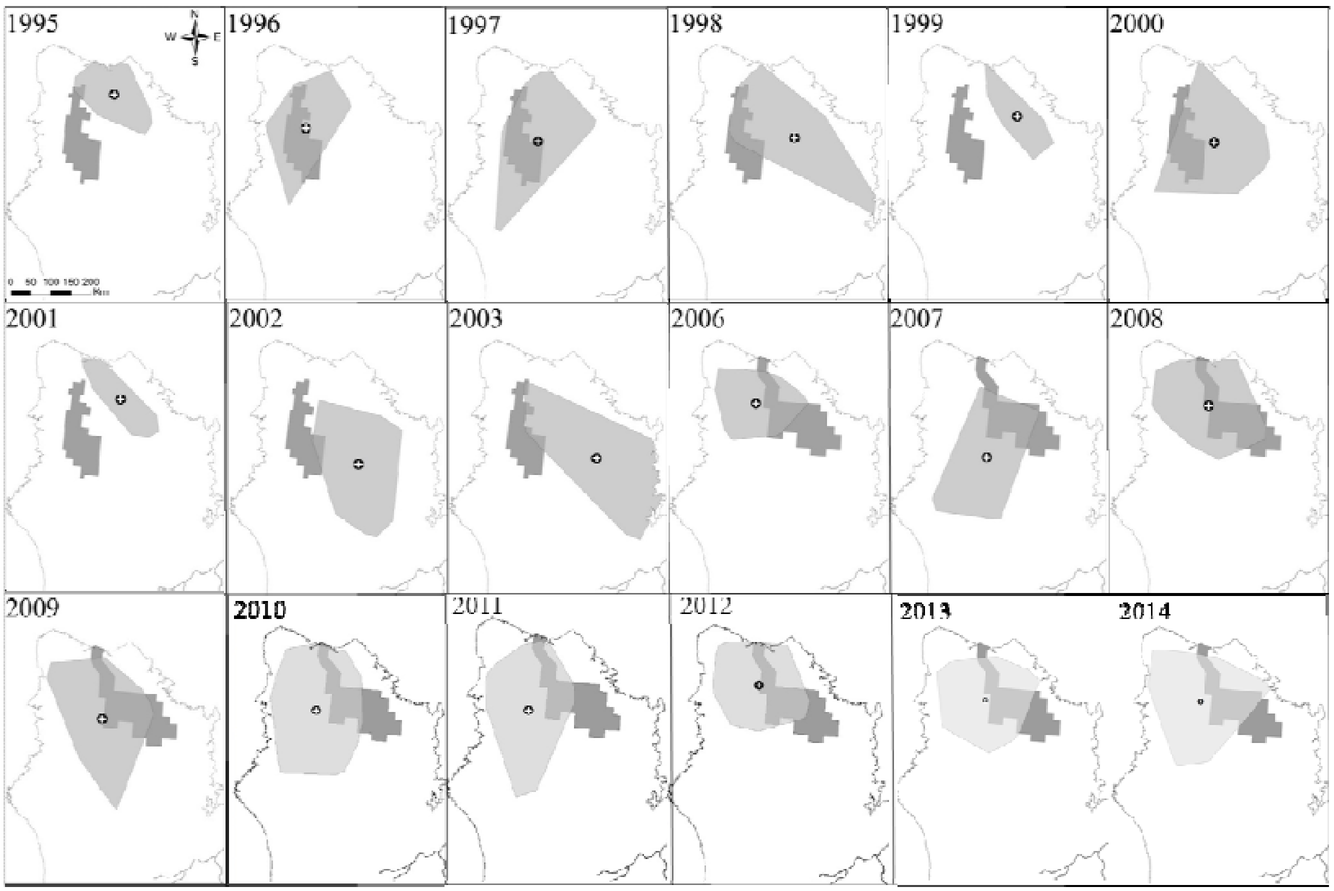
The woodland caribou (*Rangifer tarandus*) is a land mammal present in the extended study area. This species is very important to the Inuit, due to its abundance and the nutritional value of its flesh (ECCC, 2005). In Québec, three caribou ecotypes related to use of the ecosystem are present, the migratory ecotype (the status of this ecotype is under analysis), the mountain ecotype (species designated as threatened in Québec and endangered in the SARA at the federal level), and the woodland ecotype (designated a vulnerable species in Québec and threatened according to the SARA). The ecotype present in the study area is the migratory caribou. Two distinct populations are part of this ecotype in Québec, the George River Herd and the Leaf River Herd (LRH), which occupies the extended study area. The LRH uses the study area during the calving period and as a summering area, between the months of May and September.

The data observed from the tracking collars installed on adult individuals between 2008 and 2014 gives a good overview of the areas used by caribou (Figure 5-11). The fall migration begins up to the rutting period (end of October to beginning of November) and then continues until the caribou reach the wintering area, where they will stay from December to the end of March. In spring, the herd follows its spring migration (end of April to mid-May) to return to the calving area (Figure 5-11).

Source: Taillon et al., 2016

Figure 5-11: Seasonal caribou migrations of the Leaf River Herd (LRH)

The LRH therefore uses the local study area as a summering and calving area, but it is not legally delineated at the projected implementation site of the two wind turbines. Indeed, the calving area presents spatiotemporal dynamics (Figure 5-12). The legal wildlife habitat, namely the calving area legally protected by the Gouvernement du Québec under the *Act respecting the conservation and development of wildlife* (ACDW; CQLR, c. C 61.1, r. 18), was expanded in 2004 and has remained the same ever since, covering an area of 153,400 km² (Couturier et al. 2004; Taillon et al., 2016). Although the legal limit of this habitat begins about 24 km southwest of the work area planned for implementation of the wind turbines (Map 5-3), the sector of the work nonetheless constitutes a habitat used by the caribou population. Moreover, during inventories conducted in summer 2022, two caribou sightings were made in the work area (Map 5-3). Compared to the legally recognized calving area, the work area represents approximately 0.003% of the territory recognized for the calving area.

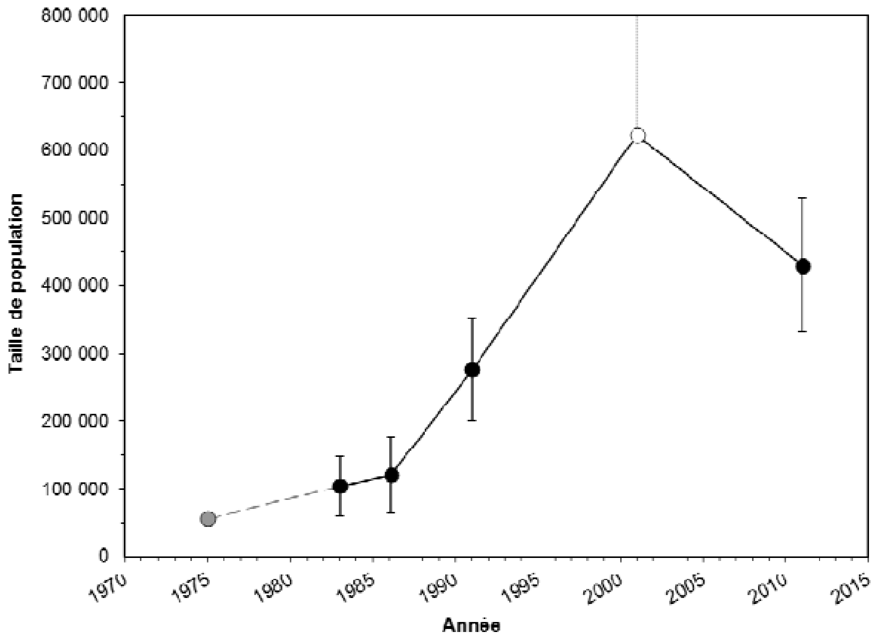


Source: Taillon et al., 2016

Figure 5-12: Caribou calving area of the Leaf River Herd between 1995 and 2014 (light grey). The legally recognized calving area is presented in dark grey.

The studies show that in fall and winter, migratory caribou prefer the regions with low snowfalls and high availability of lichen. In summer, the caribou visit the cooler areas, probably corresponding to a lower prevalence of insects. They also would avoid disturbed areas (Sharma et al. 2009). This presence on the site also corresponds to the biological needs of the species for the accomplishment of its lifecycle, starting from the south and migrating northward for calving due to the lower abundance of predicators in the north, and returning south for the less harsh winter period. During this migration, the caribou use sites rich in shrubs (S*alix* sp. and *Betula* sp.), grasses, herbaceous plants and terrestrial lichen (Plante, 2020). The projections concerning the caribou response to climate change show an increase in the range of the Leaf River Herd (Sharma et al. 2009). The direct and indirect consequences of climate change possibly include a change in habitat use, migration habits, food behaviours and demographics. These changes could create significant social and economic stress for the Inuit (Sharma et al. 2009).

Tracking of the LRH since 1975 shows that the population size increased up to 2001, when it was estimated at 628,000 individuals, and then decreased. The most recent inventory conducted in 2011 shows a population of 430,000 caribou (Figure 5-13). Demographic indicators show that the population remained stable between 2008 and 2013. Since 2013, the population has been in decline. In 2014, the fall recruitment rate was 14 calves/100 females, which is very low (COSEWIC, 2017). The population size estimate done in 2015 shows about 332,000 individuals (Taillon et al. 2016), while COSEWIC (2017) reports an estimate of 199,000 individuals in 2016, a considerable decrease. In 2018, the population was still in decline, falling to 187,000 individuals (MFFP, 2018). To protect this species, the Gouvernement du Québec has prohibited hunting of migratory caribou since February 1, 2018 (MFFP, 2018). Although this species has no legal status in Québec or Canada, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) listed the species as endangered in 2017.



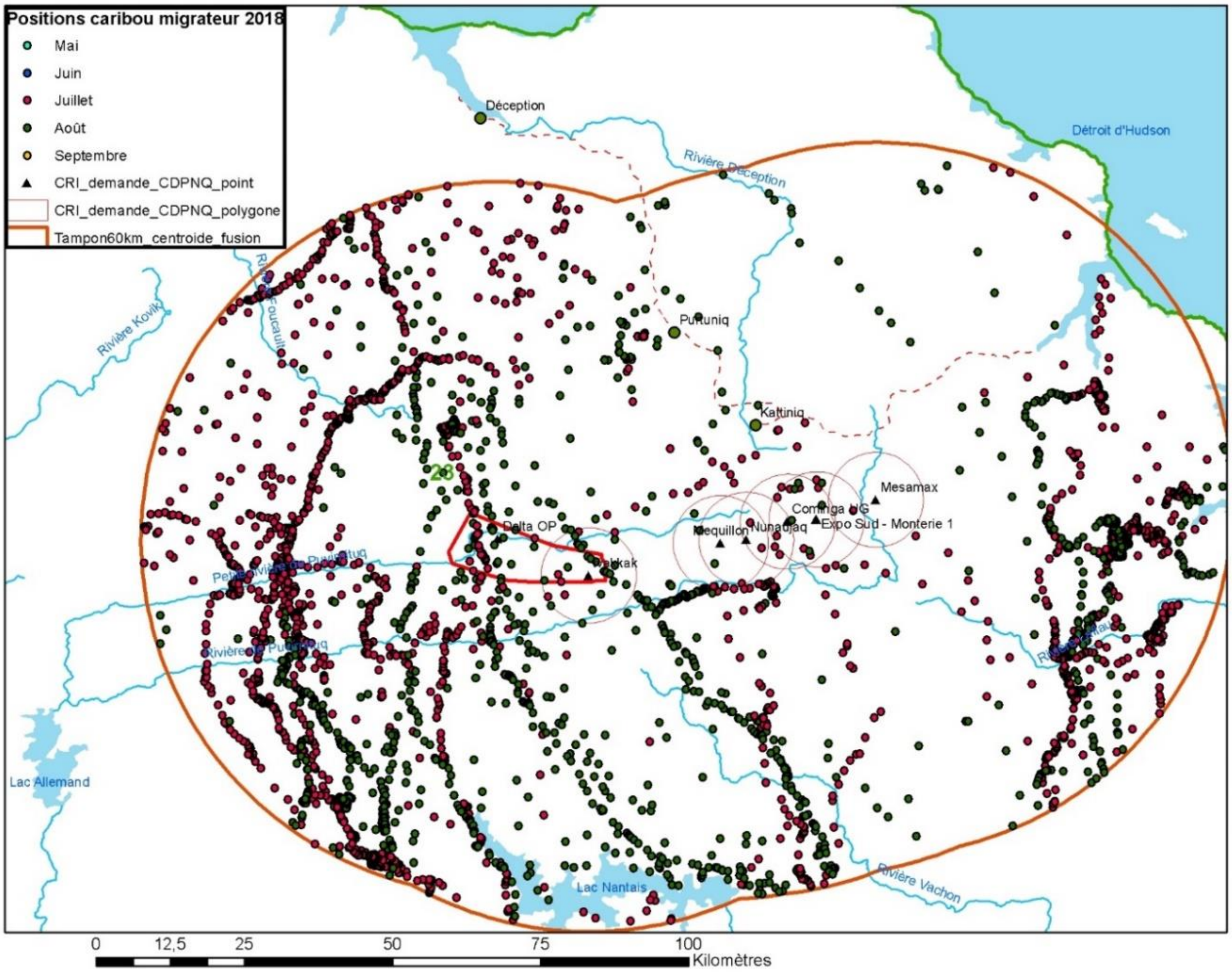
Source: Taillon et al., 2016

Figure 5-13: Size of the Leaf River Herd estimated from the aerial inventories conducted between 1975 and 2011[22]

During the vegetation inventory conducted in summer 2022 on the NNiP site, more specifically on the Expo South site, and on the projected implemented site of the wind turbines, signs of the presence of caribou were observed on the ground. Indeed, tracks, feces and hairs were found in certain vegetation stations. Caribou were also observed in the work area, one mature individual and one juvenile individual. These two individuals represent distinct sightings and were found on the wetlands and the tundra ostiole polygonal soils (Map 5-3).

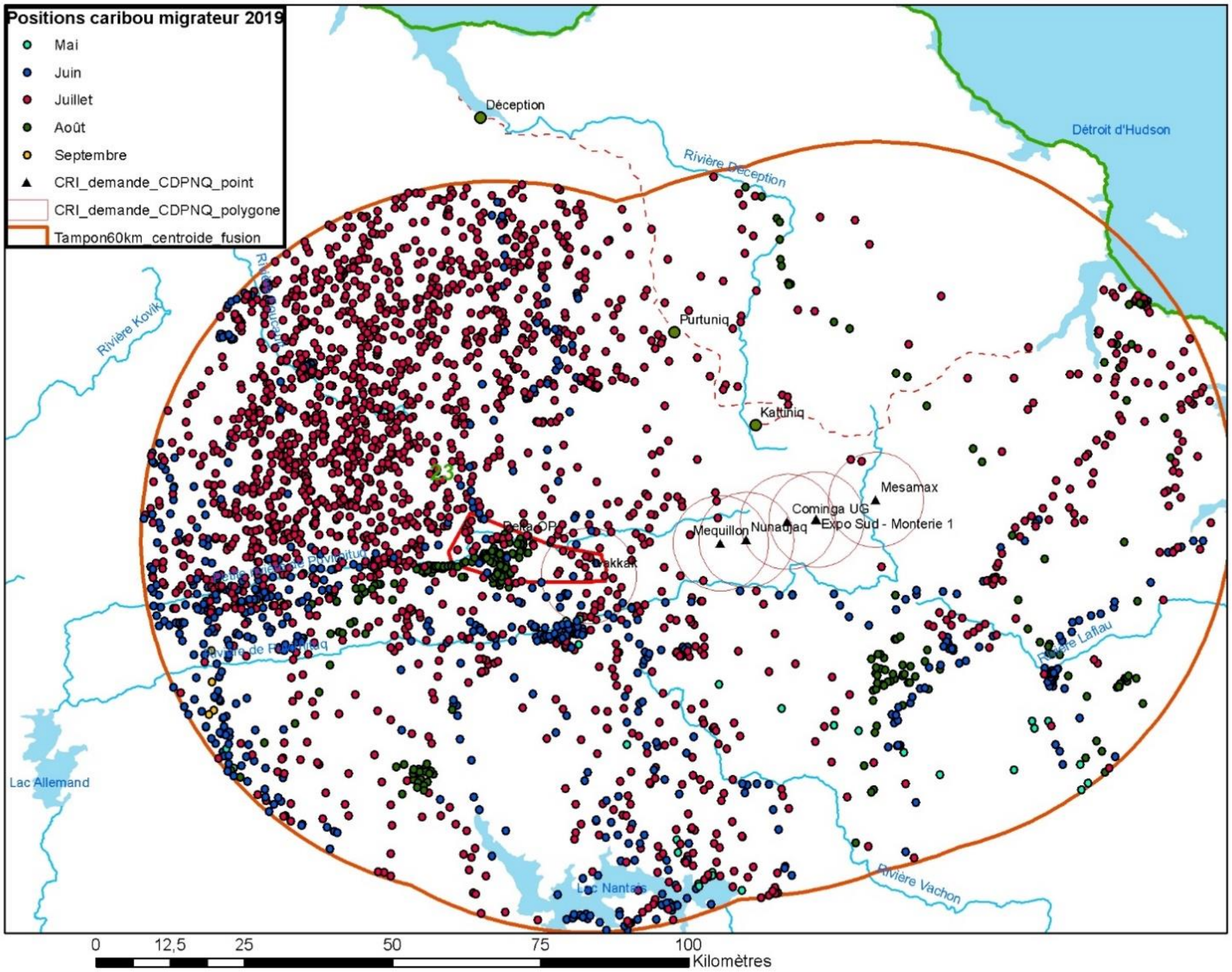
The following figures (Figures 5-14 to 5-17) present the use of the NNiP sector by migratory caribou between 2018 and 2021. This data is taken from the telemetric tracking done by the MFFP and shows that the majority of the caribou avoid the sector with significant mining activities, such as the South Expo sector. Let us remember that the projected wind turbines are found near this mine site.

[22] The year 1975 (light grey dot) represents a minimal count (without associated error), while the estimate reported in 2001 (white dot) represents the lower limit of the confidence interval (628,000 caribou).



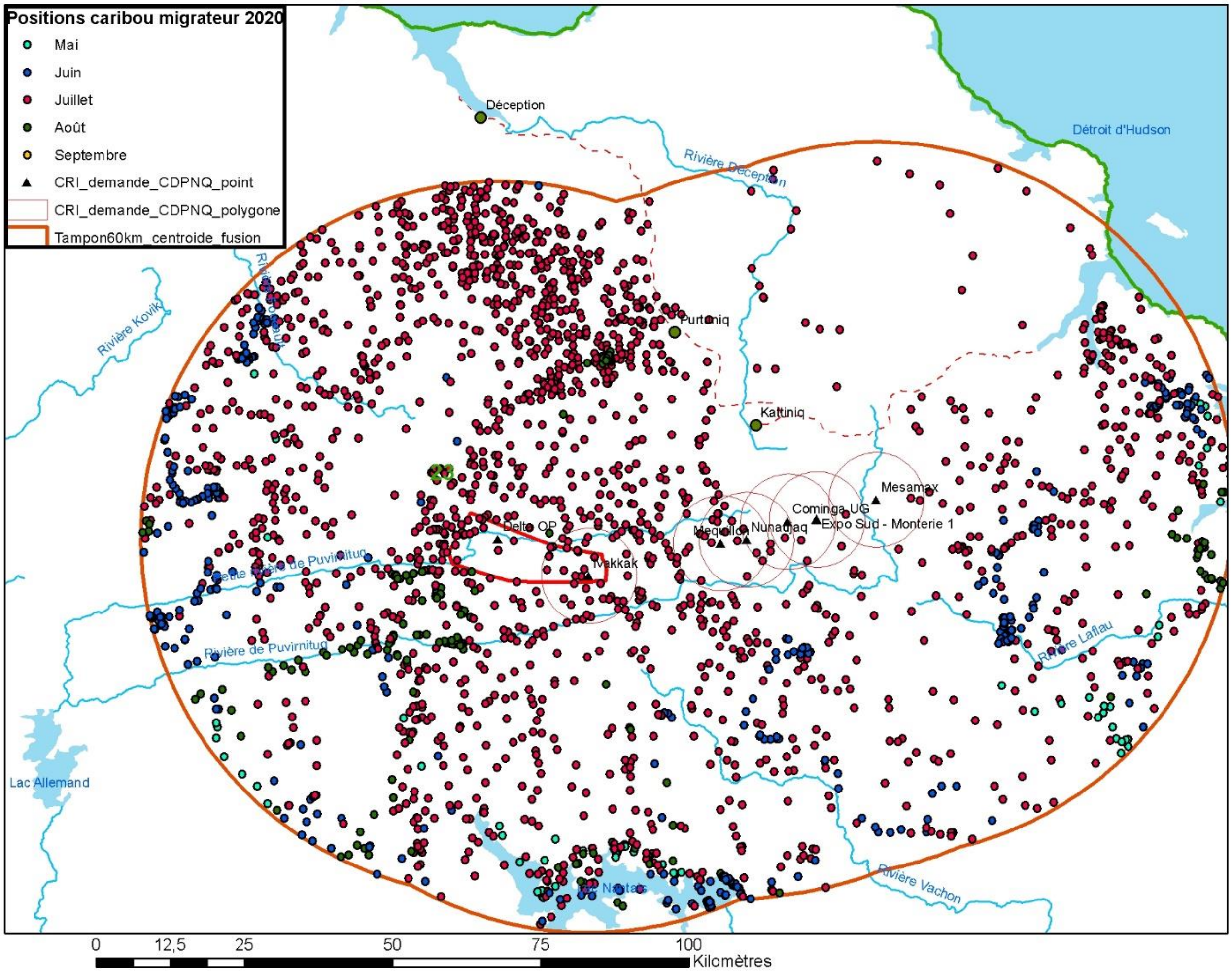
Source: S. Boudreault, Direction de la gestion de la faune du Nord-du-Québec, pers. comm., October 19, 2021

Figure 5-14 : Positions of migratory caribou in 2018



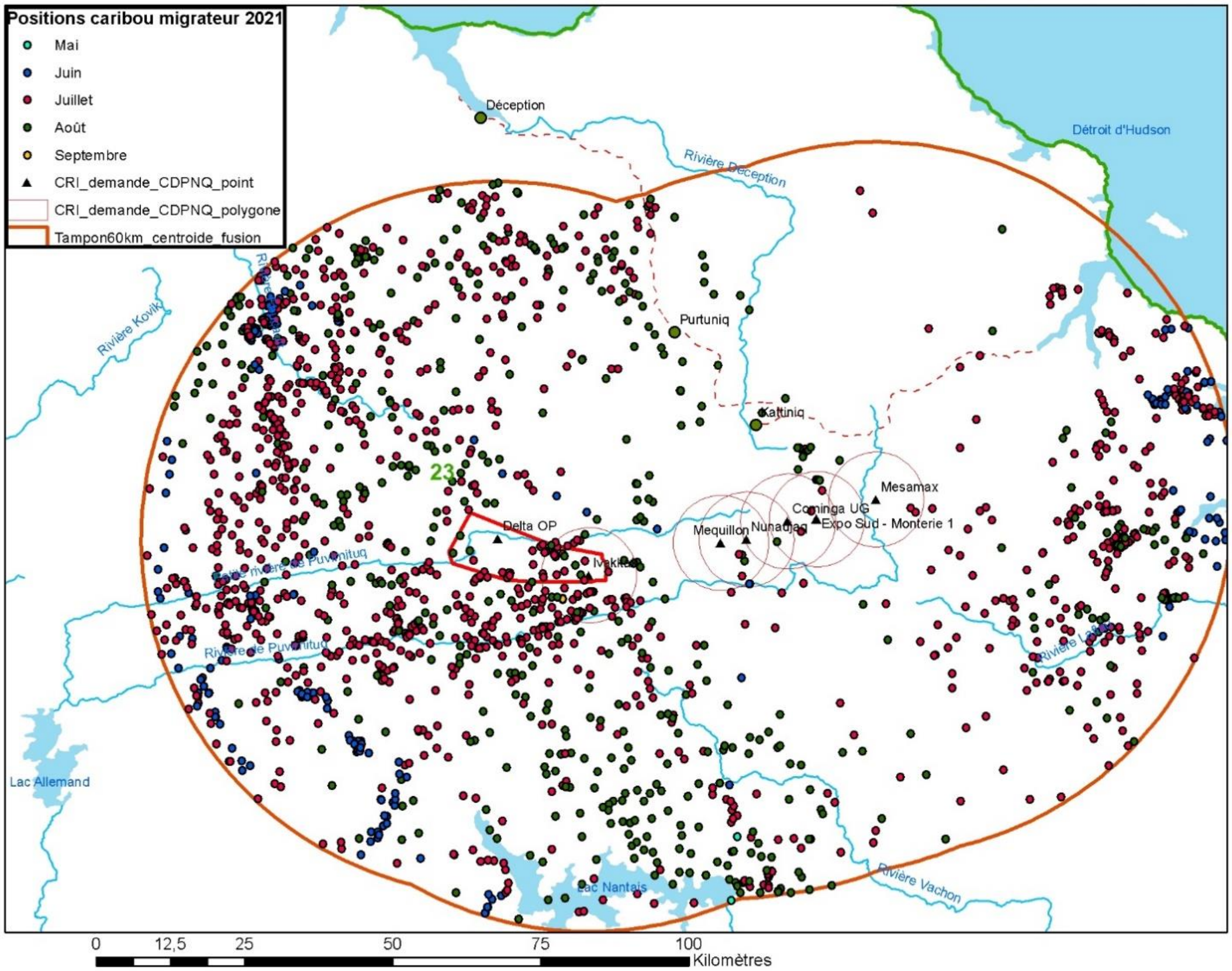
Source: S. Boudreault, Direction de la gestion de la faune du Nord-du-Québec, pers. comm., October 19, 2021

Figure 5-15 : Positions of migratory caribou in 2019



Source: S. Boudreault, Direction de la gestion de la faune du Nord-du-Québec, pers. comm., October 19, 2021

Figure 5-16 : Positions of migratory caribou in 2020



Source: S. Boudreault, Direction de la gestion de la faune du Nord-du-Québec, pers. comm., October 19, 2021

Figure 5-17 : Positions of migratory caribou in 2021

5.3.8.2 Other land mammals

Apart from caribou, signs of the presence of other mammal species were also noted during the inventories conducted in summer 2022. Indeed, fox feces and lemming bones were observed in the work area.

Concerning the wildlife species at risk, we should note that no wolverine population estimate exists for Québec because of its very great rarity. Moreover, during the NNiP initial impact statement, the Salluit and Kangiqsujuaq Inuit interviewed mentioned they had never observed any wolverines (Genivar, 2007). Least weasels were never observed and polar bears are very rarely present in the NNiP area. The CDPNQ does not mention any wildlife species at risk in the vicinity of the Expo site.

5.4 Human Environment

The description of the human environment presents the main social and cultural characteristics of the local communities concerned by the project, the populations of the Inuit villages of Kangiqsujuaq and Salluit. It also addresses the activities practiced at Pingualuit National Park, the use of the access roads leading from Deception Bay to the Expo mine site, the use of Kattiniq-Donaldson Airport, and the practice of wildlife harvesting activities by non-Natives. The landscape, archaeology and the noise climate are also taken into account in the human environment study component.

5.4.1 Socioeconomic and Demographic Profile of the Local Communities

5.4.1.1 Demographics

Nunavik is a vast region that extends from north of James Bay to Hudson Strait and that contains the eastern part of Hudson Bay and all of the lands bordering Ungava Bay. It is bounded on the south by the 55th parallel and on the east by Labrador to form a territory with an area of approximately 507,000 km^2. Today, Nunavik has a population of about 12,000 permanent residents. They essentially live in one of the 14 Inuit villages[23] distributed along the shores of Hudson Bay and Ungava Bay.

The population of Nunavik is very young. In most of the Inuit villages, over 60% of the inhabitants are under 30 years of age, the equivalent of double the corresponding proportion in southern Québec. The population is growing at a rhythm three to four times faster than the Québec average (Makivik Corporation, 2022a).

The Inuit villages closest to the site planned for installation of the wind turbines are Kangiqsujuaq, located about 75 km to the east, and Salluit, a little more than 140 km to the northwest. In 2021, the villages of Kangiqsujuaq and Salluit respectively had 837 and 1,580 habitants (Statistics Canada, 2022). The population of the two villages was relatively young, because the 0-14 year age bracket accounted for nearly 30% of the population in Kangiqsujuaq and 37% in Salluit (Table 5-12). In comparison, the same age bracket accounted for 16% of the total population of the Province of Québec during the same year, a proportion twice as small as in the two Inuit villages.

Table 5-12: Population Distribution by Age in the Villages of Kangiqsujuaq and Salluit, and in the Province of Québec as a Whole, in 2021

Territory	0-14 years	15-64 years	65 years and over	Average age (years)
Province of Québec	16%	63%	21%	42.8
Kangiqsujuaq	29%	66%	5%	28.0
Salluit	37%	59%	4%	25.9

Source: Statistics Canada, 2022

Moreover, the 15-64 year age bracket, the working age population, was also fairly significant in the two Inuit villages, amounting to over 65% of the total population in Kangiqsujuaq and nearly 60% in Salluit, proportions comparable to the one prevailing for the entire province.

The average age prevailing in the two Inuit villages was much lower (28 years in Kangiqsujuaq and nearly 26 years in Salluit) than the one prevailing for the entire province. This is largely explained by the significant presence of people aged 14 years and under, and the small proportion of people aged 65 years and over in Salluit and Kangiqsujuaq.

[23] A15th Inuit village is located at Chisasibi, on the shore of James Bay, outside Nunavik.

5.4.1.2 Economy and Employment

Inuit society has gone through a considerable transformation over the past 50 years. The Inuit of Nunavik have gone from a way of life centred on the land and its resources to a more sedentary lifestyle, more geared to wage-earning work. Nunavik now lives under a mixed economic system based on employment income and traditional means of subsistence (Nunavik Regional Board of Health and Social Services, 2015).

In 2015, in Kangiqsujuaq, the employment rate for the population aged 15 years and over was 57.4%, compared to 56.3% for Salluit (Statistics Canada, 2022). However, the unemployment rate was higher in Kangiqsujuaq (23.7%) than in Salluit (15.1%). The unemployment rate is higher for men than for women in the two villages.

In general, the Nunavik economy is much less diversified than that of Québec. In 2012, the public administration, mining and construction sectors represented 85% of all activity in the region. The mining sector alone represented 40% of economic activity. According to an analysis produced in 2012, although the economic activity allied with the region's low population translated into a per capita GDP (established on a territorial basis) far greater than for the province as a whole, the disposable income of Nunavik's inhabitants was lower than that of the province. This disparity would be explained by the fact that a large portion of the wages of the mining sector (operation and exploration) and the construction sector was paid to workers who do not live in the region. This gap would also tend to be reduced over time (Robichaud and Duhaime, 2015).

Moreover, certain data from the Aboriginal Peoples Survey conducted by Statistics Canada in 2017 (Statistics Canada, 2019) allows a better grasp of Inuit participation in the wage economy and the resource-based economy (hunting, fishing, trapping, gathering). Thus, in 2017, 27% of the Inuit of Nunavik aged 25 to 54 years were inactive and did not participate in the wage economy. Compared to the other regions of Inuit Nunangat,[24] people living in Nunavik were among those most likely to participate in resource-related activities (hunting, fishing, trapping) to complete their income (35%). The results of this analysis indicated that the conventional measurements of labour market activity, combined with participation in resource-relatsed activities sucsh as hunting, fishing and gathering, provided a more precise overview of the complex reality of work in these communities. Public administration, healthcare and assistance, education services and retailing ranked among the leading wage-earning employment sectors.

5.4.1.3 Governance

Although it is part of the Province of Québec, Nunavik benefits from some autonomy and is administered by a regional government, the Kativik Regional Government (KRG). The KRG was formed in 1978, following the signing of the James Bay and Northern Québec Agreement. It holds the same powers and responsibilities as the regional county municipalities (RCM), but also deals with management of other fields, such as local and regional economic development, wildlife management, development and management of national parks, social housing or childcare (MAMH, 2022). The KRG exercises its powers throughout the territory of Nunavik. It is directed by a Council of 17 members, composed of representatives of each of the fourteen Inuit villages of Nunavik and the Naskapi village of Kawawachikamach.

Makivik Corporation was also created after the signing of the James Bay and Northern Québec Agreement, for the purpose of administering the funds resulting from this Agreement (Makivik Corporation, 2022b). In particular, it has the mission to promote and foster the economic, social and cultural development of Nunavik. It also represents the Inuit villages and Nunavik in their relations with the other levels of government.

Like the other Inuit villages of Nunavik, the villages of Kangiqsujaq and Salluit are northern villages, as defined in the James Bay and Northern Québec Agreement. These villages have essentially the same powers and competencies as the other municipalities of Québec and are directed by councils composed of a mayor and councillors (MAMH, 2022).

[24] Inuit Nunangat is composed of the four regions of Northern Canada containing Inuit communities, namely Inuvialuit (northern Yukon and Northwest Territories), Nunavut, Nunavik (northern Québec) and Nunatsiavut (northern Labrador).

5.4.2 Inuit Land Use and Occupancy

Under the Addendum to the Phase 2a Environmental and Social Impact Statement of the Nunavik Nickel Project (NNiP) (AECOM and Canadian Royalties Inc., 2022), maps concerning Inuit land use were transmitted to Canadian Royalties Inc. by Makivik Corporation (Figures 5-18 to 5-23). These maps are the result of interviews conducted with the Corporation in the communities of Salluit and Kangiqsujuaq during the winter of 2017.[25] They illustrate elements of Inuit land use in the zone concerned by the Nunavik Nickel Project and thus do not cover the entire zone concerned by this study. They nonetheless present information on the use of the sector planned for installation of the projected wind farm and a portion of the access roads leading to the Deception Bay port facilities.

Makivik Corporation's maps more specifically illustrate the routes taken in the territory (particularly by snowmobile), camps that were used during these trips, and harvest sites. For These sites, the resources harvested and the harvesting periods are not mentioned. Moreover, for each of the elements identified on the maps (routes, camps, harvest sites), it is impossible to know if they were mentioned by more than one person, or if they were visited on more than one occasion between 2007 and 2017. It is therefore impossible to know the intensity of their use. It is also impossible to know if the elements illustrated on the maps have been used since 2017.

The maps provided by Makivik Corporation identify eight routes (probably travelled by snowmobile) passing within or near the projected location for installation of the wind turbines on the edge of the Expo site, in the limited study area (Figure 5-18). These routes were travelled by Kangiqsujuaq residents during outings lasting several days in the territory. The maps also identify a route travelled by Salluit residents crossing the access roads leading from Deception Bay to north of the Expo site (Figure 5-19).

The camps illustrated on Makivik Corporation's maps are relatively far from the proposed site for installation of the wind farm. The nearest camps were mentioned by Kangiqsujuaq residents and are located a little over 15 km south and about 20 km southwest of the site proposed for development of the wind turbines, outside the limited study area (Figure 5-20). The only camp mentioned by Salluit residents in the territory covered by Phase 2a of the NNiP is found on the north shore of a lake located north of Lac Beauparlant, over 60 km west of the site planned for installation of the wind turbines (Figure 5-21).

About twenty harvest sites appearing on the maps provided by Makivik Corporation are located not far from the site proposed for installation of the wind farm. These essentially are sites mentioned by Kangiqsujuaq residents. They are located near Lac du Bombardier and Lac Rocbrune, in the limited study area, and some are found about 2 or 3 km from the site proposed for development of the wind turbines (Figure 5-22). Only one site mentioned by Salluit residents is found in the local study area. It is located on a lake, about a dozen kilometres west of the site proposed for development of the wind turbines (Figure 5-23). As in the case of the camps, the harvest sites illustrated on Makivik Corporation's maps were probably visited during trips made in the sector.

Let us remember that all the land use elements appearing on Makivik Corporation's maps were mentioned during interviews conducted in 2017 and pertain to use between 2007 and 2017. Certain sectors, particularly those closest to the Expo site, are no longer used today.

A security and emergency preparedness supervisor at the Expo site questioned during this study mentions that he had never seen Inuit users engaging in activities or travelling in the vicinity of the Expo site as long as he had worked there. To this effect, he explained that the Inuit users are not authorized to approach within 5 km of the sites operated by Canadian Royalties Inc., for safety reasons related to the performance of mining work on these sites.

[25] These interviews were conducted with users of the territory and covered a 10-year period, from 2007 to 2017. They only pertained to the current use of the territory and did not amass any historical data predating 2007.

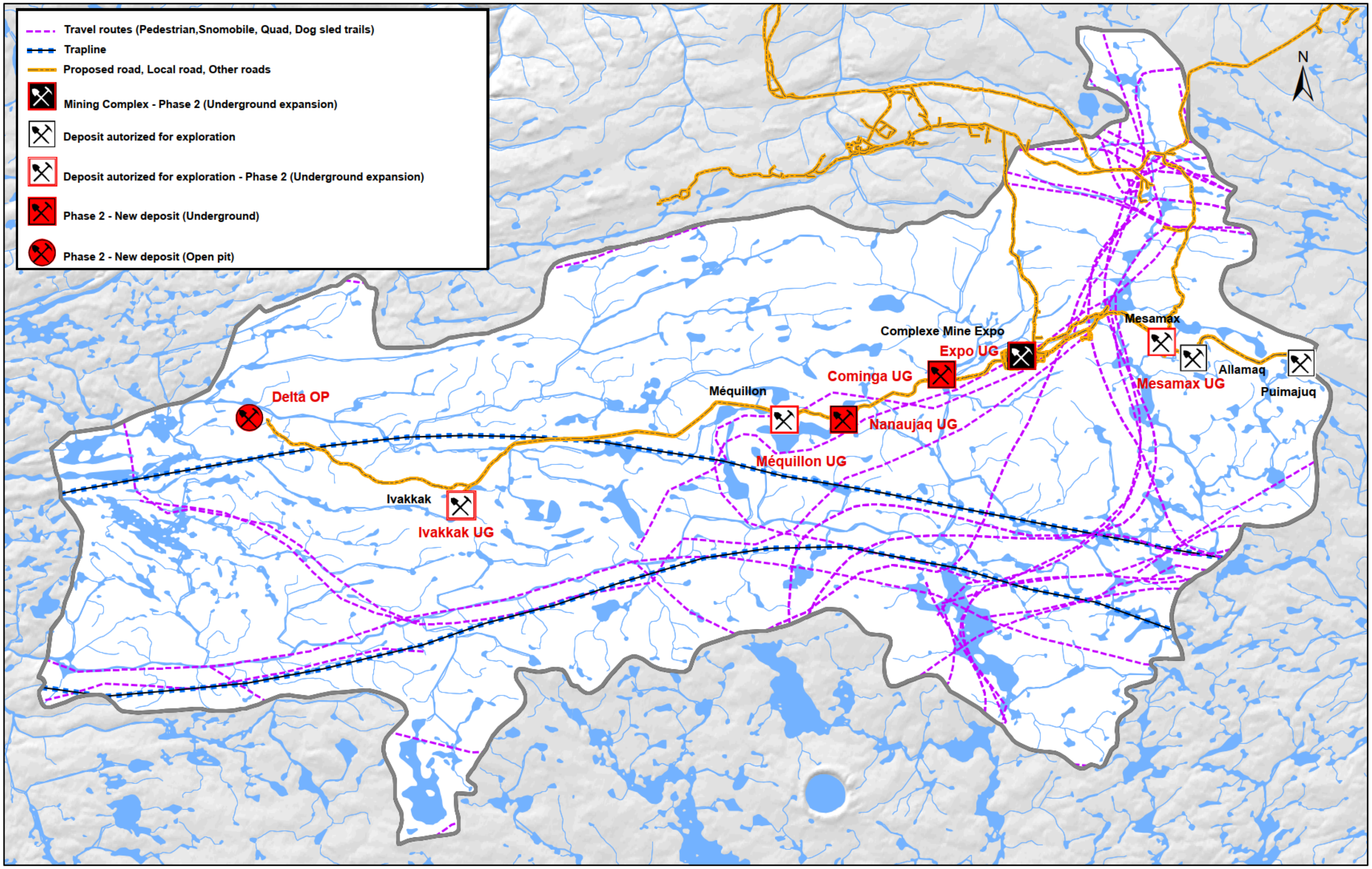


Figure 5-18: Routes Travelled by Kangiqsujuaq Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

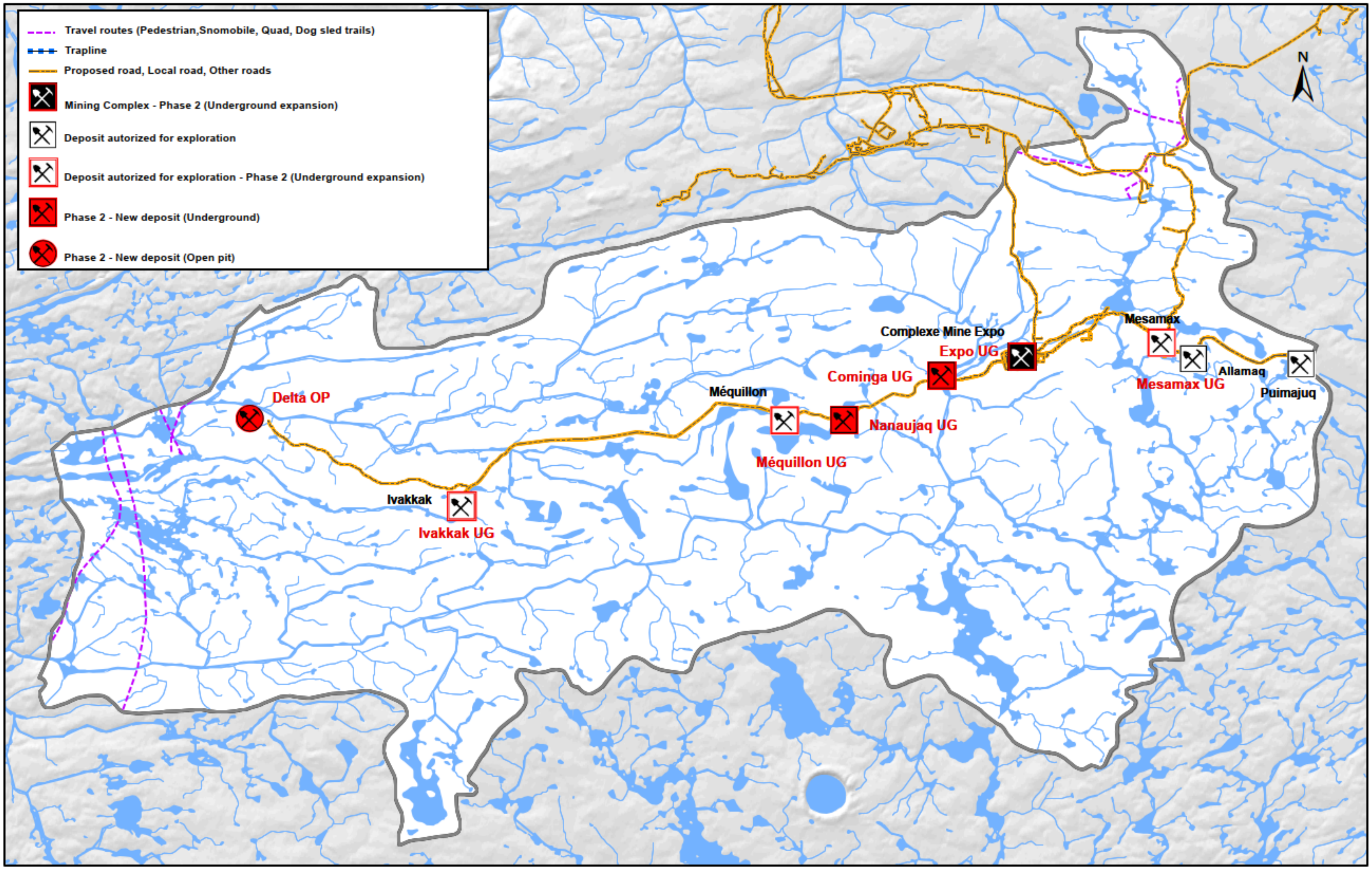


Figure 5-19: Routes Travelled by Salluit Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

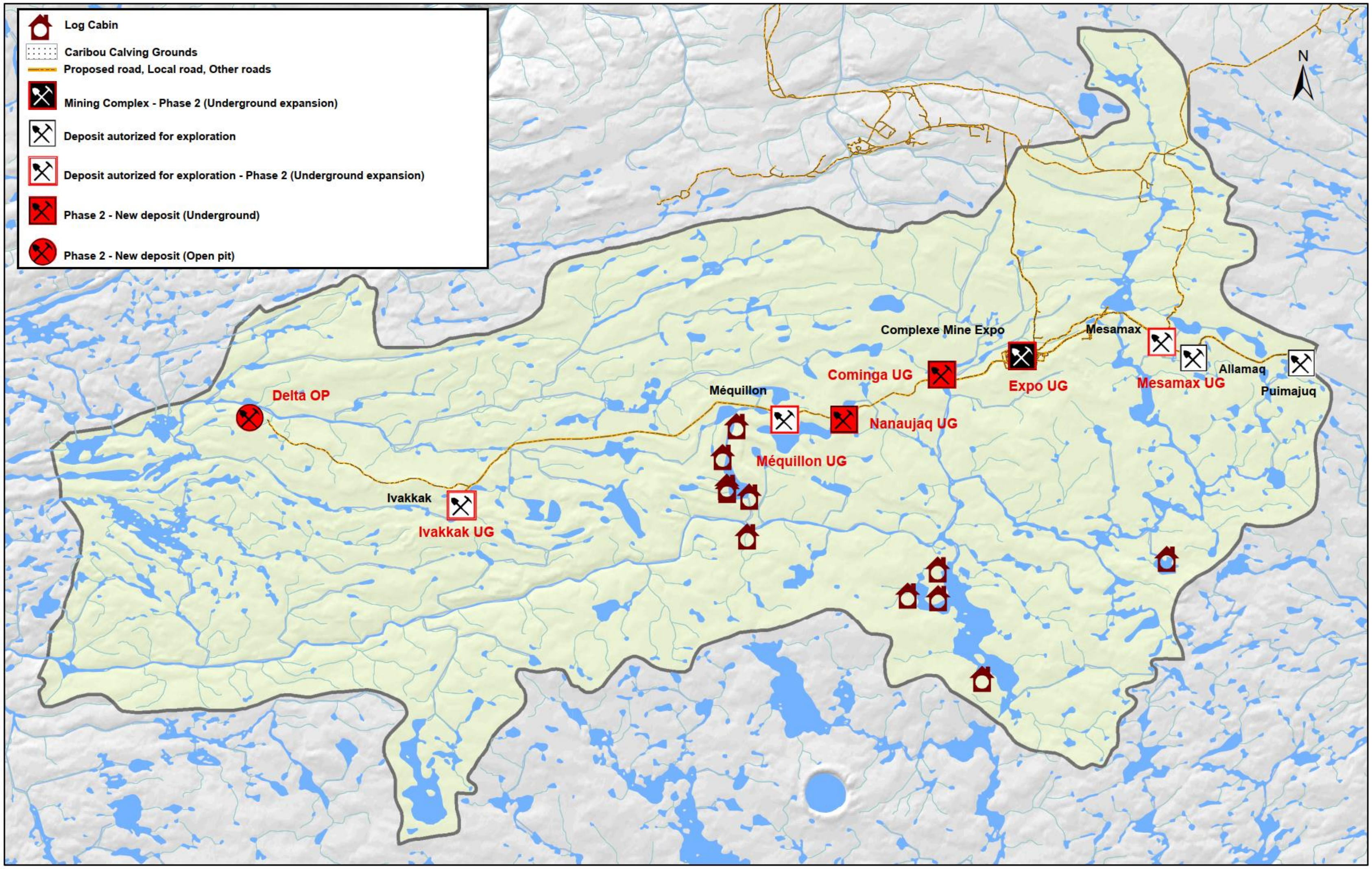


Figure 5-20: Camps Used by Kangiqsujuaq Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

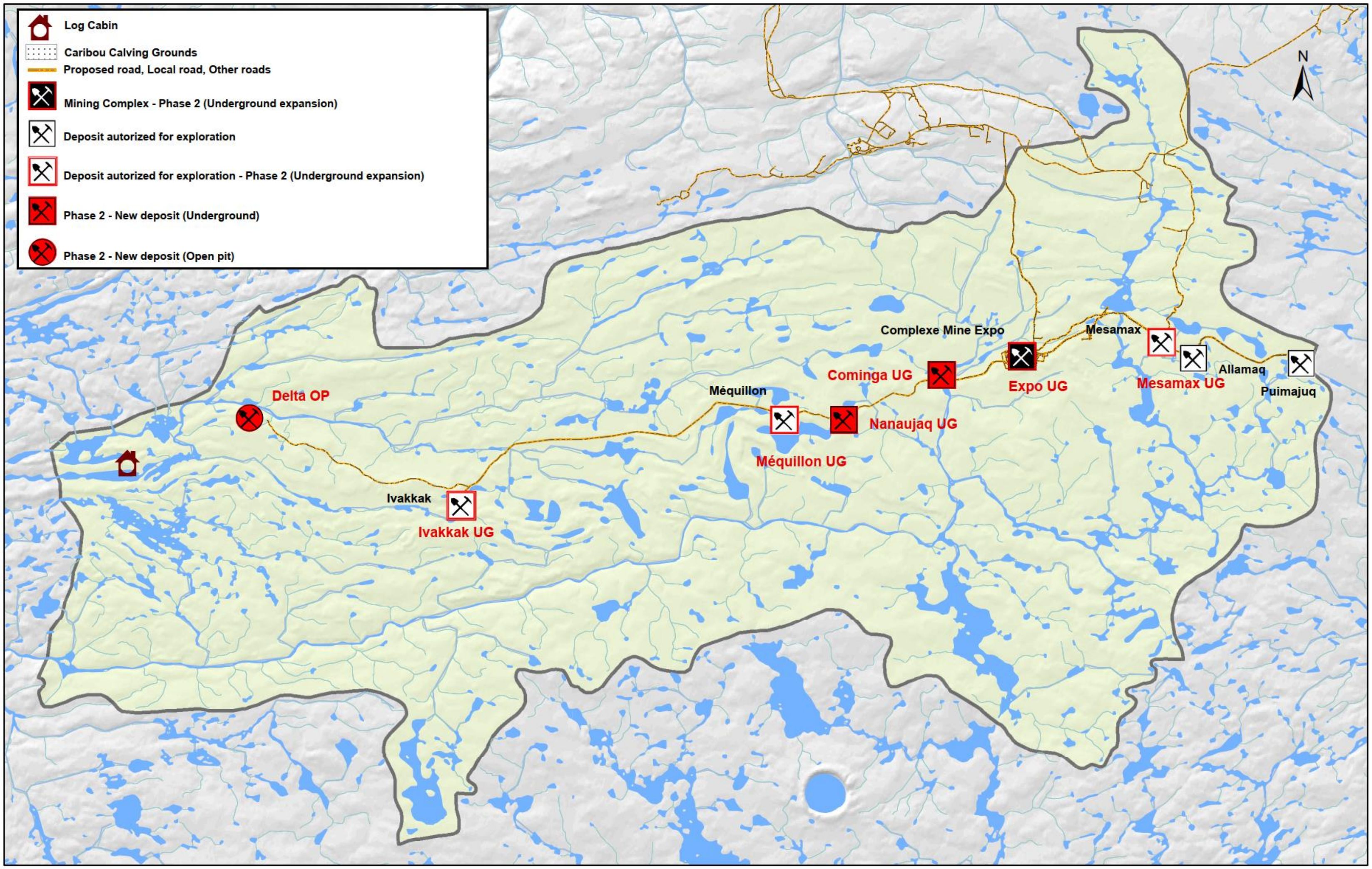


Figure 5-21: Camps Used by Salluit Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

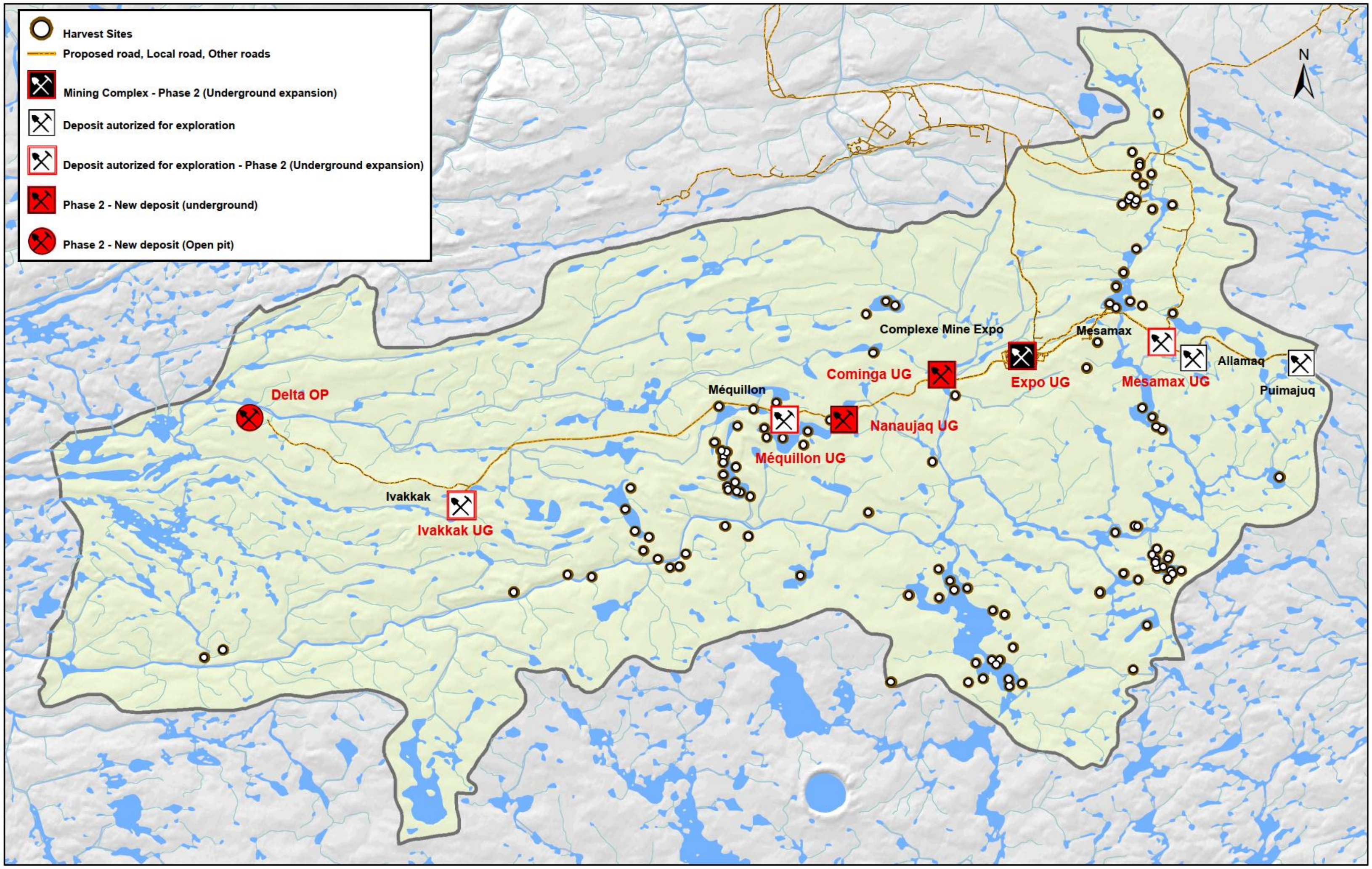


Figure 5-22: Harvest Sites Mentioned by Kangiqsujuaq Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

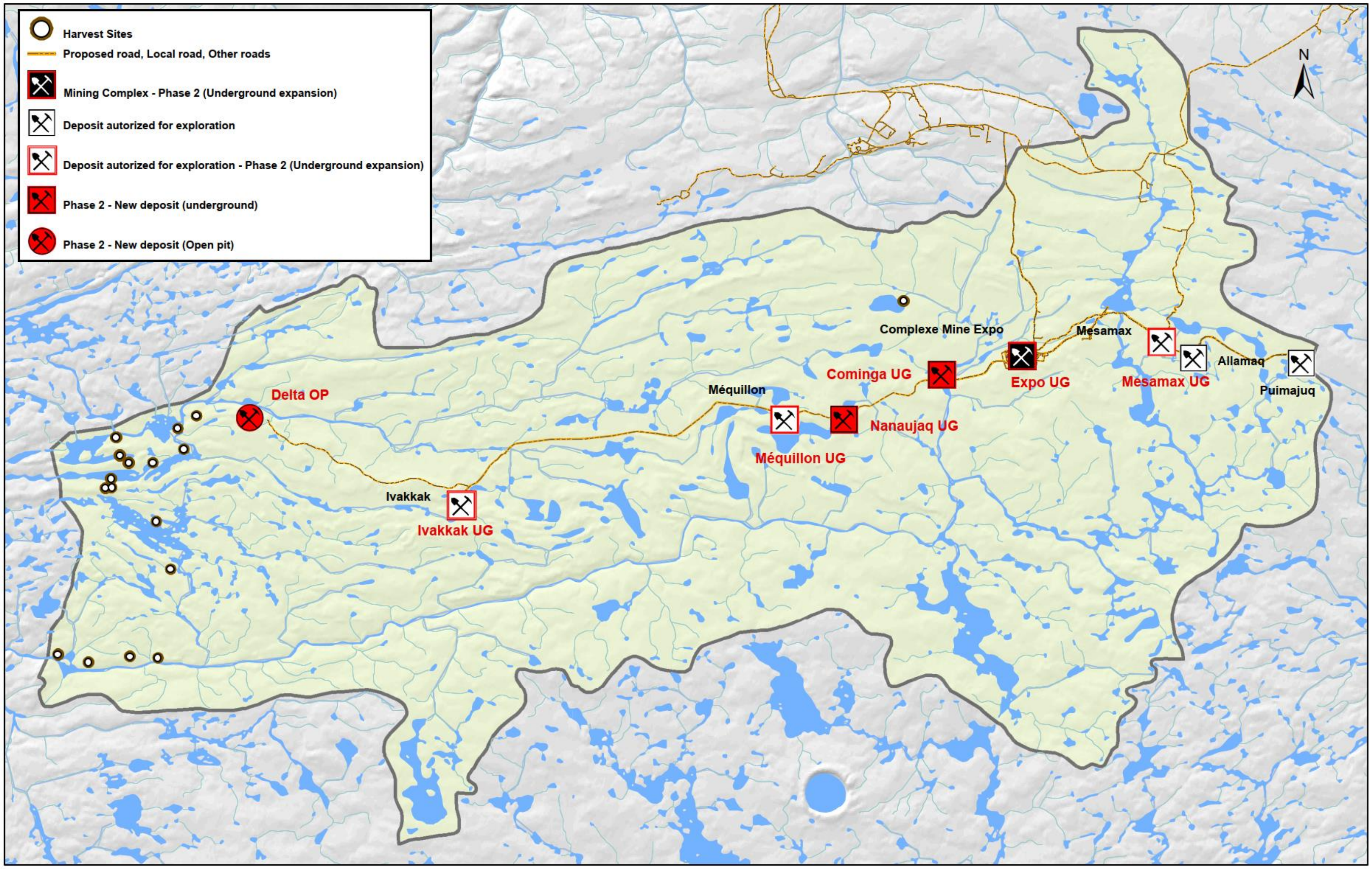


Figure 5-23: Harvest Sites Mentioned by Salluit Inuit Users in the Territory Concerned by Phase 2a of the NNiP, 2007-2017

We were unable to have discussions with Salluit land users during this study. However, discussions with representatives of this Nordic Village and his landholding corporation showed that the areas used by people of this community located the closest to the local study area are found along Deception Bay and the nearby lakes.

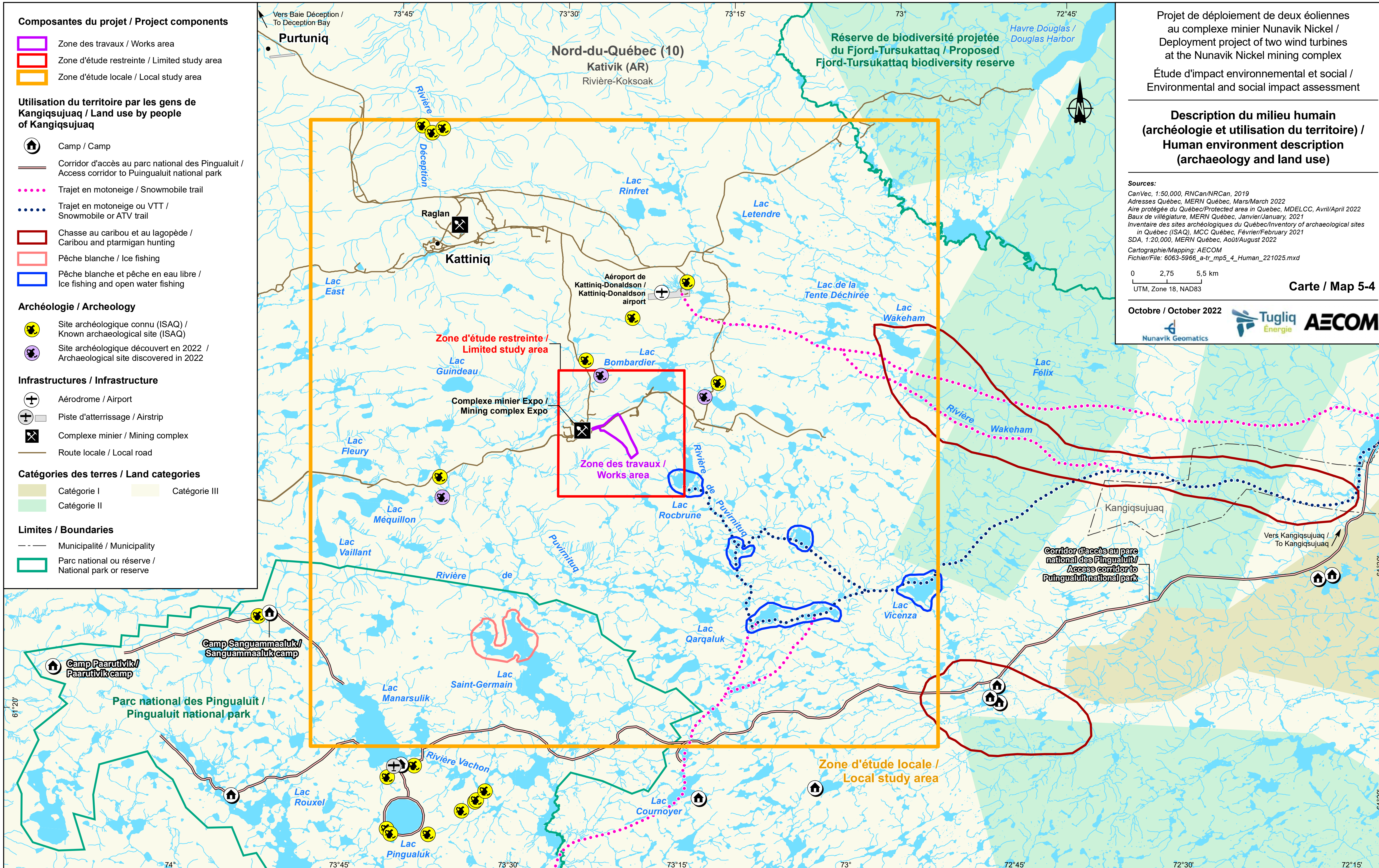
Representatives of Glencore Canada and CRI are providing similar information, stating that Salluit Inuit users practice traditional activities along the access road linking Deception Bay to the Raglan mine. They add that these Inuit land users visit camps (unknown number) on the shores of Lac Duquet and Lac Françoys-Malherbe, respectively located in the vicinity of km 10 and 24 of the road. Two other camps are located in the vicinity of km 5 of the road, just south of Deception Bay.

According to the two informants consulted, these camps are mainly used in the spring (April and May) and in the fall period (end of August to mid-November), during stays dedicated to hunting (waterfowl, caribou, ptarmigan). To a lesser extent, Inuit users also visit them in June and July to fish for Arctic char. The users of these camps engage in their hunting and fishing activities along the roadside, between km 5 and 33. They travel along the road in pickup trucks or ATVs. The Glencore representative estimates that the Inuit users make between 50 and 100 trips per year on this portion of the road. He adds that dust reducers are spread on the first 28 km of the road in June and July to limit the effects of the road's presence on Inuit activities nearby.

The Salluit users visiting the approaches to the Raglan Mine access road mainly access their camps by snowmobile. Some also travel to the vicinity of Deception Bay by boat and then drive along the road in pickup trucks. According to the Glencore representative, the camps located on the edge of the access road are more used in spring, on the occasion of a cultural event. About sixty users, including some elders, then visit the camps. Some of them access the sector by airplane, via a runway located about km 10 from the road, just south of Deception Bay.

Information from communication with a Nunavik Parks representative shows that Kangiqsujuaq residents visit the southern portion of the local study area in winter. They travel there by snowmobile, during two or three-day excursions dedicated to ice fishing and ptarmigan hunting. They then take the access corridor to Pingualuit National Park, which crosses a large part of the southern portion of the local study area (Map 5-4). Some camps present in the national park and nearby are then visited for stopover, particularly the Qulusuttalik and Itirviluarjuk camps (located east of the local study area) and the Kangirsuttuq and Manarsulik camps (located just south of the local study area).

A discussion with the President of Nunaturlik Corporation of Kangiqsujuaq made it possible to describe with a little more precision the current use of the approaches to the local study area and the limited study area by Kangiqsujuaq residents. This informant also indicates that people from his community go ice fishing in the winter period (December to May) on Lac Saint-Germain, in Pingualuit National Park. He explains that the users then visit the northern portion of the lake to fish for Arctic char and lake trout. The informant adds that Arctic char and lake trout fishing activities are also practiced on Lac Vicenza, on the unnamed lake located west of it, as well as two other nameless lakes located a little farther north, in the southeastern portion of the local study area (Map 5-4). Fishing activities for the same species also take place in the southern portion of Lac Rocbrune, within the limited study area. This last location is the sector used by Kangiqsujuaq residents that is closest to the work area planned for this project (less than 3.5 southeast of it). Kangiqsujuaq residents go to these various lakes by snowmobile between the end of December and the beginning of May to engage in ice fishing. To a lesser degree, some users from the community go there by ATV in July and August to fish in open water.



Composantes du projet / Project components
Zone des travaux / Works area
Zone d'étude restreinte / Limited study area
Zone d'étude locale / Local study area
Utilisation du territoire par les gens de Kangiqsujuaq / Land use by people of Kangiqsujuaq
Camp / Camp
Corridor d'accès au parc national des Pingualuit / Access corridor to Puingualuit national park
Trajet en motoneige / Snowmobile trail
Trajet en motoneige ou VTT / Snowmobile or ATV trail
Chasse au caribou et au lagopède / Caribou and ptarmigan hunting
Pêche blanche / Ice fishing
Pêche blanche et pêche en eau libre / Ice fishing and open water fishing
Archéologie / Archeology
Site archéologique connu (ISAQ) / Known archaeological site (ISAQ)
Site archéologique découvert en 2022 / Archaeological site discovered in 2022
Infrastructures / Infrastructure
Aérodrome / Airport
Piste d'atterrissage / Airstrip
Complexe minier / Mining complex
Route locale / Local road
Catégories des terres / Land categories
Catégorie I
Catégorie III
Catégorie II
Limites / Boundaries
Municipalité / Municipality
Parc national ou réserve / National park or reserve
Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex
Étude d'impact environnemental et social / Environmental and social impact assessment
Description du milieu humain (archéologie et utilisation du territoire) / Human environment description (archaeology and land use)
Sources:
CanVec, 1:50,000, RNCan/NRCan, 2019
Adresses Québec, MERN Québec, Mars/March 2022
Aire protégée du Québec/Protected area in Quebec, MDELCC, Avril/April 2022
Baux de villégiature, MERN Québec, Janvier/January, 2021
Inventaire des sites archéologiques du Québec/Inventory of archaeological sites in Québec (ISAQ), MCC Québec, Février/February 2021
SDA, 1:20,000, MERN Québec, Août/August 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp5_4_Human_221025.mxd
0 2,75 5,5 km
UTM, Zone 18, NAD83
Carte / Map 5-4
Octobre / October 2022
Nunavik Geomatics
Tugliq Énergie
AECOM
Vers Baie Déception / To Deception Bay
Purtuniq
Nord-du-Québec (10)
Kativik (AR)
Rivière-Koksoak
Réserve de biodiversité projetée du Fjord-Tursukattaq / Proposed Fjord-Tursukattaq biodiversity reserve
Havre Douglas / Douglas Harbor
Rivière Déception
Raglan
Kattiniq
Lac Rinfret
Lac Letendre
Lac East
Aéroport de Kattiniq-Donaldson / Kattiniq-Donaldson airport
Lac de la Tente Déchirée
Lac Wakeham
Zone d'étude restreinte / Limited study area
Lac Guindeau
Lac Bombardier
Lac Félix
Complexe minier Expo / Mining complex Expo
Rivière Wakeham
Lac Fleury
Zone des travaux / Works area
Rivière de Puvirnituq
Lac Rocbrune
Lac Méquillon
Kangiqsujuaq
Lac Vaillant
Puvirnituq
Rivière de
Corridor d'accès au parc national des Pingualuit / Access corridor to Puingualuit national park
Vers Kangiqsujuaq / To Kangiqsujuaq
Lac Vicenza
Lac Qarqaluk
Camp Sanguammaaluk / Sanguammaaluk camp
Camp Paarutivik / Paarutivik camp
Lac Saint-Germain
Lac Manarsulik
Parc national des Pingualuit / Pingualuit national park
Rivière Vachon
Zone d'étude locale / Local study area
Lac Rouxel
Lac Cournoyer
Lac Pingualuk
73°45'
73°30'
73°15'
73°
72°45'
74°
72°30'
72°15'
61°30'
61°20'

A little more to the southeast, caribou and ptarmigan hunting activities take place in the winter period on the approaches to Lac Itirviluarjuk, just at the end of the local study area, where camps that serve as living quarters are also located. Farther north, Kangiqsujuaq users sometimes travel by snowmobile just south of Lac Wakeham and Lac Mercile, in the northeast portion of the local study area. These trips are made during caribou and ptarmigan hunting excursions, during trips to the sector used by Salluit residents (around Lac Duquet and Lac Françoys-Malherbe and south of Deception Bay) or during trips to the northern village of Salluit. People travelling to Salluit or to the sectors used by people from this community go to Kattiniq-Donaldson Airport. They then must contact the Glencore Canada authorities to indicate that they will be circulating near their infrastructure. Because it is not permitted to ride a snowmobile along various access roads used by the mining companies, the Inuit users then must have their snowmobiles transported by truck by Glencore employees to the desired sectors, or to Deception Bay. From there, they may use their snowmobiles to engage in activities a good distance from the road or to continue their trip to Salluit.

5.4.3 Non-Native Land Occupancy and Use

5.4.3.1 Pingualuit National Park

Pingualuit National Park covers an area of 1,133.9 km^2 on the Ungava Plateau. It is found just south of the territory concerned by the Nunavik Nickel Project (NNiP) and overlaps the southwest part of the local study area of this project (Map 5-4).

The first park to emerge in Nunavik, Pingualuit National Park was created in 2004 with the goal of preserving this sector's natural and cultural heritage, but also to make it accessible to the public. Discovery programs and the practice of low-impact activities (hiking, canoeing, cross-country skiing, etc.) are the preferred means of discovering this territory.

The park is managed by Nunavik Parks, a body of the Kativik Regional Government. It has eight full-time employees (all Inuit) and six temporary employees (all Inuit). In addition, it employs about twenty assistants from the Kangiqsujuaq community, who can lend a hand to the employees at various times of the year, when activities are held (Nunavik Parks, pers. comm.).

The park welcomes between 150 and 250 visitors a year. Half come from outside the region (primarily from Québec and Europe). The other half are Nunavik Inuit (organized groups, often school groups, participating in activities).[26] Users from local communities, essentially from Kangiqsujuaq, also visit the park's interior to engage in traditional activities, such as ice fishing or ptarmigan hunting. However, they are not counted among the park's visitors.

The park is in operation during the winter period (from January to May) and the summer period (from mid-July to the beginning of September). The visitors go there for stays of different durations. In the winter period, four-day stays are offered, while in the summer period, the packages offered last three or nine days (including three days spent in Kangiqsujuaq).

The park can be accessed by plane, via the landing strip developed near the south shore of Lac Manarsulik. In winter, it is also possible to go to the park by snowmobile, via the access corridor that reaches the Kangiqsujuaq community and passes from east to west through the southern part of the local study area (Map 5-4).

Various activities are practiced within the park year round. In winter, the visitors go to the Lac Pingualuk Crater, the park's main attraction, and to the Puvirnituq River Canyon on snowmobile excursions. They then do stopovers at the Sangummaaluk and Paarutivik camps located along the Puvirnituq River, west of the local study area. Ski trips also take place along the access corridor to the park. Ice fishing excursions are also organized on Lac Saint-Germain (southern portion of the local study area), and on the Vachon River (just south of the local study area) and Lac Rouxel.

[26] Nunavik Parks wanted to put more emphasis on intra-Nunavik tourism since 2020 due to the sharp decline in the number of external visitors related to the COVID-19 pandemic.

In summer, hikes are organized to the Lac Pingualuk Crater and to the Puvirnituq River Canyon. Once again, stopovers are made at the Sangummaaluk and Paarutivik camps. Activities are also held at Lac Manarsulik, where the park's reception building and main camps are located. The visitors can navigate the lake by canoe or kayak, fish and even swim. A visit to an archaeological site located near Lac Manarsulik is also offered to visitors.

In addition to the Lac Manarsulik landing strip and the camps already named, the park also has a camp at Lac Rouxel, as well as various emergency shelters along the travel routes taken on different organized hikes. No new infrastructure development is scheduled in the park over the next few years. We should also point out that Nunavik Parks is currently in the process of having the park's territory recognized as a Dark-Sky Preserve. Dark-Sky Preserves are protected areas where a special commitment is made to protect and preserve the night sky and reduce or eliminate all forms of light pollution. In Canada, the Royal Astronomical Society of Canada determines what protected areas can be Dark-Sky Preserves (Parks Canada, 2022).

5.4.3.2 Fjord-Tursukattaq Proposed Biodiversity Reserve

The northeast portion of the local study area overlaps a portion of the Fjord-Tursukattaq proposed biodiversity reserve. Biodiversity reserves are protected areas under provincial jurisdiction constituted for the purpose of fostering the maintenance of biodiversity in the terrestrial environment and, more specially, the representativeness of the different natural regions of Québec (MELCC, 2022).

The Natural Heritage Conservation Act governs and defines the activities authorized in the proposed biodiversity reserves. In particular, it prohibits any construction, drainage, drilling or excavation work likely to degrade the bed of the shores of a body of water or a watercourse or directly and substantially alter the quality or the biochemical characteristics of aquatic, riparian or wetland environments; any soil development work, including any landfill, earthmoving, removal or displacement of surface materials or plant cover, for any purpose whatsoever; and any work likely to damage the plant cover, in particular, by performing stripping, trenching or excavation (MDDEP, 2009). It is also forbidden to make excessive noise or to conduct oneself or behave in a manner that unduly disturbs the other users or prevents them from enjoying the sites (Idem).

The Fjord-Tursukattaq proposed biodiversity reserve covers an area of 1959.8 km^2 (Idem). Its limit is located 31 km northwest of Kangiqsujuaq. Its southwest limit is 29 km northwest of the work area provided for this project and about 30 km east of the km 13 road which gives access to the Expo site (Map 5-4).

5.4.3.3 Marine Transportation in Deception Bay

Ships regularly visit the CRI port facilities in Deception Bay to unload supplies (diesel, food and all kinds of equipment) for the company's mining complexes, and to pick up ore concentrates, equipment and residual materials for transport out of Nunavik. In 2021, 13 ships circulated in Deception Bay bound for the CRI port facilities between the months of January and December, namely 1 in January, 1 in March, 1 in June, 3 in July, 2 in September, 4 in October and 1 in December (Canadian Royalties, 2022). In 2020, 12 ships circulated in the bay bound for the CRI port facilities between January and November, namely 1 in January, 1 in March, 1 in June, 2 in July, 4 in September, 1 in October and 2 in November (Canadian Royalties, 2021).

Measures were deployed in the course of CRI's mining activities to limit the impact marine transportation in Deception Bay could have on the activities practiced by the Inuit users. Thus, ships must avoid crossing the bay between mid-March and mid-June, during the seal calving period and at the height of the hunting season by Inuit users. Moreover, ships circulating in the bay must all follow the same course during the ice period, to limit the impact on the pack ice. They must follow an "S"-shaped course to limit ice breaking. In addition, the local Inuit communities are informed of the date scheduled for the passage of ships, the dangers associated with opening of the ice cover in the bay and the possible impacts on the activities they conduct there.

Port facilities are also used by Glencore Canada in Deception Bay. According to Glencore's Superintendent of Surface services (Raglan Mine), the company usually receives eight cargoes per year at its facilities, during a period from June to March. The ships that visit Glencore Canada's port facilities in Deception Bay must comply with rules similar to those followed by ships operating on CRI's account.

5.4.3.4 Use by the Mining Companies of Access Roads Leading from the Deception Bay Port Facilities to the Expo Site

Three successive access roads connect the Deception Bay port facilities to the Expo site, i.e. the road connecting the bay to the Raglan Mine (93 km long), the road connecting the Raglan Mine to Kattiniq-Donaldson Airport (23 km long) and the road leading to the Expo site, which crosses the road leading to Kattiniq-Donaldson Airport at km 13 (Map 1-1 and 5-4). The first two roads are under the responsibility of Glencore, which operates the Raglan Mine. The road leading to the Expo site is maintained by Canadian Royalties Inc. The two companies use the roads leading to Kattiniq-Donaldson Airport and Deception Bay, while CRI is the only company to use the road leading to the Expo site.

The two companies use these roads daily for the transport of ore and merchandise between the mine sites and the Deception Bay port infrastructure, or for the transport of personnel and merchandise between Kattiniq-Donaldson Airport and the mine sites.

The Supervisor, Security and Emergency Response at Canadian Royalties (Expo site), questioned during this study, indicates that the company's operations require a little over 6,000 transports per year on the three roads, or about 5,550 transports to take refined ore to Deception Bay and bring back merchandise arriving by cargo ship, around 600 clean water and wastewater transports between the Deception Bay port facilities and the Expo site,[27] and 200 to 250 miscellaneous transports (personnel travelling along the roads between the Expo site, Kattiniq-Donaldson Airport and Deception Bay). According to the informant, the number of trips is relatively stable year round. He adds that raw ore is transported between the mineral deposits and the Expo site mill via roads other than those leading to Deception Bay. Apart from transport of personnel, all transport done on the access roads on CRI's account (transport of ore, merchandise and water) is performed by Kattiniq Transport Inc., a company partially held by Salluit interests.

Kattiniq Transport Inc. also transports several loads of ore and material in the context of the operations of the Raglan Mine held and operated by Glencore Canada. Glencore's Superintendent of Surface Services (Raglan Mine), also questioned during this study, indicates that between 17 and 20 loads are transported by heavy truck each day between the Raglan Mine and Deception Bay by Kattiniq Transport Inc. Trips by heavy truck are a little more frequent (around 20 per day) when cargoes are present at the Glencore port facilities in Deception Bay. Sporadic trips by Glencore personnel are also made by van between Deception Bay and the Raglan Mine, and by van and bus between the Raglan Mine and Kattiniq-Donaldson Airport.

Very strict rules have been established concerning traffic on the access roads, particularly concerning the speed limits, as well as overtaking and passing of vehicles. Moreover, wide-bodied vehicles have the obligation to be accompanied by escort vehicles to be able to circulate.

Sometimes non-standard transportation occurs on the three access roads to carry large equipment or machinery to the mine sites. The representatives of the two mining companies indicate that traffic is never really disturbed during these events, because there are not many trips on the road, the roads are in good condition, and they have several widenings allowing trucks to clear the lane in case they encounter wider convoys. Moreover, the good communication that prevails between the two companies and the well-established coordination within the transport teams facilitates these trips.

Glencore's Superintendent of Surface Services indicates that maintenance work sometimes is performed in the summer period (June to August) along the two roads that are under the company's responsibility, culverts are sometimes replaced and aggregates are added periodically on certain road sections. He adds that the two roads are graded on a regular basis year round.

[27] The Expo site is equipped with drinking water production and wastewater treatment infrastructure, which is not the case for the CRI port facilities at Deception Bay. Drinking water is therefore transported by truck to the Deception Bay facilities. The same applies for wastewater, which is transported to the Expo site for treatment.

No major maintenance work or any significant change in the use of the access road is scheduled by Glencore in 2023. CRI plans to extend mining activities to other deposits over the next few years. However, the company's representative questioned during this survey notes that this will not translate into an increase in traffic on the access roads in 2023, nor a notable increase in subsequent years. To this effect, he recalls that the ore extracted from the company's mineral deposits does not transit via the roads leading to Deception Bay. He also adds that the tonnage of ore that can be refined by the Expo site mill is limited. Thus, a larger quantity of ore extracted from the mines would not lead to an increase in daily transport of refined ore to the Deception Bay port infrastructure.

5.4.3.5 Use of Kattiniq-Donaldson Airport

Kattiniq-Donaldson Airport is located about 12 kilometres north of the CRI Expo mine site and about 10 km north of the site planned for installation of the two projected wind turbines (Map 5-4).

An airport employee questioned during this study indicates that the airport is under the responsibility of the Glencore Mining Company, which operates the Raglan mining complex, located about fifteen kilometres to the west. It is mainly used to supply cargo and transport personnel for the Raglan and Expo mining complexes. The site is also used for medical evacuations and sometimes accommodates Inuit users travelling to the nearby territory.

The airport has a single runway. Four employees are present permanently,[28] two operators in charge of infrastructure maintenance and aircraft refueling, and two air traffic controllers in charge of communications and logistics with aircraft. Glencore Canada and CRI employees are added periodically during the passage of their respective aircraft.

The airport accommodates at least 12 to 13 flights a week, or five to six flights to transport cargo and employees between southern Québec and the Raglan mining complex, four flights to transport cargo and employees between southern Québec and the Expo complex, and three flights to transport Inuit employees from various Nunavik villages to the two mining complexes. Additional flights are added regularly to transport cargo and employees to the two mining complexes, or for medical evacuations. Thus, in fact, the airport handles an average of between 15 and 18 flights per week. They essentially take place on weekdays (Monday to Friday), except for medical evacuations that may occur on weekends. The number of flights accommodated by the airport each week is essentially the same year round.

The airport employee questions during this study indicates that the runway lights will be changed in the next two summers (July and August), in 2023 and 2024. He specifies that the performance of this work should not result in changes in the airport`s operations. No other change or project (whether in infrastructure, personnel or operations) is scheduled over the next few years.

5.4.3.6 Non-Native Harvesting of Wildlife Resources

Few if any wildlife harvesting activities are practiced by non-Natives in the local study area. We should mention from the outset that the territory considered is within the Nouveau-Québec beaver reserve.[29] Thus, trapping and hunting of fur-bearing animals are activities reserved exclusively for Indigenous users.

The main species of interest for non-Native users in the local study area was caribou, but the MFFP abolished sport caribou hunting for an indeterminate period at the end of January 2018 due to the sharp decline of the Leaf River herd. Moreover, the closest outfitters to the local study area are located a good distance away, offering fishing activities on the Arnaud River, upstream of Kangirsuk (Arctic Adventures), and on Leaf River, upstream of Tasiujaq (Leaf River Lodge). Finally, no resort lease has been issued within the local and extended study areas, which thereby limits the presence of non-Native users likely to engage in wildlife harvesting activities there.

[28] This number remains the same year round.

[29] The beaver reserve system was established by the provincial government between 1930 and 1950 with the goal of controlling trapping of the species and stemming its decline. These reserves were established in concert with the Indigenous populations concerned. Today, there are 11 beaver reserves in Québec. In each of them, except for the Saguenay beaver reserve, hunting and fishing of fur-bearing animals are activities reserved exclusively for Indigenous users.

As mentioned previously, Pingualuit National Park organizes ice fishing excursions in the local study area, in which non-Native users participate. The excursions closest to the area planned for development of the projected wind turbines are held on Lac Saint-Germain, a little over fifteen kilometres to the southwest. These excursions are held on a few occasions between January and May.

Although visitors to Pingualuit National Park go there, the vast majority of non-Natives present in the local study area are workers from Glencore Canada and CRI working at the various mine sites operated by the two companies, and at Kattiniq-Donaldson Airport. These employees have very little time to devote to recreational activities during their rotations and thus are unlikely to engage in wildlife harvesting activities.

According to a Glencore representative questioned during this study, no hunting activities are practiced by the company's employees when they work at the Raglan Mine, Kattiniq-Donaldson Airport or the Deception Bay port facilities. He adds that sport fishing excursions were previously organized in concert with members of the local Inuit communities in the vicinity of km 4 of the Deception Bay road (extended study area). An application then had to be made to the MFFP to permit these activities. However, fishing activities have been held since 2019, because the MFFP has not given its authorization.

The CRI representative indicates that no hunting activities are practiced by the employees working at the various mine sites operated. Sport fishing activities had been held at Lac du Bombardier, located outside the limited study area, about 5 km east of the Expo mine site. These activities were organized once a week when the lake was free of ice (in July and August). The number of fishers who could participate was limited to 14 and it was only possible to participate once a year. As in the case of the Glencore sport fishing activities held near Deception Bay, an MFFP authorization was required to hold this activity. The authorization was not issued in 2022, because the fish population in the lake was not high enough. Therefore, no sport fishing activity was held there that year.

5.4.4 Archaeology

5.4.4.1 Context

Archaeology testifies that human occupancy of the Nunavik territory has been episodic, initiated by waves of migration beginning about 4,000 years ago. The material culture of this period consists of housing foundations, as well as tools and ornaments made of stone and bone, for an ancestral occupancy mainly located on the seashore (Makivik Corporation, 2014).

The interior is much less occupied. Anthropologist Bernard Saladin d'Anglure, one of the first to study the Inuit people of northern Ungava, subdivides the Tarramiut (the population of this territory) into three groups, the insular Inuit (Qikirtamiut) who inhabit the islands, the coastal Inuit (Sinamiut) who inhabit the edge of the littoral ice, and the inhabitants of the interior of the peninsula (Nunamiut), whom he defines as more nomadic Inuit bands who divide their activities between fishing in the lakes and caribou hunting. However, the interior's limited resources oblige them to migrate seasonally to the coast or engage in economic exchanges with the people who live there (Graburn, 1973; Saladin D'Anglure, 1967). Some large lakes of the hinterland are very rich in fish and allow winter occupancy, even in the absence of caribou. However, when caribou were abundant, the Nunamiut might spend all winter near the large lakes, thanks to the provisions accumulated in the fall. During the first half of the 19th century, some families could live there more permanently. But in general, the people who travelled to the interior came from Hudson Bay and Ungava Bay and only stayed there temporarily (Labrèche, 2012).

5.4.4.2 Known Archaeological Sites in the Study Areas

The archaeological interventions performed in the past few decades in the context of the various mining projects made it possible to identify occupancy sites in the interior and thus increase our knowledge of the use of this territory, which has been studied too little (Artéfactuel, 2008; Chrétien, 2007).

Less than twenty kilometres south of the site planned for installation of the wind turbines, the Puvirnituq River, which today delineates the northern part of Pingualuit National Park, served as a waterway between the west coast and the Pingualuit Crater (located about thirty kilometres from the area planned for installation of the wind turbines). This place has one of the biggest concentrations of archaeological sites in the interior of Nunavik. According to Labrèche's anthropological research (1986, 1989), this crater, located about a hundred kilometres from the sea, was known since time immemorial by the Inuit populations of the coast, and archaeology confirms the occupancy of this territory.

Archaeology shows that seasonal occupancy of the interior existed. All of the archaeological sites present in the study area attest a Thulian and/or non-Eskimo Inuit presence, dating mainly from the contact period and after (1350 to 1950) (Chrétien, 2007; MCC, 2022). However, since none of the known sites has been researched, their dating remains uncertain. The current appellation identifies these places as sites of traditional Inuit occupancy attributed to the historical period (Elsa Cencig, Avataq, per. comm. 2022).

On the scale of the local study area, there are more than ten known sites (Map 5-4). They all testify to traditional Inuit occupancy attributed to the historical period (1350 to 1950) and are mainly composed of round tent structures. The limited study area only includes a single known archaeological site. This is a site discovered during the inventory conducted in the context of the present study (July 2022). It is located about 5 km north of the site planned for installation of the projected windmills and is composed of two double-lobed tent structures and a possible stone hunting cache.

5.4.4.3 Field Inventory (Work Area)

The field inventory of the work area was conducted on July 27, 2022. During this inventory, the route of the road connecting the projected wind turbines to the Expo mine site, and the areas intended for installation of the wind turbine platforms, were covered on foot. During this inventory, food cans dating from forty years ago were observed. They are attributed to Euro-Canadian activities, probably related to mineral prospecting around the 1950s. Also, the area covered contains many small heaps of stones less than one metre high, also associated with mineral prospecting. Some of these heaps still have a wooden prospecting stake in their centre.

No cultural sign that could be associated with traditional Inuit occupancy was observed in the work area during the inventory conducted in July 2022.

5.4.5 Landscape

5.4.5.1 Description of the Landscape

The landscape of the study area was the subject of a characterization including the following elements:

- The analysis of the territorial and regional landscape according to the ecological reference framework classification (CER);
- The identification of the valued elements of the landscape by the local populations;
- The photographic survey of the sites according to their valuation by the local populations;
- The characterization of the types of observers of the landscape;
- The analysis of the topography and visibility of the wind turbines according to the geomatics tools;
- The characterization of the visual access areas.

5.4.5.2 Big Landscapes

The study area is an integral part of the Ungava Peninsula natural province, a Level 1 ecological reference framework (CER) classification at the MELCC. It is surrounded by Hudson Bay (on the west), Hudson Strait (on the north) and Ungava Bay (on the east). This Arctic area, more precisely the “Herbaceous Arctic Tundra” bioclimatic domain, is the northernmost in Québec.

The projected site for implementation of the wind turbines, near the Expo mining complex, is located in the Puvirnitug Mountains (Level 2 CER), in the Lac Raglan Hills (Level 3 CER) and in the Lac Rocbrune Knolls (Level 4 CER). Regarding the existing vegetation, the study area is found in a tundra landscape and the plant cover mainly consists of ground cover.

5.4.5.3 Valued Elements of the Landscape

The valued elements of the landscape are directly associated with human activities and the way the territory is used by the population. The local study area includes industrial and mining activities associated with the Nunavik Nickel mining complex (CRI) and the Raglan Mine (Glencore), and recreational or subsistence activities, such as hunting, fishing, snowmobile trails and the activities practiced in Pingualuit National Park.

Further to the analyses of the landscape and land use, several sites were identified as valued elements of the landscape. Five main sites were identified, combining several characteristics of the big landscape and the landscape units found in the study area. The five main valued sites identified are as follows:

- Lac Gindeau;
- Lac du Bombardier;
- Lac Rocbrune;
- Lac Saint-Germain;
- Lac Pingualuk Crater.

Four secondary sites were also identified; they combine fewer characteristics of the big landscape compared to the main sites but nonetheless still are sites to consider because they represent the different landscape units found in the study area. The three secondary sites identified are as follows:

- Airport road and Km 13 crossroads;
- South of Lac Rocbrune;
- Lac Mequillon.

A detailed description of the use of these sites was already given in sections 5.4.2 and 5.4.3 of this chapter.

5.4.5.4 Types of Observers

Three types of observers are found in the landscape. The first type of observers are permanent observers, who represent people working in mining complexes located within the project’s visual access area. The second type of observers are mobile observers, such as truckers working for Kattiniq Transport Inc., mining company employees travelling on the roads, and Inuit users travelling by snowmobile or ATV in the study area. The third type of observers are temporary observers found in and at the approaches to the local study area, such as users of Pingualuit National Park, more specifically in the Lac Pingualuk Crater sector, which is this park’s main attraction, and Inuit hunters and fishers visiting the territory.

5.4.5.5 Topography of the Study Area

An analysis of the existing topography was done in section 5.2 of this study (Map 5-1). In the landscape, the topography of the limited study area includes several hills, knolls and plains with altitude variations of about 200 m between the high points and the low points. These variations offer a rugged landscape with discontinuous visual basins. The proposed wind turbines will be positioned on a high point in a landscape at an altitude corresponding to about 640 m.

5.4.5.6 Landscape Units

It is established that a landscape unit contains a distinct portion of the place within a visual basin defined on the basis of similar elements, such as topography, vegetation, use of the soil and typology of the views, as well as the ambiances specific to each of these units. Three types of landscapes are identified in the local study area.

5.4.5.6.1 Landscape Unit 1: Access Roads

Description of the Landscape Unit

This landscape unit is mainly characterized by the presence of access roads crossing the local study area (Figure 5-24). These roads are mainly straight with winding portions. They are mainly located in the north sector of the local study area.

Visual Fields and Observers

This landscape unit contains mobile observers, such as workers and road users.

Figure 5-24: Landscape Unit 1: Point of View from Lac du Bombardier

5.4.5.6.2 Landscape Unit 2: Plateaus and Rolling Hills

Description of the Landscape Unit

This landscape unit is mainly characterized by a pronounced topography formed by plateaus and rolling hills (Figure 5-25). The surface consists of exposed rocky surfaces with a sporadic presence of ground cover. This landscape unit includes several key landscape elements, such as lakes, watercourses, hills, snowmobile trails and hunting and fishing sectors.

Visual Fields and Observers

This landscape unit contains mobile and temporary observers, i.e. Inuit hunters and fishers, and visitors to Pingualuit National Park.

Figure 5-25: Landscape Unit 2: Point of View from Lac Rocbrune, Southward View

5.4.5.6.3 Landscape Unit 3: Industrial

Description of the Landscape Unit

This landscape units consists of the elements dedicated to the mining industry, such as industrial buildings, machinery and camps. These elements occupy an important place in the landscape by their colours and shapes. They contrast strongly with the neighbouring natural context (Figure 5-26).

Visual Fields and Observers

This landscape unit contains permanent observers, such as the workers found on the site of the Expo mining complex and whose observation point is permanent in the landscape from the different buildings of the site.

Figure 5-26: Landscape Unit 3: Point of View form Lac Gindeau Toward the Expo Mining Complex

5.4.6 Noise Climate

Based on the information obtained in the preliminary analysis of Inuit and non-Native land use, three sensitive receptors for the study of the noise climate were identified in the limited study area of the project. Receptor R1 is located near Lac du Bombardier, receptor R2 is located in the northern portion of Lac Rocbrune, and receptor R3 is found near the workers' camp on the Expo site.

Up to 2021, sport fishing activities were carried on by CRI employees on Lac du Bombardier (receptor R1) and it is possible that fishing excursions will still take place in the next few years if the MFFP gives its authorization to this effect. The Inuit users have the obligation not to approach within 5 km of the mine sites operated by Canadian Royalties. In this sense, Lac Rocbrune (receptor R2) thus constitutes the site visited by Inuit users that is closest to the projected wind turbines. Ice fishing and open water fishing activities take place there, mainly in the southern portion of the lake, and temporary tent camps are possibly installed.

The initial ambient noise measurements were taken from July 25 to 29, 2022, near the sensitive receptors identified. A first measurement (receptor R1), lasting 24 hours, was taken near Lac du Bombardier from July 25 to 27, 2022. The second measurement (receptor R3), lasting 24 hours, was taken near the workers' camp on the Expo site from July 27 to 29, 2022. The measurements allowing characterization of the recreational environment (at receptor R1), found in most of the study area and the residential environment (workers' camp) of the Expo site (receptor R3), have the purpose of assessing the criteria to be respected (initial ambient noise or criterion of the MELCC instruction note).

The ambient noise is primarily associated with wind for Lac du Bombardier (receptor R1), while it mainly comes from mining activities on the Expo site (receptor R3). Moreover, the noise level observed at receptor R1 between 5 p.m. and 10 p.m. would correspond to the noises caused by the pumping station, which is used for the water requirements of the Expo mine site. For site R2 (Lac Rocbrune),it was impossible to take noise measurements in the field due to its inaccessibility by road. It can reasonably be considered that the noise at receptor R2 (Lac Rocbrune) would be similar to the noises measured at receptor R1 (Lac du Bombardier).

The noise measurements are expressed in equivalent (or mean) noise level over one hour (LAeq). The ambient noise determined corresponds to the minimum noise level measured during reference periods (day and night). Consequently, the ambient noise near sensitive receptor R1 (Lac du Bombardier), for the period measured, was 34.4 dBA (hourly LAeq) by day and 28.8 dBA (hourly LAeq) by night. For receptor R3 (workers' camp of the Expo site), the ambient noise for the period measured was 44.9 dBA (hourly LAeq) by day and 33.2 dBA (hourly LAeq) by night.

6 Identification and Assessment of the Impacts

6.1 Methodological Approach

6.1.1 Description of the Impact Assessment Method

The method used for impact identification and assessment conforms to the Gouvernement du Québec general directive on the production of impact assessments (MDDELCC, 2016). This approach depends on a detailed description of the project (Chapter 3) and the receiving environment (Chapter 5).

The description of the project allows the identification of the impact sources based on the technical characteristics of the structures to be built and the activities, methods and time frame of construction, operation and dismantling of the project. The description of the receiving environment allows an understanding of the environmental and social context in which the project is integrated, identification of the issues to consider, and determination of the most sensitive components of the environment regarding the project. The concerns and expectations of the Inuit communities expressed during the public consultations conducted in Kangiqsujuaq in September 2022 are also considered.

It should be noted that the environmental assessment is simplified by the integration, starting from the operational phase of the project, of various environmental optimizations of the project concept, so as to mitigate, from the outset, the number and importance of the impacts that could occur. The various issues targeted at the beginning of the analysis are also taken into account in the optimization of the project to increase its environmental and social acceptability.

Finally, the information taken from the performance of the projects already authorized under the Nunavik Nickel Project (NNiP) and the results of the environmental follow-ups conducted for the NNiP, as well as those conducted for the Raglan Mine wind farm, provide relevant data that allows the nature and intensity of certain impacts associated with this type of project to be determined, as well as the effectiveness of certain mitigation measures.

The impact assessment method is presented in the following text. An impact may be positive or negative. A positive impact (or positive spinoff) generates an improvement of the component of the environment affected by the project, while a negative impact contributes to its deterioration. An impact is assessed based on the criteria defined below.

6.1.1.1 Intensity of the Impact

The intensity of the impact depends on the magnitude of the changes observed in the component affected by an activity of the project or the resulting disturbances. It also accounts for the cumulative, synergic or deferred effects which, beyond the simple direct effect on the component, may amplify the disturbance of a component when the environment is particularly sensitive.

Thus, **low intensity** is associated with an impact that only provokes slight changes to the component concerned, without jeopardizing its use or characteristics. For the components of the biological environment, a low-intensity impact implies that only a small proportion of the plant or animal population or their habitats will be affected by the project. A low intensity also means the project does not jeopardize the integrity of the populations concerned and does not affect the abundance and range of the plant and animal species affected. For components of the human environment, an impact is considered low intensity if the disturbance affects only a small proportion of a community or a population, or if it only slightly or partially reduces the use or integrity of a component without thereby jeopardizing the vocation, use or functionality and safety of the living environment.

An impact is said to be **medium intensity** when it generates tangible disturbances for the use of a component or its characteristics, but not to reduce them completely and irreversibly. For flora and fauna, the intensity is considered medium if the disturbances affect a medium proportion of the populations or habitats, without compromising the integrity of the populations affected. However, the disturbances nonetheless may result in a decrease in the abundance or a change in the range of the species affected. Concerning the human environment, the disturbances of a component must affect a significant segment of a population or a community to be considered medium intensity.

Finally, an impact is qualified as **high intensity** when linked to very important changes to a component. For the biological environment, a high intensity corresponds to the destruction or alteration of an entire population or a high proportion of a population or a habitat or a given species. At the extreme, a high-intensity impact translates into a decline in the abundance of this species or a change of magnitude in its geographic range. For the human environment, the intensity is considered high when the disturbance irreversibly affects or limits the use of a component by a community or a population, or when its functional and safe use is seriously compromised.

6.1.1.2 Extent of the Impact

The extent of the impact refers to its radius of action. It may be limited, local or regional. To a certain extent, it is independent of the limits of the study area selected for this project.

A **regional extent** generally pertains to a vast territory with a geographic or administrative structure. This territory may be defined and perceptible by a given population or by the presence of natural components of the environment, such as an ecological district that includes similar physiographic characteristics.

A **local extent** refers to a more limited portion of the territory, a specific ecosystem, a given municipal entity (local municipality) or an environmental dimension perceptible only by part of a regional population.

Finally, a **limited extent** corresponds to a well-circumscribed disturbance, affecting a small area or perceptible by only a limited group of individuals. An impact of limited extent may be limited to the footprint of the project (work area) or affect only a few individuals (animals, plants or humans). The impact on the built environment at a given crossroads is an example of limited extent.

As an indication, for this project, an impact that can be felt on the scale of the extended, local or limited study areas may be respectively considered to have a regional, local or limited extent.

6.1.1.3 Duration of the Impact

The duration of the project's impact refers to the temporal dimension of the impact. It assesses the period during which the effects will be felt in the environment. This period may be the recovery or adaptation time of the component affected.

The impact has **a long duration** when an effect is felt continuously or discontinuously throughout the life cycle of the site. The impact is often permanent and irreversible.

The impact has a **medium duration** when the effects are felt continuously or discontinuously for more than one year or up to a few years after the end of the construction work.

The impact has a **short duration** when the effects are felt continuously or discontinuously during the construction period or when the recovery or adaptation time of the component affected is less than one year.

6.1.1.4 Importance of the Impact

The importance of the impact is the outcome of an overall judgment on the effect of an activity of the project regarding a component of the receiving environment and that is based on the three criteria defined above, namely the intensity, extent and duration of the impact. Three classes of importance are used for this purpose: minor, medium or major. The importance of the impact is determined by an interpretation that combines the criteria described in the previous sections, all put into perspective by one or more experienced specialists in the field.

Table 6-1 presents the grid determining the overall importance of an impact, based on the criteria of intensity, extent and duration of the impact. This applies both to the positive impacts and the negative impacts.

For each of the impacts identified in the context of this study, the importance of the residual impact is assessed. The **residual impact** is defined as the impact that persists after the application of the various mitigation measures. For each environmental component, special mitigation measures intended to reduce or eliminate the importance of the impacts of the identified impacts have been developed. The integration of these mitigation measures at this stage is a commitment by TUGLIQ Energy that they will be applied during the construction, operational and dismantling phases of the project.

Several generic mitigation measures were already established by Canadian Royalties under their mining project (NNiP), following the Nunavik Nickel Agreement, and these mitigation measures will also be applied to this wind energy project when they are applicable.

Table 6-1: Grid for Determining the Importance of the Residual Impact

Intensity[a]	Extent	Duration	Importance of the residual impact		
			Major	Medium	Minor
High	Regional	Long	×		
		Medium	×		
		Short	×		
	Local	Long	×		
		Medium	×		
		Short		×	
	Limited	Long	×		
		Medium		×	
		Short		×	
Medium	Regional	Long	×		
		Medium	×		
		Short		×	
	Local	Long	×		
		Medium		×	
		Short			×
	Limited	Long		×	
		Medium			×
		Short			×
Low	Regional	Long		×	
		Medium		×	
		Short			×
	Local	Long		×	
		Medium			×
		Short			×
	Limited	Long			×
		Medium			×
		Short			×

[A]: The intensity is assessed according to the presence or absence of a cumulative effect on the component. For example, the impacts on air quality and soil quality may have a cumulative impact on water quality, because these two components have a potential impact on water quality.

The impact sources and the components of the environment sensitive to the project are presented in more detail in the following sections (6.1.2 and 6.1.3). An interrelationship grid then makes the connections between the impact sources and the components of the environment (section 6.1.4), allowing the probable impacts of the project to be foreseen.

6.1.2 Impact Sources

The detailed description of the project (Chapter 3) allows the production of an overall picture of all the components of the project that could have an impact on the environment. The impact sources are associated with the construction, operational and closure phases of the project (Table 6-2).

Table 6-2: Wind Energy Project Impact Sources

Impact sources	Description
Construction Phase	
Preparation of the work and mobilization of the site	Surveying and work area marking activities, deployment of site facilities (trailer, toilets, etc.), preparation of work areas, including mobilization of the personnel on the work site.
Transportation of materials and equipment	Activities related to transportation of all materials and equipment required to the work site, including marine and road transportation.
Preparation of access roads and wind turbine procedures	Soil stripping, excavation, backfilling and grading activities required for deployment of access roads and wind pads, including installation of culverts and drainage ditches.
Construction of wind farm structures	All of the activities related to the installation of the wind turbines and their connection to the Expo mine site electric power grid: drilling, concreting and installation of the foundations, assembly and erection of the wind turbines with cranes, installation of the power transmission cables, installation of the battery storage system, connection to the mine's electric power grid.
Restoration of the work areas and demobilization of the site	Activities related to the demobilization of the site, including restoration of the work areas at the end of the work, recovery and management of waste and residual materials, and demobilization of personnel.
Operational Phase	
Operation of wind turbines	Physical presence of infrastructure on the site and effects associated with the movement of wind turbine blades.
Maintenance of the wind farm	Activities required to perform maintenance of the wind turbines and the wind farm in general, including all the infrastructure maintenance activities, maintenance of the access roads and wind pads (snow removal, resurfacing, etc.) and transportation of the personnel required on the work site (mobilization/demobilization).
Dismantling Phase	
Preparation of the work and mobilization of the site	Deployment of site facilities (trailer, toilets, etc.) and preparation of work areas, including mobilization of the personnel on the work site.
Transportation of materials and equipment	Activities related to transportation of all the materials and equipment required, including management and disposal of equipment and materials dismantled at the end of the work.
Dismantling of wind farm structures	All the activities related to dismantling and uninstallation of the wind turbines and the other project infrastructure.
Restoration of disturbed sites and demobilization of the job site	Activities related to restoration and rehabilitation of all the disturbed sites at the end of the work, recovery and management of waste and residual materials, and demobilization of personnel.

6.1.3 Components of the environment

The detailed description of the receiving environment (Chapter 5) allows the identification of the components of the physical, biological and human environments that are likely to be affected by one or more potential project impact sources and by the potential interactions among the various sources. The impact assessment will address the environmental components presented in Table 6-3.

Table 6-3: Environmental Components Likely to Be Affected by the Wind Energy Project and Covered by the Impact Assessment

Component	Description
Physical environment	
Air Quality	Physicochemical characteristics of the air
Soil Quality	Physicochemical characteristics of the soil
Water Quality	Physicochemical characteristics of the surface water and groundwater
Hydraulic and sedimentary regime	Flow of surface water and sedimentary transport
Biological environment	
Terrestrial flora	Terrestrial environments (felsenmeer, tundra ostiole polygonal soils, eskers and boulder fields) and the plant species that compose them, including species at risk
Wetland flora	Wetlands (lowland fens, snowbed fens), ecological functions and plant species that compose them, including species at risk
Avian fauna	All of the bird species and their habitats, including species at risk
Caribou and other Mammals	Caribou and other mammal species and their habitats, including species at risk
Human environment	
Economy and employment	Economic impacts associated with construction, operation and dismantling of the wind farm
Inuit land use	Current and projected land occupancy and use by Inuits of the Salluit and Kangiqsujuaq communities
Non-Native land occupancy and use	Current and projected non-Native land use, including use of Pingualuit National Park, use of Kattiniq-Donaldson Airport, use of the access roads leading from the Deception Bay port facilities to the Glencore and CRI mining facilities, and use of wildlife resources
Archaeology	Known occupancy sites and potential archaeological sites
Noise climate	Ambient noise emissions
Landscape	Visibility of wind turbines for users of the environment

Let us mention, in particular, that no body of water or permanent watercourse will be directly affected by the performance of the project in the work area. Consequently, no aquatic wildlife organism will be directly influenced by the work. Only the water quality of certain intermittent watercourses may suffer a potential impact caused by the project in the work area.

6.1.4 Interrelationships Between the Impact Sources and the Components of the Environment

The potential impact sources and the components of the environment likely to be affected by the project are presented in an interrelationship grid (Table 6-4). This matrix determines which phase of the project (construction, operation and dismantling) and which specific activities risk causing impacts on the various components of the physical, biological and human environments.

A priori, the impact sources that risk affecting the greatest number of components of the environment are preparation of the access roads and wind pads (soil stripping, excavation, backfilling and grading), and construction of the wind farm structures. Indeed, these activities will durably alter the receiving environment. The other impact sources are likely to have a more targeted impact on certain specific components of the environment.

Table 6-4: Interrelationship Grid of Impact Sources and Components of the Environment for the Wind Energy Project

Components of the environment / Impact sources	Physical environment				Biological environment				Human environment					
	Air quality	Soil Quality	Water quality	Hydraulic and sedimentary regime	Terrestrial flora	Wetland flora	Avian fauna and their habitats	Mammals and their habitats	Economy and employment	Inuit land use	Non-Native land occupancy and use	Archaeology	Noise climate	Landscape
Construction Phase														
Preparation of the work and mobilization of the site	■	■	■		■	■	■	■	■	■			■	
Transportation of materials and equipment	■	■	■					■	■	■	■		■	
Preparation of access roads and wind pads	■	■	■	■	■	■	■	■	■	■		■	■	■
Construction of wind farm structures	■	■	■		■	■	■	■	■	■	■		■	■
Restoration of the work areas and demobilization of the site	■	■	■		■	■	■	■	■	■			■	
Operational Phase														
Operation of wind turbines					■	■	■	■	■	■	■		■	■
Maintenance of the wind farm	■	■	■						■				■	
Dismantling Phase														
Preparation of the work and mobilization of the site	■	■	■		■	■	■	■	■	■			■	
Transportation of materials and equipment	■	■	■					■	■	■	■		■	
Dismantling of wind farm structures	■	■	■		■	■	■	■	■	■	■		■	■
Restoration of disturbed sites and demobilization of the job site	■	■	■		■	■	■	■	■	■			■	■

6.2 Impacts on the Physical Environment

Each component of the physical environment likely to present risks of degradation during one of the three project phases (construction, operation and dismantling) is the subject of a description of the impacts in this section. These components are air quality, soil quality, water quality (including surface water and groundwater) and the hydraulic and sedimentary regime.

The mitigation measures are numbered according to the component of the physical environment they concern (AIR, SOIL, WATER, etc.). The measures that are applicable and common to several components of the physical environment are identified according to the first number under which they are presented in the following subsections.

6.2.1 Air Quality

Most of the anticipated impacts on air quality are applicable to each of the three phases of the project and are described below.

6.2.1.1 Construction Phase

All of the operations during the construction phase, including mobilization and demobilization of the job site, stripping, backfilling and grading of the soil for the development of the access road and the wind pads, and use of machinery and traffic of transport vehicles, are temporary sources of growth of airborne dust and contaminant emissions. Indeed, the materials and equipment will be transported to the wind turbine implementation site from Deception Bay, which will generate dust and gas emissions from combustion over the route by the passage of heavy vehicles. About 80 round trips by semi-trailer trucks will have to be made between Deception Bay and the work area to ship all the material and equipment required. Vehicular traffic will also take place between the implementation site of the projected wind turbines (work area) and the Expo mine site, particularly for daily transportation of workers accommodated on the Expo site.

Marine transportation of materials and equipment to Deception Bay will also be a source of atmospheric pollutant emissions. It is foreseen that two or three marine shipments will be necessary to transport all the material required. However, given that transportation by boat will be performed in the context of trips already planned by CRI for their regular operations, no increase in atmospheric pollutants is forecast compared to the current situation for this type of transportation.

The main contaminants and greenhouse gases resulting from transportation and machinery running on fuel are nitrogen oxides, sulphur dioxide, carbon monoxide and dioxide, particulate matter and methane.

Since the winds in the local study area are relatively strong and blow freely due to the absence of arborescent vegetation and the low topographic relief, dust and atmospheric pollutants will tend to remain above the emission source. This reality also applies to marine and road transportation to the work site.

6.2.1.2 Operational Phase

The main atmospheric emissions related to the operational phase are associated with the maintenance and servicing work necessary for the efficient operation of the wind turbines in the long term. These exhaust gases and dust are attributable to fuel combustion resulting from the use of machinery for the maintenance of the access road and the wind pads and for the transportation of personnel and repair materials when required. The traffic of transport vehicles may also be a source of airborne suspended dust.

These will be limited events and the effects will have a short duration and dissipate rapidly. Dust and atmospheric pollutants will tend not to remain above the emission source due to winds and topography.

6.2.1.3 Dismantling Phase

During this phase, local airborne gas and dust emissions will be caused by the site work necessary for dismantling of infrastructure, and by restoration work. These activities will cause local emissions, in addition to transportation of material and equipment required for these activities. The nature of the contaminants and dusts is the same as listed previously for the construction phase.

6.2.1.4 Mitigation Measures

To limit the impact of the work on air quality, mitigation measures relating to the use of combustion material, traffic of transport vehicles and control of emissions of hazardous materials will have to be deployed. These measures provide, in particular, for regular maintenance of vehicles and equipment that may constitute an atmospheric pollutant emission source, the application of procedures and the use of equipment limiting airborne emissions, as well as adequate storage of hazardous materials. As a reminder, as mentioned in the section 5.2.2 of the description of the physical environment, air quality in the Expo mine sector is qualified as “good” most of the time.

Table 6-5 summarizes the mitigation measures that will be applied

Table 6-5: Mitigation Measures to Minimize the Impacts on Air Quality

Nº	Mitigation measures
AIR 1	Avoid leaving internal combustion vehicles and equipment idling needlessly.
AIR 2	Spread dust suppressant (calcium chloride or water) on the access roads in dry and windy weather. The moistening frequency will be adjusted according to the weather conditions and the dust emissions observed.
AIR 3	Use machinery meeting the Environment and Climate Change Canada emission standards for road and off-road vehicles.
AIR 4	Limit handling of materials in periods of high winds to reduce dust emissions.
AIR 5	Use generators and equipment with low contaminant emissions.
AIR 6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and in good working order.
AIR 7	Use sealed and standard trucks covered with a tarp, depending on the needs, to limit airborne dispersion of fine particulate matter.

6.2.1.5 Residual Impact

Table 6-6 describes the characteristics that can determine the importance of the residual impact for each of the three phases of the project, following the application of the mitigation measures. Since the construction and dismantling phases involve similar activities and impacts, they are discussed jointly.

The anticipated impact on air quality during the construction and dismantling phases is low intensity, given that the expected air quality alteration will be weakly felt in the receiving environment. The extent of the impacts identified is local because they will be restricted primarily to the local study area of the project. Transportation of materials and equipment between Deception Bay and the implementation site of the wind turbines will be negligible, given that the essential emissions will be generated on the site, during the work. The duration of the effect is short due to its temporary nature limited to the construction and dismantling periods, less than one 1 year in each. **In short, the importance of the residual impact on air quality is considered minor during the construction and dismantling phases.**

For the operational phase, greenhouse gases and dust will be emitted during wind farm maintenance and servicing operations. The intensity of the impacts on air quality is considered low in the operational phase, the identified impacts have a limited extent because they will be mainly restricted to the limited study area of the project, and the duration of the effect is short because of its limited nature. **The importance of the residual impact on air quality in the operational phase is therefore considered minor.**

Table 6-6: Description of the Importance of the Residual Impact of the Project on Air Quality

Component	Performance phase	Description of the impact	Mitigation Measures[A]	Intensity	Extent	Duration	Importance of the residual impact
Air Quality	Construction Dismantling	Increase in airborne dust and atmospheric pollutants and greenhouse gas (GHG) emissions	AIR 1 to AIR 7	Low	Local	Short	Minor
	Operational		AIR 1 AIR 3 to AIR 6	Low	Limited	Short	Minor

[A] The numbers of the mitigation measures refer to the table above.

6.2.2 Soil Quality

The anticipated impacts on soil quality for each of the three phases of the project are described below.

6.2.2.1 Construction Phase

All the activities composing the construction phase are likely to cause soil quality impacts, including site mobilization, transportation of materials and equipment, preparation of access roads and wind pads, construction of structures and restoration of work areas.

Site machinery traffic and operation throughout the work could alter soil quality in case of an accidental spill or leaks of wastewater, oil and fuel.

Stripping, backfilling, excavation, drilling and earthmoving work are limited in nature over relatively limited surfaces but could disturb the profile of the land, due to soil compaction and rutting, and lead to erosion in certain places. The stripped and graded surfaces will lose their plant cover, which can favour the dispersion of soil particles accidentally contaminated during the work.

Any accidental spill or runoff of contaminated water could also accumulate in the deep depressions generated in the soil by the work.

The majority of the soil excavated in the work will be reused directly on the site for backfilling, except for a surplus of 3,038 m^3 of excavated soil, which will have to be sent offsite for disposal. These excess materials will be managed by CRI according to their usual process and disposed of in the mine's tailings dump.

6.2.2.2 Operational Phase

For this phase, the impacts are limited to the risks of accidental oil or hydrocarbon spills that may come from equipment necessary for maintenance and servicing activities, or vehicular traffic for the transport of personnel or road maintenance.

6.2.2.3 Dismantling Phase

All the activities composing the dismantling phase are likely to cause soil quality impacts, including site mobilization, transport of materials and equipment, dismantling and uninstallation of wind turbines and restoration of disturbed sites.

As in the construction phase, site equipment traffic and operation throughout the work could alter soil quality in case of an accidental spill or leaks of wastewater, oil and fuel.

The use of heavy machinery could disturb the profile of the land by soil compaction and rutting, as well as leading to erosion in certain places.

During the dismantling of the wind turbines, the piles (steel and concrete) of the foundations will not be removed because they will be razed to ground level and thus will remain in place in the soil, constituting a permanent impact. This impact nonetheless is negligible regarding the soil quality, given that it does not induce special or additional degradation. The visible part of the foundations (above-ground) will be completely dismantled and recovered, like the rest of the wind farm infrastructure.

6.2.2.4 Mitigation Measures

To limit the impact of the work on soil quality, mitigation measures will be provided relating to the emergency responses in case of an accidental spill of hazardous products. The measures concern transportation activities, the use of material and equipment, and soil protection measures against erosion. These measures, in particular, will provide for regular maintenance of machinery that may be a source of accidental or polluting spills, as well as appropriate storage of hazardous materials.

Table 6-7 summarizes the mitigation measures that will be applied

Table 6-7: Mitigation Measures to Minimize Soil Quality Impacts

Nº	Mitigation measures
AIR 6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and in good working order.
SOIL 1	Apply the CRI prevention and emergency preparedness plan in case of a spill and make emergency recovery kits for petroleum products and hazardous materials easily accessible at all times, in accordance with the laws and regulations in force.
SOIL 2	Perform general maintenance and fuel supply for machinery at the places identified by the site supervisor. Storage of petroleum products and maintenance, refuelling and cleaning of machinery and equipment must be done over 30 m from a watercourse or a wetland, on a site developed for this purpose where no risk of contamination of soil, surface water and groundwater exists.
SOIL 3	Place the receptacles containing hydrocarbons and other hazardous products in a bin or between berms with the capacity to collect 110 % of the stored reserve.
SOIL 4	Use fuel transfer equipment equipped with automatic valves detecting leaks.
SOIL 5	Divert the runoff water from the work areas, exposed soil and erodible slopes to stabilized facilities or locations, ensuring that it flows slowly on the surface. Runoff water in the work areas must be contained, sampled and treated, if required.
SOIL 6	Contain heavy machinery traffic on preferred routes within the work area.
SOIL 7	Avoid performing work in heavy rain periods to minimize the leaching of soil and dispersion of sediments.
SOIL 8	Proceed, as the work progresses, with the cleaning of the site (removal of materials and provisional facilities, removal of waste and wash water to the authorized storage or disposal sites).
SOIL 9	Reuse the excavated oil directly on the site as much as possible for backfilling and disposal of the excess soil offsite. These excess materials will be managed by the mine according to their usual process.

Tableau 6-7 : Mitigation Measures to Minimize Soil Quality Impacts (cont'd)

Nº	Mitigation measures
SOIL 10	Take the necessary precautions during temporary storage of accidentally contaminated soils (as the case may be) to avoid contamination of the underlying and adjacent soils, at least: (1) segregate the soils according to their contamination level and the stratigraphy observed; (2) store the soils on an impermeable cover (geotextile) and cover them, or store them in any other type of hermetic containment system. The covers must be fastened solidly to prevent them from being lifted by the wind.
SOIL 11	The soils presenting signs of contamination must not be piled with soils not presenting these signs. They must be managed offsite according to the excavated contaminated soil management grid of the MELCC policy (disposal at a site authorized by the MELCC at a technical landfill site, as the case may be).
SOIL 12	Avoid leaving soil stripped and exposed to atmospheric agents.
SOIL 13	Restore the job site areas rapidly at the end of the work.
SOIL14	Report any spill with environmental consequences to the following authorities: Environment Canada Environmental Emergency Response (1-866-283-2333) and Urgence Environnement in Québec (1-866-694-5454); recover the contaminated materials, as applicable, and dispose of them with a company approved by the MELCC.
SOIL 15	Take precautions to avoid any accidental spill near a hole during drilling and recover the escaped residual products, as applicable.
SOIL 16	During earth moving in steep-sloped areas, stabilize the bottom of the ditches as the work proceeds, using well-drained granular materials, and proceed with rock ballasting.

6.2.2.5 Residual Impact

Table 6-8 describes the characteristics of the importance of the residual impact for each of the three phases, after the application of the mitigation measures.

The intensity of the impact of the work on soil quality is low because the component is only slightly affected by the project after the deployment of the mitigation measures. Since the effect is felt only in the work area, the extent of the effect is considered limited. The duration of the impact associated with the construction and dismantling phases is short because the work will be carried out over a period of less than one year, while the duration of the impact associated with the operational phase is also short due to the limited nature of the wind farm maintenance and servicing work. **The importance of the residual impact on soil quality for each of the three phases of the project is considered minor.**

Table 6-8: Description of the Importance of the Residual Impact of the Project on Soil Quality

Component	Performance phase	Description of the impact	Mitigation Measures[A]	Intensity	Extent	Duration	Importance of the residual impact
Soil Quality	Construction Dismantling	Risk of soil contamination and dispersion in the environment	AIR 6 SOIL1 to SOIL16	Low	Limited	Short	Minor
	Operational		AIR 6 SOIL1 to SOIL 4 SOIL14	Low	Limited	Short	Minor

[A] The numbers of the mitigation measures refer to the table above

6.2.3 Water Quality

The activities likely to have impacts on surface water and groundwater quality are summarized below, for each phase of the project.

It should be noted that in the case of groundwater, the project's impacts are considered negligible, given that the permanence and thickness of the permafrost do not allow water infiltration into the soil from the surface. The drilling work planned for the deployment of the piles of the wind turbine foundations will be limited to a maximum depth of about 18 m in the soil and the underlying rock, which is relatively low in comparison to the depth of the permafrost in this region.

6.2.3.1 Construction Phase

Transportation and traffic of heavy vehicles (associated with the risks of accidental contamination by hydrocarbons or other potentially deleterious products), stripping, excavation, backfilling, drilling and concreting work, and all the construction and site restoration work are the main impact sources likely to deteriorate the quality of the surface water. This work could alter the drainage and thus accentuate runoff at some locations.

Soil stripping and removal of the plant cover in the work areas and creation of ruts during machinery movements could generate erosion in some locations and expose the surface of the soil to the effect of meteorological agents, which can favour the dispersion of fine particulate matter to the natural waterways and accentuate runoff of water potentially contaminated by the work.

However, the absence of permanent watercourses in the sectors that will be directly affected by the work limits the contamination risks inherent in surface water runoff.

6.2.3.2 Operational Phase

As in the case of the soil, for this phase of the project, the water quality impacts are limited to the risks of an accidental oil or hydrocarbon spill that could come from equipment necessary for the maintenance and servicing activities, or vehicular traffic for the purposes of transport of personnel or road maintenance.

However, let us remember that the absence of permanent watercourses in the sectors directly affected by the work limits the risks of surface water contamination.

6.2.3.3 Dismantling Phase

The dismantling phase presents the same potential impacts as those anticipated for the construction phase. Indeed, as in the construction phase, the dismantling phase involves site preparation and mobilization, transport of materials and equipment, and site restoration.

The work could alter the drainage by rutting and thus accentuate erosion and runoff at some locations. These changes of the profile of the soils will expose them more to meteorological agents, favour the dispersion of fine particulate matter to the natural waterways and accentuate runoff of water potentially contaminated by the work. However, the absence of permanent watercourses in the sectors directly affected by the work limits the risks of surface water contamination.

6.2.3.4 Mitigation Measures

The mitigation measures to be applied relating to the containment of the water that potentially could be found on the surface in the work area. These measures concern all wash water, for example, during concreting work planned for construction of the piles of the wind turbine foundations, and any direct contamination of water via debris, site waste, and accidentally contaminated soil (hydrocarbons and oils). The mitigation measures also concern any transportation and use of materials and equipment. These measures provide, in particular, for regular maintenance of the equipment and vehicles, which may be a source of accidental spills of pollutants, as well as appropriate storage of hazardous materials.

Table 6-9 summarizes the mitigation measures that will be applied

Table 6-9: Mitigation Measures to Minimize Water Quality Impacts

Nº	Mitigation measures
WATER 1	The surplus concrete from the cement mixers and concrete pumps must be poured into a contained enclosure. The concrete residues must be managed with the construction waste.
WATER 2	The wash water from the concrete mixers must be collected in a leakproof pond developed to avoid any flow into the environment.
WATER 3	Dispose of excavated materials to limit the dispersion of suspended particulate matter as much as possible.
WATER 4	During construction of access roads and wind turbine platforms, all the work located near a watercourse, a wetland or a site that could lead to significant runoff (steep slope) must be circumscribed (where required) with sediment barriers to avoid the transport of sediments via surface water. The sediment barriers must remain efficient during heavy rain periods.
AIR 6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and good working order.
SOIL 1	Apply the CRI prevention and emergency preparedness plan in case of a spill and make emergency recovery kits for petroleum products and hazardous materials easily accessible at all times, in accordance with the laws and regulations in force.
SOIL 2	Perform general maintenance and fuel supply for machinery at the places identified by the site supervisor. Storage of petroleum products and maintenance, refuelling and cleaning of machinery and equipment must be done over 30 m from a watercourse or a wetland, on a site developed for this purpose where no risk of contamination of soil, surface water and groundwater exists.
SOIL 3	Place the receptacles containing hydrocarbons and other hazardous products in a bin or between berms with the capacity to collect 110 % of the stored reserve.
SOIL 4	Use fuel transfer equipment equipped with automatic valves detecting leaks.
SOIL 5	Divert the runoff water from the work areas, exposed soil and erodible slopes to stabilized facilities or locations, ensuring that it flows slowly on the surface. Runoff water in the work areas must be contained, sampled and treated, if required.
SOIL 6	Contain heavy machinery traffic on preferred routes within the work area.
SOIL 7	Avoid performing work in heavy rain periods to minimize the leaching of soil and dispersion of sediments.
SOIL 8	Proceed, as the work progresses, with the cleaning of the site (removal of materials and provisional facilities, removal of waste and wash water to the authorized storage or disposal sites).
SOIL 12	Avoid leaving soil stripped and exposed to atmospheric agents.
SOIL 13	Restore the job site areas rapidly at the end of the work.
SOIL14	Report any spill with environmental consequences to the following authorities: Environment Canada Environmental Emergency Response (1-866-283-2333) and Urgence Environnement in Québec (1-866-694-5454); recover the contaminated materials, as applicable, and dispose of them with a company approved by the MELCC.
SOIL 15	Take precautions to avoid any accidental spill near a hole during drilling and recover the escaped residual products, as applicable.
SOIL 16	During earth moving in steep-sloped areas, stabilize the bottom of the ditches as the work proceeds, using well-drained granular materials, and proceed with rock ballasting.

6.2.3.5 Residual Impact

Table 6-10 describes the characteristics of the importance of the residual impact for each of the three phases, after the application of the mitigation measures.

Given the nature of the work and the mitigation measures proposed to minimize the risks of accidental spills, surface runoff and contamination of waterways, the intensity of the impact on water quality is considered low. The effects will be felt only in the work area (limited extent). The duration of the construction and dismantling work will be short (less than one year in each case), with limited maintenance and servicing work in the operational phase, also for a short duration. **The importance of the residual impact on water quality is therefore considered minor for each of the three phases of the project.**

Table 6-10: Description of the Importance of the Residual Impact of the Project on Water Quality

Component	Performance phase	Description of the impact	Mitigation Measures[A]	Intensity	Extent	Duration	Importance of the residual impact
Water Quality	Construction	Risk of surface water contamination and dispersion in the environment	WATER 1 to WATER 4 AIR 6 SOIL 1 to SOIL 8 SOIL 12 to SOIL 16	Low	Limited	Short	Minor
	Operational		AIR 6 SOIL1 to SOIL 4 SOIL14	Low	Limited	Short	Minor
	Dismantling		WATER 3 AIR 6 SOIL 1 to SOIL 8 SOIL 12 to SOIL 14 SOIL 16	Low	Limited	Short	Minor

[A] *The numbers of the mitigation measures refer to the table above.*

6.2.4 Hydraulic and sedimentary regime

The activities likely to have impacts on the hydraulic regime and the sedimentary regime are summarized below, for each phase of the project.

6.2.4.1 Construction Phase

Several activities have the potential to affect the hydraulic and sedimentary regime, particularly the development of the work areas, wind pads and access roads. These changes to the natural profile of the soil could lead to a change in the surface water flow regime. Soil compaction and the passage of machinery will affect the drainage locally by the creation of depressions or ruts. Considering that the wind turbine implementation sites are located on hilltops, the effects incurred for the hydraulic and sedimentary regime are of low importance, however. In addition, no watercourse division is planned in the context of the project because no permanent watercourse is present in the sectors that will be directly affected by the work.

The deployment of culverts under the access road is planned at some locations to allow the surface water to flow to the other side of the road. Moreover, drainage ditches will be developed on the roadside in places where this proves to be required, namely where the natural slope of the land would cause surface water to flow to the road. The plans provided in Appendix C indicate the locations where the development of culverts and drainage ditches is planned.

6.2.4.2 Operational Phase

No impact is anticipated during the operational phase.

6.2.4.3 Dismantling Phase

During this phase, the natural profile of the land will be restored to its initial state. The activities likely to affect the hydraulic and sedimentary regime are essentially the same as those raised by the construction phase, to the extent that the development of the site and heavy machinery traffic constitute risks of creating changes to the flow profile in places, by the creation of depressions and ruts.

Because the natural profile of the land will be restored after dismantling of the infrastructure, the final impact on the hydraulic and sedimentary regime is positive. Since no permanent watercourse is present in the sectors directly affected by the work, the impact on the hydraulic regime is almost nil.

6.2.4.4 Mitigation measures

The mitigation measures intended to limit the effects on the hydraulic and sedimentary regime concern stabilization of the depression and rutting zones that will be created and circumscribe traffic of transport vehicles and heavy machinery in the work area.

Table 6-11 lists the mitigation measures that will be deployed.

Table 6-11: Mitigation Measures to Minimize the Impacts of the Project on the Hydraulic and Sedimentary Regime

Nº	Mitigation measures
RHS1	Reuse the stones removed during the grading work to stabilize the depression areas and ruts.
SOIL 6	Contain heavy machinery traffic on preferred routes within the work area.
SOIL 12	Restore the job site areas rapidly at the end of the work.
SOIL 16	During earth moving in steep-sloped areas, stabilize the bottom of the ditches as the work proceeds, using well-drained granular materials, and proceed with rock ballasting.

6.2.4.5 Residual Impact

Table 6-12 describes the characteristics of the importance of the residual impact for each of the three phases, after the application of the mitigation measures.

Very few changes to the hydraulic and sedimentary regime are expected during the construction and dismantling phases. The mitigation measures deployed will allow the conservation of soil stability and prevent the formation or obstruction of new surface waterways. The intensity of the impact thus is considered low. Because the effects will only be felt at the location of the work (limited extent) and only during the work period (short duration), **the importance of the residual impact on the hydraulic and sedimentary regime is considered minor.**

In the operational phase, no impact is anticipated on the hydraulic and sedimentary regime, given that the soil profile will not be altered during this phase. Therefore, the importance of the residual impact is not assessed for this phase of the project.

Table 6-12: Description of the Importance of the Residual Impact of the Project on the Hydraulic and Sedimentary Regime

Component	Performance phase	Description of the impact	Mitigation Measures[A]	Intensity	Extent	Duration	Importance of the residual impact
Hydraulic and sedimentary regime	Construction Dismantling	Alteration of the flow pattern during the work and the sedimentary regime	RHS1 SOIL 6 SOIL 12 SOIL 16	Low	Limited	Short	Minor
	Operational	None	None	N.A.*	N.A.	N.A.	N.A.

[A] The numbers of the mitigation measures refer to the table above.

* Non applicable

6.3 Impacts on the Biological Environment

6.3.1 Terrestrial and Wetland Flora

6.3.1.1 Construction Phase

The construction phase of the project will lead to a direct loss of 9.08 ha of terrestrial environments and 0.05 ha of wetlands, respectively representing 99.5 % and 0.5 % of the area impacted by the proposed infrastructure (Table 6-13). To calculate this impact, a right of way 12 m wide (on average) was considered for the access road that will be developed to the implementation sides of the two wind turbines, a right of way 0.5 m wide was considered for the power transmission cable, and a right of way with a diameter of about 200 m was considered for the wind pads (Map 5-3).

The wetlands most impacted, particularly by construction of the wind pads, are tundra ostiole polygonal soils (80 %), followed by felsenmeers (15 %) and boulder fields (5 %). The plant species that will be affected during the stripping work required for the development of the wind pads and the access road are mainly sedges, tufted hairgrass, Arctic cinquefoil and Arctic white heather. Note that none of these plants has legally protected status. Tufted hairgrass was removed in 2008 from the list of species likely to be designated threatened or vulnerable according to the Québec Act respecting threatened and vulnerable species (CDPNQ, 2008).

Lowland fens and snowbed fens are the two types of wetlands impacted by the project, representing 0.02 ha and 0.03 ha respectively. No wetland will be impacted by the construction of the wind pads. The impacts on the wetlands instead come from the construction of the road and passage of the power cable, most of which will be deposited directly on the ground. Let us remember that the route of the access road was optimized during the project design phase to minimize its encroachment on sensitive wetlands as much as possible (see section 2.3 of this report). No plant at risk was identified in these environments. Indeed, the main species found in the wetlands of the work area are bryophytes, sphagnums and sedges.

In addition to soil stripping, and thus the complete removal of the flora on the surfaces concerned, the work risks raising dust. By redepositing on the plants, this dust has the potential to affect the photosynthetic activity of the vegetation (Thompson et al., 1984). Since the winds of the local study area are relatively strong and blow freely due to the absence of arborescent vegetation and the low topographic relief, the dust will tend to be transported over a certain distance, mainly eastward (based on the prevailing winds from the west). However, this impact related to the deposit of dust on the vegetation will be relatively unimportant because the duration of the work will be short and the terrestrial environments and wetlands on the periphery of the work area are not considered particularly sensitive.

Moreover, the risk of trampling by personnel or machinery of the natural vegetation on the perimeter of the work areas will be minimal, given that the habitats on the edge of the work areas will be protected and traffic will be prohibited there. These activities will also increase the risk of contamination of the neighbouring terrestrial environments and wetlands with hydrocarbons, in the event of an accidental spill, but this risk will remain very low with regard to the mitigation measures that will be applied.

Table 6-13: Direct and Indirect Impacts on the Various Types of Terrestrial Environments and Wetlands in the Work Area

Infrastructure	Type of environment	Direct impact (ha)	Indirect impact (ha)	Direct impact (m^2)	Indirect impact (m^2)
Wind turbines and wind pads	Felsenmeer	0.71	6.21	7,148	62,097
	Boulder field	0.10	5.76	1,020	57,571
	Tundra ostiole polygonal soil	5.47	21.28	54,740	212,792
	Lowland polygonal fen	-	0.39	-	3,944
	Snowbed fen	-	-	-	-
	Total – Wind turbines and wind pads	6.29	33.64	62,908	336,404
Access road	Anthropogenic	< 0.01	-	15	-
	Felsenmeer	0.56	-	5,647	-
	Boulder field	0.29	-	2,868	-
	Tundra ostiole polygonal soil	1.75	-	17,504	-
	Lowland polygonal fen	-	-	-	-
	Snowbed fen	0.03	-	276	-
	Total - Access road	2.63	-	26,310	-
Power cable	Anthropogenic	0.05	-	460	-
	Felsenmeer	< 0.01	-	40	-
	Boulder field	0.07	-	746	-
	Tundra ostiole polygonal soil	0.06	-	632	-
	Lowland polygonal fen	0.02	-	186	-
	Snowbed fen	< 0.01	-	5	-
	Total – Power cable	0.21	-	2,069	-
Total for all environments		**9.13**	**33.64**	**91,287**	**336,404**
Total for terrestrial environments		**9.08**	**33.25**	**90,820**	**332,460**
Total for wetlands (fens)		**0.05**	**0.39**	**467**	**3,944**

6.3.1.2 Operational Phase

No additional direct impact on terrestrial environments and wetlands is foreseen during the operational phase. Indeed, once the work is completed, the access road will be used mainly for wind turbine maintenance needs. Due to this fact, there will be no additional encroachment on the natural environments and little dust from the road will be raised, given that it will be used only periodically.

Indirect impacts are considered at locations that may suffer ice falls from the rotation of the wind turbine blades. This indirect impact is calculated on a surface about 500 m in diameter around the wind turbines. Although they represent a greater impact area (33.64 ha; Table 6-13), these ice falls will not result in a direct habitat loss for fauna and flora.

6.3.1.3 Dismantling Phase

In the same way, as for the construction phase, the work risks raising dust that can harm the vegetation present around the site. No other impact is foreseen because no additional encroachment will be necessary on the surfaces already impacted during the construction phase. After dismantling the infrastructure, the site will be restored, but the loss of vegetation on the site is considered permanent. It should be noted that no plant at risk was found in the work area.

6.3.1.4 Mitigation Measures

The mitigation measures set out in the initial impact assessment of the NNiP (Genivar, 2007) and applicable to this project will be implemented, as well as the proposed new measures (Table 6-14). The purpose of these measures is to circumscribe the footprint of the construction work to the strict minimum, namely the perimeter planned for the surface developments. The traffic throughout the project's life cycle will also be circumscribed to the work areas. Measures for the purpose of limiting dust and the risks of contamination of habitats by accidental spills will also be implemented.

Let us remember that the route of the access road was optimized during the project design phase to avoid and minimize encroachment on the wetlands present in the study area.

Table 6-14: Mitigation Measures to Minimize the Impacts on Terrestrial Environments and Wetlands

Nº	Mitigation measures
VEG 1	Prevent machinery traffic outside the limits of the work areas (except with special authorization).
VEG 2	Protect the habitats on the edge of the work areas.
VEG 3	Limit the extent of soil stripping to the strict minimum necessary during the work.
AIR 2	Spread dust suppressant (calcium chloride or water) on the access roads in dry and windy weather. The moistening frequency will be adjusted according to the weather conditions and the dust emissions observed.
AIR 6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and in good working order.
SOIL 1	Apply the CRI prevention and emergency preparedness plan in case of a spill and make emergency recovery kits for petroleum products and hazardous materials easily accessible at all times, in accordance with the laws and regulations in force.
SOIL 2	Perform general maintenance and fuel supply for machinery at the places identified by the site supervisor. Storage of petroleum products and maintenance, refuelling and cleaning of machinery and equipment must be done over 30 m from a watercourse or a wetland, on a site developed for this purpose where no risk of contamination of soil, surface water and groundwater exists.
SOIL 3	Place the receptacles containing hydrocarbons and other hazardous products in a bin or between berms with the capacity to collect 110 % of the stored reserve.

6.3.1.5 Residual Impact

Infrastructure development will lead to the destruction of 9.08 ha of natural terrestrial environments and 0.05 ha of wetlands, as well as a reduction of the functions associated with the wetlands affected. Since the wetland area that will be destroyed is negligible in the northern landscape, the destruction of these environments will not jeopardize the functioning of wetlands on the local scale, but only on a limited scale.

Although the proponent is responsible for restoring the site when the wind turbines reach the end of their life cycle (dismantling phase), it will not regain exactly the same functions it had in the original state. Moreover, this site restoration will take place over several years, which gives this impact on the terrestrial environments and wetlands a long duration.

Considering the various mitigation measures that will be applied, the intensity of the residual impact is considered low, with a limited extent and a long duration (Table 6-15). **The importance of the residual impact on the terrestrial environments and wetlands is therefore considered minor for all phases of the project.**

Table 6-15: Description of the Importance of the Residual Impact of the Project on Terrestrial Environments and Wetlands

Component	Performance phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance of the residual impact
Flora of terrestrial environments and wetlands	Construction, operation, dismantling	Losses of area in terrestrial environments (9.08 ha) and wetlands (0.05 ha) and losses of ecological functions for the environments affected.	VEG 1, VEG 2, VEG 3	Low	Limited	Long	Minor
		Risk of trampling of vegetation by personnel or machinery, deposit of dust on vegetation, and risk of contamination of neighbouring natural environments.	VEG 1, VEG 2, VEG 3, AIR 2, AIR 6, SOIL 1, SOIL 2 and SOIL 3	Low	Limited	Short	Minor

6.3.2 Avian fauna

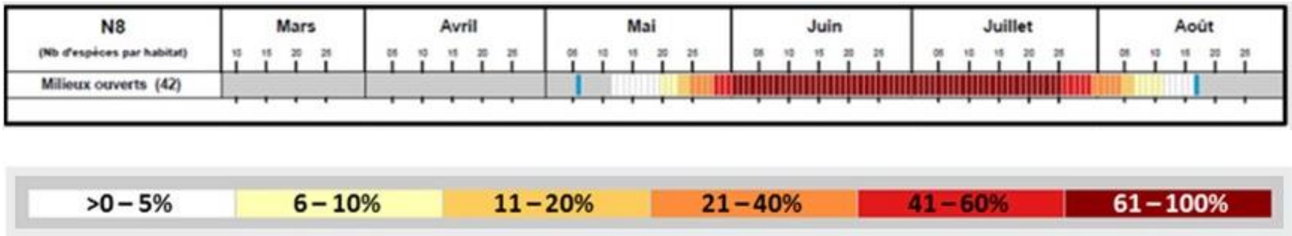
6.3.2.1 Construction Phase

During the construction phases, the sources of impacts on avian fauna are preparation of the work and site mobilization, development of the access road and the wind pads, construction of the structures, restoration of the work area and demobilization.

The main impact that may occur during the work is related to the disturbance of avian species caused, in particular, by noise, by the presence of machinery and workers, and by artificial light sources. However, the peripheral environment of the site planned for the implementation of the wind turbines is already a noisy environment. Truck and machinery traffic is very present, given the proximity of the mining complex in operation, particularly the Expo site. The disturbance caused by noise and by construction activities thus should be limited. The same is true for the additional light sources on the site.

In the nesting period, the performance of the work could also affect the nesting species present in the sector, especially those nesting on the ground, due to disturbance or destruction of nests. Let us remember that migratory species, including those nesting on the ground, are protected under Canada's *Migratory Birds Convention Act, 1994* and that, according to this Act, it is forbidden to damage, destroy, remove or disturb their nests. The density of birds observed in the work area during the inventories is low, however, at 0.38 birds/ha. Moreover, according to the inventories conducted in the study area, the waterfowl and birds of prey, which respectively nest on the edge of bodies of water or high on cliffs, should not be affected by the construction work, because these types of habitats are not present in the work area. In addition, because the density of prey is low in the sector, it is unlikely that birds of prey use it as a hunting territory.

The work area is located in nesting zone N8. For this sector, the general nesting period (which covers lain and the presence of nestlings in the nest) extends from May 12 to August 17 (ECCC, 2022b; Figure 6-1). However, the intensive nesting period ended at the end of July. The work performed since August thus will have few perceptible impacts on the breeding and hatching period of the year, while the work performed between the end of May and the end of July will generate more impacts.



Note: Number of species by percentage The blue milestones include the predicted extreme dates.

Figure 6-1: Nesting Period of Migratory Birds in the Arctic Plain Zone in Québec (taken from ECCC, 2022b)

According to the analysis by Zimmerling et al. (2013), the presence of wind turbines would generate mean direct habitat losses of 1.23 ha ± 0.72 ha per wind turbine. This direct loss would be due to stripping of the vegetation and the presence of wind pads and other associated structures, such as access roads and power transmission lines. However, the effect of habitat loss would be lower than direct mortality, and much lower than the losses generated by other anthropogenic activities, such as forestry, agriculture and mining mines (Zimmerling et al., 2013). For avian species, the construction phase thus will have the impact of temporary or permanent habitat loss caused by the development of access roads, wind pads and work area necessary for the construction phase. The permanent encroachment area planned in terrestrial environments is 9.08 ha for the present project and 0.05 ha in wetlands (see Table 6-13).

6.3.2.2 Operational Phase

In the operational phase, the operation of wind turbines could cause impacts on avian fauna, due to the presence of structures, movement of the blades, noise, vibrations and light sources. The two main impacts are the risks of collision with the wind turbines, and disturbance of the birds.

6.3.2.2.1 Risk of Collision with Wind Turbines

Bird collisions with anthropogenic structures, such as wind turbines, are a well-documented phenomenon. The movement of the blades causes collisions with birds, which may result in mortality. The collision risks with a wind turbine increase during nesting and migration periods.

Zimmerling et al. (2013) report that the mortality rates per collision presented in the follow-up studies of wind farms conducted in Canada are low, especially if these rates are compared to those generated by other anthropogenic structures, such as telecommunications towers.

Analyzing mortality in 43 Canadian wind farms, Zimmerling et al. (2013) calculated the mortality rate related to wind turbines of 8.2 birds per structure per year. In comparison, telecommunications towers would generate 28 mortalities per tower per year (Zimmerling et al., 2013).

The mortality rates are also variable from one wind farm to another because the collision risks are influenced by several factors. For example, in the monitoring of bird mortality in 2018 at the Mont Rothery wind farm in Gaspésie, composed of 39 wind turbines, no bird of prey carcass was discovered. In 2016 and 2017, the inventories conducted at this wind farm allowed the same conclusion to be reached. After the fall migration, a New World warbler carcass was found. The estimated bird mortality rate for 2018 was 0.39 birds/wind turbine/year. At the Erie Shore wind farm in Ontario, the mortality rate was assessed at between 2.0 and 2.5 birds/wind turbine/year for sparrows (James, 2008).

Bird mortality related to collisions with a wind turbine would depend on three main factors: the proximity of the bird movement and concentration areas, the characteristics of the implementation site, and the weather conditions (Environment Canada, 2007; Regroupement Québec Oiseaux, 2010). The number of wind turbines and the configuration of the wind farm are also factors to consider (Environment Canada, 2007). The factor in relation to the number of wind turbines is particularly important for this project because the wind farm planned by TUGLIQ includes only two wind turbines. These different factors are examined in more detail in the following paragraphs.

Number of Wind Turbines and Configuration of the Wind Farm

According to Environment Canada (2007), a wind farm with a greater number of wind turbines would pose more collision risks for birds, by intercepting more air. A reduced number of large wind turbines, as is the case for this project, is also less harmful than a greater number of small wind turbines (Environment Canada, 2007). The fact that the wind farm planned for this project only has two large wind turbines thus reduces the collision risk.

The arrangement of the wind turbines also influences the collision risk. In this project, the installation of the two wind turbines is planned in a north-south axis (or more precisely, in an NNW- SSE axis[30]). This is the general axis of migration of several species passing through Nunavik to the south in the fall or to the north in the spring, including the greater snow goose and the short-eared owl (Audubon, 2022), which limits the collision risk with a wind turbine line that would be perpendicular to the axes of migratory movement. Moreover, the two wind turbines planned will not be close together (about 750 m distance between them), thus leaving space for the birds to avoid them. This space also reduces the risk avian fauna will be caught in the turbulence created when the wind turbines are too close together.

The Raglan Mine wind farm, located about 20 km northwest of this project, also includes two wind turbines, but they are arranged on a NE-SW axis,[31] which theoretically would be more unfavourable depending on the migratory movements of avian fauna. The data available from the environmental follow-ups conducted in 2015, 2016, 2017 and 2019 does not report any bird mortality for this wind farm according to the carcass searches done (Glencore Canada, 2016; 2017, 2018; 2020).

Light sources installed on high infrastructure may also represent an additional collision risk. Avian fauna may be disoriented by light and trapped in the lit zone, a phenomenon that is even more important when the weather conditions are poor, as in a period of fog, dense clouds, etc. (Genivar, 2012). Red flashing lights (during the night) will be installed on the two proposed wind turbines, given the proximity of Kattiniq-Donaldson Airport. However, this type of lighting is less risky for birds than continuous lighting, because it attracts birds less, in addition to being necessary in the presence of an airport (Environment Canada, 2007).

Considering the factors related to the number of wind turbines (n = 2), the configuration of the wind farm (NNW-SSE axis, spacing of about 750 m between the wind turbines) and the light sources (flashing red lights), the collision risk with the wind turbines is considered very low for this project for all the avian species likely to be found in the sector, including species at risk, such as golden eagle and peregrine falcon.

Proximity of Bird Mobility and Concentration Zones

The location of the wind turbines in relation to the movement zones, such as the migration corridors, and in relation to the bird concentration areas, such as wintering and nesting areas and migration stops, is a factor that influences the bird collision risk (Environment Canada, 2007).

The migration corridors that pass through the local study area are not precisely known. However, according to the data made available by the Audubon Society via the Bird Migration Explorer website (Audubon, 2022), passages by certain bird species monitored by telemetry were recorded in Nunavik, in the project region, specifically land birds, waterfowl species and shore species. Species like the American golden plover and the peregrine falcon would transit via Nunavik during the migration, on a north-south axis. Species like snow goose and Canada goose also

[30] North-northwest – South-southeast
[31] Northeast–Southwest

migrate according to this general north-south axis, but the migration corridors in northern Québec are not particularly well defined (Genivar, 2013). In the case of the Canada goose, migration is almost everywhere, without a precise corridor. Few longitudinal movements of birds of prey were recorded, but the golden eagle and the peregrine falcon follow a longitudinal corridor according to the available data (Audubon, 2022). As mentioned in section 5.3.6, the peregrine falcon migration is considered dispersive in North America and the migration front is wide for this species (Fuller et al. 1998). More regional movements, in different orientations, were recorded for the snowy owl in the study sector (Audubon, 2022).

Mortality related to collisions and identified in Canada would particularly affect sparrows, which migrate at night and which represent 80 % of mortalities by collision with turbines (Zimmerling et al., 2013). In general, for nocturnal migrants, little evidence shows that some species would be more vulnerable than others, and mortality would be proportional to the relative abundance of species present locally (Zimmerling et al., 2013). According to Barclay et al. (2007), birds in nocturnal migration would fly at heights greater than the new wind turbines in the majority of cases, which would greatly reduce the collision risk for these species. Structures over 150 m high, such as telecommunications towers and highrise buildings, would be riskier for nocturnal migrators (Environment Canada, 2007).

However, the greatest concerns are related to the behaviours of certain diurnal migrators, such as birds of prey, which are vulnerable to collisions with wind turbines, particularly when searching for prey or hunting. The fact these species concentrate on their prey and less on the rest of the environment when hunting may increase the risks of collision with structures (Lapointe et al., 2013). Some researchers suggest that new wind turbines, higher and with wider blades, pose fewer risks for these species (Zimmerling et al., 2013). Moreover, diurnal migrators, such as birds of prey, would easily avoid the structures under suitable weather conditions (Regroupement Québec Oiseaux, 2010). During migration, species like the peregrine falcon may fly up to 600 m high (USDA, 2022), altitudes greater than the height of the wind turbines.

For waterfowl, according to the literature, many species fly at high altitudes and thus would avoid wind turbines. For example, the snow goose migrates at high altitudes to avoid the turbulent air layer and may reach 600 m (Bellrose, 1980), while the common loon may reach over 1,500 m (Kerlinger, 1982). According to Katzner et al. (2012), migrating birds would fly at altitudes between 135 and 1200 m. Table 6-16 summarizes the flying altitudes taken from the literature.

Table 6-16: Flying Altitude of Certain Migrating Bird Species Taken from the Literature

Species	Flying altitude in migration (m)	References
Avian fauna in general	135 - 1200	Katzner et coll. (2012)
Raptors		
Golden eagle	150 – 300 (average of 284)	Katzner et coll. (2012)
	40 – 300 (average of 89)	SNC-Lavalin (2008)
Peregrine falcon	Up to 600	USDA (2022)
	10 – 350 (average of 68)	SNC-Lavalin (2008)
Gyrfalcon	50 – 500 (average of 275)	SNC-Lavalin (2008)
Rough-legged buzzard	1 – 600 (average of 161)	SNC-Lavalin (2008)
Waterfowl		
Waterfowl in general	2 – 1000 (average of 113)	SNC-Lavalin (2008)
Canada goose	Average of 116	SNC-Lavalin (2008)
Snow goose	Up to 600	Bellrose (1980)
	Average of 145	SNC-Lavalin (2008)

Based on the flying heights mentioned above, the collision risks thus appear to be limited for the majority of birds of prey, waterfowl and sparrows in the context of the current project, at least concerning migration. The proposed wind turbines for this project will have a projected height of 80 m for the tower and 120 m for the total height including the blades, which is lower than the critical height of 150 m identified previously (Environment Canada, 2007).

However, on condition of a low or medium cloud ceiling, the flying heights could be lower. During fall inventories conducted in the context of the Raglan Mine wind energy project, the flying heights of the species present varied from 1 m to 200 m with an average of 79 m (Genivar, 2012). During inventories in the extended study area, the maximum flying altitude was 1000 m, with an average of 113 m (Genivar, 2012).

No known bird concentration area or wintering area is present in the project's limited study area. The bird densities observed in the work area during the inventories conducted in summer 2022 were low (0.38 birds/ha). Among the species nesting in the work area are snow bunting, buff-bellied pipit and Lapland longspur. These species then would leave Nunavik to winter in the south (Audubon, 2022).

Concerning nesting, Zimmerling et al. (2013) mention that avian species may avoid the vicinity of wind turbines to nest, feed and rest. This effect has rarely been studied and would vary depending on the species. Some species would adapt to the presence of wind turbines while others would avoid the sector because wind turbines obstruct the movement corridors and the feeding areas (Zimmerling et al., 2013). Some species that have riskier behaviours, such as high-altitude nuptial flights, could be more at risk of collision. According to another study, birds nesting locally would become accustomed to the presence of wind turbines and better able to avoid them (CWS, 2007).

A telemetric monitoring study of birds of prey conducted in Montérégie in the context of a wind farm project showed that, in the nesting period, for their flying height, 93 % of individuals flew above 139 m, 3 % flew at about 139 m and 4 % flew below 139 m. However, the majority of the species observed flew at over 200 m (Tremblay and Léveillé, 2011).

For the peregrine falcon specifically, the known mortality cases related to wind turbines are limited to date and involve small numbers of individuals (Meek et al., 1993; Smallwood and Karas, 2009). Moreover, several studies interested in bird mortality on wind farms noted no peregrine falcon deaths, even though the species used the sector impacted by a wind turbine (De Lucas et al., 2004; Johnson and Erikson, 2011). These results suggest that the peregrine falcon could be less likely to collide with wind turbines than other raptor species (Équipe de rétablissement des oiseaux de proie du Québec, 2018).

The only known nesting site of birds of prey within a 20 km radius around the proposed wind turbine implementation is the peregrine falcon nesting site found 15.8 km south of the nearest wind turbine. A lone individual was also noticed on a perch within a 10 km radius of the wind turbines. The home range of individuals in Nunavik is unknown. Monitoring of female peregrine falcons in four regions of southern Québec (Montérégie, Bas-Saint-Laurent, Chaudière-Appalaches, Abitibi-Témiscamingue) with satellite transmitters allowed an assessment that, in the nesting period, the collision risks with wind turbines were high when they were located less than 2.5 km from the nest and became negligible when the wind turbines were over 16 km away (Lapointe et al., 2015). In the case of the wind turbines operating at the Raglan Mine, no impact on the peregrine falcon was observed during environmental monitoring studies conducted between 2015 and 2019 (Glencore Canada, 2016; 2017, 2018; 2020) despite the fact that a confirmed nesting site for this species is present about 21 km northwest of the wind farm (SNC-Lavalin, 2008). This last distance is in the same order of magnitude as the one observed between the falcon nest identified in the summer of 2022 and the proposed wind turbines near the Expo site.

In short, the collision risks due to the presence of wind turbines are judged to be relatively low for this project if one considers the movement corridors, the flying altitude during migration and the absence of nearby bird concentration areas, including birds of prey. The monitoring results for the Raglan Mine wind farm, which also includes two wind turbines and is located about 20 kilometres northwest of this project, did not identify any bird mortality during the monitoring studies conducted between 2015 and 2019 (Glencore Canada, 2016; 2017, 2018; 2020).

Site Characteristics

The characteristics of the wind turbine implementation site would also influence the risk for avian fauna. According to Zimmerling et al. (2013), differences in mortality rates were observed between different types of sites, ranging from 0 to 27 birds per wind turbine per year. Thus, mortality could be higher depending on the specificities of the different sites.

For example, the presence of wind turbines on a promontory or along a crest line could present a higher collision risk, because birds adapt their fight to the terrain to use the ascending air currents (Katzner et al., 2012). Golden eagles would fly at a lower altitude during local movements and approach wind turbines more closely than during the migration. They would also adapt their flight to the terrain. According to Katzner et al. (2012), the flying altitude during migration would vary between 135 and 341 m. The lowest flying altitudes, for example, would be along crests and steep slopes (about 150 metres) and the highest would be over flat land and hills (about 300 metres; Katzner et al., 2012). Golden eagles would also use places where the wind is strong for their local movements, which match the preferred wind turbine locations. Other birds of prey species that instead use convection currents would fly at much higher altitudes, between 300 and 1200 m, thus avoiding wind turbines (Katzner et al., 2012). The presence of large expanses of water could also attract more birds in the migration period.

According to some studies, birds would exhibit avoidance behaviours when approaching modern wind turbines (Zimmerling et al., 2013). Birds nesting locally would become accustomed to the presence of wind turbines and more able to avoid them (Environment Canada, 2007). A Canadian Wildlife Service literature review conducted in 2007 also reports that collisions are infrequent and that birds generally change their flight paths to avoid wind turbines.

The two proposed wind turbines for this project are found on hills less than 5 kilometres from certain bodies of water (e.g., Lac Rocbrune and Lac du Bombardier). In the operational phase, it is therefore possible that some species that use these bodies of water must adapt their flight paths. However, the wind turbine implementation axis (NNE-SSW) will allow reduction of the collision risks, at least for migratory birds. The flying altitude during migration also gives many migratory species low susceptibility to collisions, as in the case of peregrine falcon, snow goose and Canada goose. However, the golden eagle could be slightly more at risk of collision in view of its type of flying, which follows the terrain, and the presence of rocky crests in the sector. This species was not identified in the inventories conducted in the summer of 2022 within a 20 km radius of the proposed wind turbines.

Weather Conditions

Weather conditions may affect the collision risks by reducing visibility and forcing birds to adapt their flying altitude. For example, precipitation, fog and a low cloud ceiling could force birds to fly at a lower altitude, and thus closer to wind turbines (Environment Canada, 2007). High winds are also to be considered because they reduce manoeuvrability during flight (Powlesland, 2009), and wind turbines are frequently installed in very windy sectors. These conditions thus could represent an increased risk of collisions on the site. It should be noted that during extreme wind episodes, the wind turbines must be shut down or operated at low speed for operational reasons.

According to the data available and as presented in section 5.2.1 of this study, precipitation in the project area would not be abundant due to the cold climate and the low humidity rate. Precipitation tends to fall mostly in June and July, according to the Expo site weather station, with variations over a few years. Fog episodes occur at the beginning of the summer, with the arrival of warm air masses, which may affect visibility. In winter, squalls and blizzards may hinder visibility. The average wind speed is considered high.

The collision risks due to poor visibility episodes thus would be more likely to occur in summer, during fog or rain episodes, and in winter during high winds. These periods are outside the migration periods of several species likely to migrate via this project's study area, including the golden eagle, the peregrine falcon, the Canada goose, the snow goose, etc. The collision risks for these species and for the other avian species are therefore low for this factor. However, the collision risk could be slightly higher in summer for locally nesting species.

6.3.2.2.2 Disturbance of Avian Fauna

Birds could avoid the periphery of the wind turbines and be less abundant there, due to noise and vibrations, for example, or simply due to their presence. Maintenance work is also likely to cause a disturbance. According to a study by Pierce-Higgins et al. (2009) regarding the disturbance of 12 nesting species, 7 of these species were disturbed by wind turbines over distances ranging from 100 to 800 m from the structures, which reduced the density of these species within these radii given that they moved elsewhere. However, the influence of wind turbines varies from one site to another and species do not all have the same degree of sensitivity. For sparrow species, for example, the effect of disturbance and the decrease in density would be lower and would cover distances of up to 200 m (Regroupement Québec Oiseaux, 2010).

However, birds nesting locally would become accustomed to the presence of wind turbines and more able to avoid them (Environment Canada, 2007). A behavioural study conducted for two years at the Erie Shores wind farm in Ontario, which includes 66 wind turbines, revealed that many species showed no sign of disturbance related to the presence of wind turbines and the noise they generate (James, 2008). Birds circulated between the wind turbines without apparent hesitation during the operational phase and several species nested near the wind turbines.

In the context of this project, the impacts of disturbance should be limited, because only two wind turbines will be installed. The potential disturbance is therefore reduced in view of the small number of structures. In the event that some species are disturbed by the wind turbines and avoid them, replacement habitats will be available nearby. Indeed, given the low bird density inventoried in the work area (0.38 birds/ha), it is very likely that the load capacity of the habitats will not be reached for this group of species in the study sector. Several bodies of water are available nearby for use by waterfowl and shorebirds, and sparrows can easily find a replacement habitat nearby. Moreover, their density is low in the work area.

For raptors, the limited data available in the literature seems to indicate the species would not be sensitive to the disturbance caused by wind turbines (Madders and Whitfield, 2006).

In short, the disturbance should be limited for avian fauna species in the context of this project, for the reasons mentioned above.

6.3.2.3 Dismantling Phase

During the dismantling phase, the impact sources for avian fauna will be the same as in the construction phase, with the addition of a restoration of the disturbed sites after dismantling. The projected impacts thus will be identical to those described previously for the construction phase.

6.3.2.4 Mitigation measures

Several measures for the purpose of reducing collision risks and disturbance of avian species were integrated into the project from its design, particularly the axis of the implementation of the wind turbines, the absence of guying of the wind turbines, and the integration of an avian fauna protection system that can be programmed to shut down wind turbines according to certain special conditions to protect birds from collision risks.

Bird mortality will be monitored for the two proposed wind turbines, accounting for best practices in this field. The environmental monitoring program is detailed in section 8. Following this monitoring, if a significant mortality problem is detected during specific periods or under special weather conditions, additional mitigation measures may be applied adaptively. For example, the shutdown of wind turbines could be programmed to stop the blades from rotating during periods considered critical for avifauna if the monitoring reveals a significant problem. Table 6-17 summarizes the mitigation measures that will be applied for this project.

Table 6-17: Mitigation Measures to Minimize the Impacts on Avian Fauna

Nº	Mitigation measures
VEG 1	Prevent machinery traffic outside the limits of the work areas (except with special authorization).
VEG 2	Protect the habitats on the edge of the work areas.
VEG 3	Limit the extent of soil stripping to the strict minimum necessary during the work.
AVF 1	Produce an inventory of the areas to be stripped 5 days before the work if the work must be performed between mid-May and the end of July, to ensure active nests are not destroyed. Follow the inventory protocol indicated in the *Plant life and wildlife protection plan* that will be submitted by CRI to the authorities for approval in 2022. The inventory will be produced by qualified personnel, particularly CRI environmental technicians and a biologist. If the presence of an active nest is noted, mark the location and protect it until flight (nesting species such as Snow Bunting) or departure of the nestlings (nesting species such as Willow Ptarmigan).
AVF 2	Monitor the mortality of avian fauna and adjust the mitigation measures accordingly (e.g., schedule shutdown of wind turbines during critical periods for birds).

6.3.2.5 Residual Impact

Table 6-18 describes the characteristics of the importance of the residual impact on avian fauna for each of the three phases of the project after the application of the mitigation measures.

The loss of nesting and feeding habitats for avian fauna during the construction phase is a low-intensity impact of limited extent, given the very small areas involved at the local and regional level and the low bird densities observed in the work area. Birds can easily use untouched replacement habitats nearby, the majority of which are in the Nunavik regional landscape. Although TUGLIQ has the responsibility for restoring the site when the wind turbines are no longer required at the end of their life cycle, it will not regain exactly the same functions as in the original state. Moreover, this restoration will be done in several years, which gives a long duration to this impact related to the loss of nesting and feeding habitats.

Given the mitigation measures for the purpose of limiting disturbance during the construction phase, including deployment of a wildlife protection plan[32], it is unlikely that a migratory bird nest will be destroyed during the construction work. Birds are mobile animals capable of temporarily avoiding disturbance areas. They can move as soon as disturbing events are found near the places they use. They then return quickly after the disturbance and generally suffer no effects. Accounting for these facts and the mitigation measures that will be applied, the intensity of the bird disturbance impact on the periphery of the work areas and infrastructure is considered low, with a limited extent. The duration of this impact is short in the construction and dismantling phases, but long in the operational phase.

Finally, although zero risk exists concerning collisions between birds and wind turbines, the literature review and knowledge of the site and the birds that use it suggest a very low probability of bird collision for this project, including the peregrine falcon and the other large migrators. Moreover, environmental monitoring of bird mortality, which will be deployed at the beginning of the operation of the wind farm, will allow the identification of mortality problems and adjustment of the operation of the wind turbines, as the case may be, to minimize bird mortality. The impact related to the bird collision risk in the operational phase is therefore considered low intensity, with a limited extent and long duration (Table 6-18).

In short, the application of the mitigation measures planned for this project allows the residual impact on avian fauna to be qualified as minor for all phases of the project.

[32] The wildlife and plant life protection plan is in development by CRI. It will be submitted to the authorities (MELCC, MFFP) by the end of 2022.

Table 6-18: Description of the Importance of the Residual Impact of the Project on Avian Fauna

Component	Performance phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance of the residual impact
Avian fauna	Construction Dismantling	Disturbance of avian fauna by noise, presence of machinery and workers.	VEG 1, VEG 2, AVF1	Low	Limited	Short	Minor
		Permanent loss of habitats due to development of infrastructure.	VEG 1 to VEG 3, AVF 1	Low	Limited	Long	Minor
	Operational	Collision risk with wind turbine structures and blades	AVF 2	Low	Limited	Long	Minor
		Disturbance of avian wildlife by the presence of wind turbines, noise and vibrations and maintenance work.	VEG 1, AVF 2	Low	Limited	Long	Minor

6.3.3 Caribou and other Mammals

6.3.3.1 Construction Phase

The construction activities have a high potential for disturbing caribou and other land mammals. Construction of the wind turbines and the access road and passage of the power transmission cable will cause a potential loss of habitat and food. In addition to fragmentation of their territory by the construction of the access road, the increase in road traffic for the transportation of material during the construction phase will increase the risk of collision of mammals with a vehicle. The disturbances related to human activity and noise related to construction work and land transportation may also lead to temporary or permanent avoidance of certain habitats located on the periphery of the wind turbine implementation site.

It is important to specify that the legal caribou calving habitat will not be affected by this project in any way. Moreover, the habitats that will be stripped during the construction work are mostly found in terrestrial environments (felsenmeer, boulder fields and tundra ostiole polygonal soils). Because these environments are less interesting for caribou feeding, the habitat losses are considered minimal for this species.

In accordance with what was provided in the initial NNiP impact assessment deposited by CRI in 2007 (GENIVAR, 2007), a follow-up to document collisions between caribou and tracks circulating on the roads, including the road connecting the Expo site to Deception Bay, is conducted by CRI each year. No collision or incident was reported in 2021. Several caribou were observed on the transportation roads between the CRI and Glencore mining complexes and Deception Bay. An increase in the presence of individuals is generally recognized throughout July due to the migration of species, where individuals usually can be observed at the end of August. Mitigation measures are already applied by CRI and Glencore on the different access roads separating their port and mining facilities to minimize the collision risks with caribou.

The natural environment is also used by other mammals, such as lemmings and Arctic foxes. However, no lemming or Arctic fox burrow was identified within the future areas impacted by the work.

6.3.3.2 Operational Phase

Once construction of the wind turbines is completed, the wind turbines will require periodic maintenance on a limited basis. The access road therefore will be little used and should not cause additional disturbances for terrestrial wildlife.

The wind turbines in operation may cause disturbances to wildlife due to turbine noise. According to a study by the British Wind Energy Association (2000), a wind farm 300 metres away would make noise similar to a stream running at a distance of 50-100 m (35-45 decibels) and noise slightly quieter than a car driving at 65 km/h 100 metres away. The noise produced by the wind turbines is found in the low-frequency range (20-200 Hz), which could result in a disturbance for the mammals in the vicinity. A noise modelling study was conducted, in the context of this impact assessment, to assess the impact of the noise caused by the wind turbines (Appendix L). This study shows that the addition of wind turbines in the northern soundscape, already disturbed by the mine's activities, will exercise a minor and even insignificant influence. Indeed, the expected noise levels will not exceed the MELCC standards and will be in the vicinity of the current ambient noise levels.

According to a Swedish study of 50 female woodland caribou, the operational phase would generate more disturbances for the caribou than the construction phase (Skarin et al. 2018). Indeed, the distance between the caribou calving site and the wind turbines increased during the operational phase compared to the construction phase. They also recognized a significant reduction of habitat selection in the areas near the wind turbines. Their results also reveal a visual impact of the wind turbines on the selection of the caribou's home range, namely that they avoid places where the wind turbines are visible. This study suggests an assessment of the topographic features of the sector before the implementation of the wind turbines.

Contrary to the study by Skarin et al. (2018), a study conducted on wapiti (Cervus elaphus) in Western Canada did not show a negative response after the construction and commissioning of a wind farm (Walter et al. 2006). However, the impacts of wind turbines alone are difficult to separate from the impacts caused by human activity. Vistnes and Nelleman (2008) describe 85 studies of the impacts of human disturbance on woodland caribou. For example, Weir et al. report that mining development has an impact on the movements and behaviours of woodland caribou.

In the case of the proposed wind turbines near the Expo mine site, only two caribou were observed in the work area during the inventories conducted in the summer of 2022. Indeed, given the significant disturbance already caused by the current mining activities, it is unlikely that the construction and operation of the two proposed wind turbines will induce additional significant behavioural changes because the vast majority of caribou already avoid the study area.

With regard to chiropterans, their potential presence in the area where the proposed wind turbines are to be installed is considered practically null, based on the results of the inventories obtained, the available habitats and the strong winds observed in the work area (see Section 5.3.4). Therefore, the risk of bats colliding with the wind turbines is considered practically non-existent and no impact on chiropterans is apprehended.

6.3.3.3 Dismantling Phase

The impacts of the dismantling phase are similar to the construction phase in terms of the disturbance of wildlife by the use of machinery and the increase in transportation on the access roads. Once dismantling is completed and the site is restored, the caribou will find a habitat similar to the one that was present before the construction phase.

6.3.3.4 Mitigation Measures

To reduce the disturbance of mammals using the nearby natural environments, the machinery must be inspected before its use and machinery traffic must be limited to the work areas. The mitigation measures planned for this project are enumerated in Table 6-19.

Table 6-19: Mitigation Measures to Minimize the Impacts on Caribou and Other Land Mammals

Nº	Mitigation measures
AIR 6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and good working order.
VEG 1	Prevent machinery traffic outside the limits of the work areas (except with special authorization).
LAM 1	Sensitize the workers, particularly at the approach of the calving period, to the risks of disturbance for caribou and appropriate behaviours.
LAM 2	Mobile equipment and vehicles must yield the right of way to wildlife such as caribou.
LAM 3	Do not honk at caribou or adopt behaviour that would be stressful for them.
LAM 4	Avoid any direct movement of equipment (including ATVs, snowmobiles or helicopters) and people toward caribou observed near work areas or access roads.
LAM 5	In the event that a bat collision with a wind turbine is confirmed during the operational phase, the start-up protocol will be reviewed to increase their speed without jeopardizing the equipment.

The mitigation measures during the construction and dismantling phases include the good practices to observe in case of caribou sightings near the access roads. Figure 6-2 presents the decision tree made available to all road workers working in the NNiP's territory that must be respected by them.

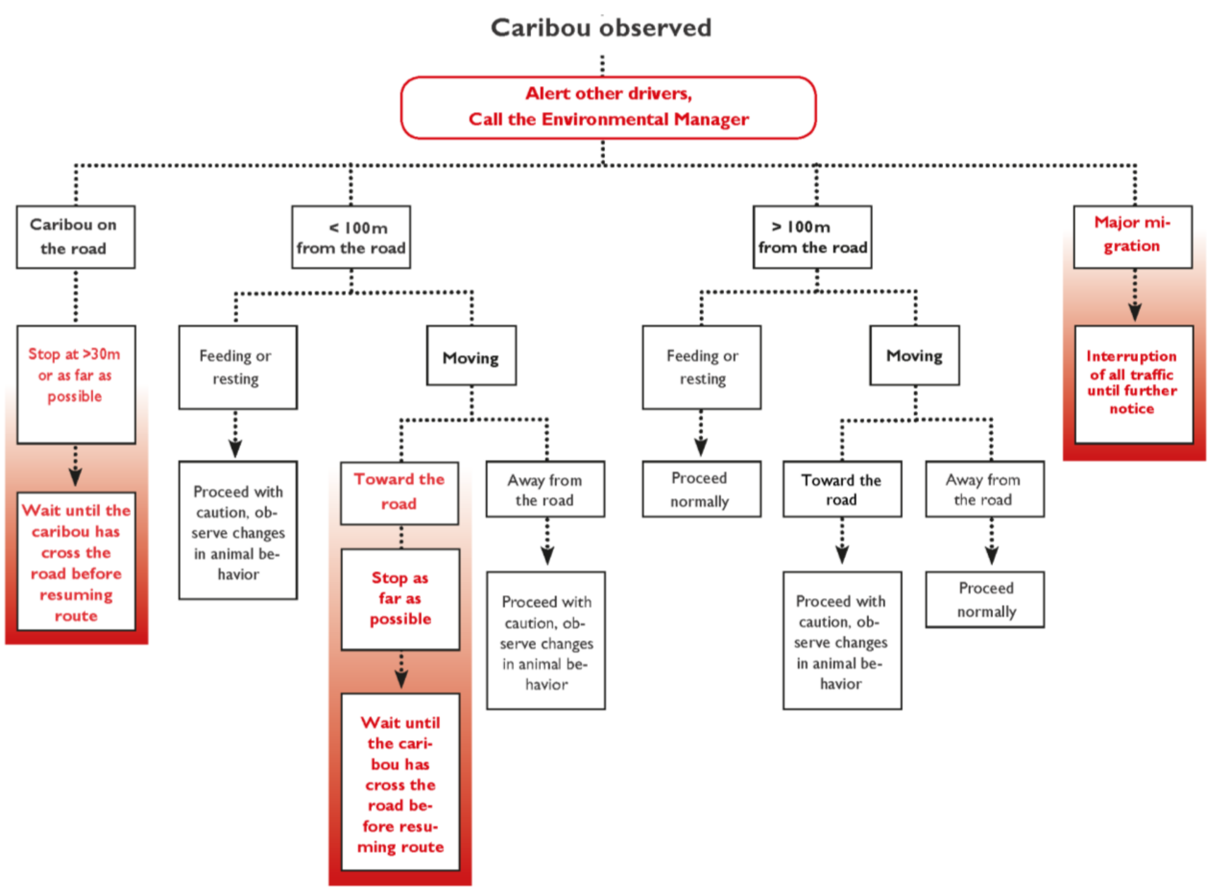


Figure 6-2: Decision Tree Concerning the Presence of Caribou on Beside the Access Roads in the NNiP's Territory

6.3.3.1 Residual Impact

The deployment of a protection plan will seek, as much as possible, to reduce the stress and injuries to caribou using the work area where the two wind turbines are located. The limitation or traffic to the work areas and the machinery inspections to avoid excessive noise will contribute to reducing the impacts on caribou. The proposed measures are based on those already existing in the NNIP's territory. Moreover, no caribou was hit in 2021 on the NNiP's different access roads.

Considering the small habitat areas that will be impacted for mammals and the intensive use of the neighbouring environment by mining activities that already generate noise and traffic on the roads, the intensity of the residual impact on mammals is considered low, with a local extent and a short duration during the construction and dismantling phases. In the operational phase, the intensity of the residual impact is also considered low, with a limited extent because it will be limited to the work area, and a long duration (Table 6-20).

Thus, the application of the mitigation measures planned for this project allows the qualification of the residual impact on caribou and other mammals as minor for all phases of the project.

Table 6-20: Description of the Importance of the Project's Residual Impact on Caribou and other Land Mammals

Component	Performance phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance of the residual impact
Caribou and other Mammals	Construction, Dismantling	Disturbance of several species, including caribou, by work noise. Possibility of injuring or killing an animal during road movements.	AIR 6, VEG 1, LAM 1 to LAM 4	Low	Local	Short	Minor
	Operational	Disturbance of several species, including caribou, by wind turbine noise. Possibility of injuring or killing an animal during road movements.	AIR 6, VEG 1, LAM 1 to LAM 4	Low	Limited	Long	Minor

6.4 Impacts on Human Environment

6.4.1 Economy and Employment

Contracts awarded by TUGLIQ Energy, as well as direct and indirect jobs created and maintained during the construction, operational and dismantling phases of the proposed project will constitute economical benefits, whether at a local (Inuit communities of Salluit and Kangiqsujuaq), regional (Nunavik) and provincial levels.

6.4.1.1 Construction Phase

The actual invested cost for the construction phase is expected to approach $40 million Canadian. TUGLIQ plans to allocate at least 70 % of this investment to Québec businesses. During the peak of the construction activities, it is expected that around 20 workers will be employed on site. The project will then have a positive impact on the provincial economy. Furthermore, in the awarding of the contracts for the required works, TUGLIQ will favour businesses owned (totally or partially) by local (Salluit and Kangiqsujuaq) or regional (Nunavik) interests, if they have the mandatory qualifications. This policy will promote job creation in concerned communities and will also contribute to maximizing the local and regional economic benefits of the project.

In this regard, it is foreseen that road transportation of needed material, equipment and machinery between Deception Bay and the area of the proposed work will be entrusted to Transport Katinniq Inc.[33] which is a business partially owned by Salluit interests. TUGLIQ is also expecting to work with Nunavik Construction, which is a joint-venture business developed between an enterprise based in Abitibi and a member of the Inuit community of Kuujjuaq. Nunavik Construction is equipped with heavy machinery and is already carrying contracts for Glencore Canada at Raglan mine.

Although job creation within Inuit communities will bring economic benefits, it may also result in a modification of lifestyle habits for the Inuit who will be employed. Mitigation measures will then have to be implemented to facilitate the integration of Inuit workers into their new working environment.

6.4.1.2 Operational Phase

For the operational phase, TUGLIQ is expecting to hire and train one Inuit worker who will participate in the operation and maintenance of the two projected wind turbines. To this end, TUGLIQ will contact local labour officers in the two local communities (Salluit and Kangiqsujuaq), and, if needed, in other Nunavik communities, to identify potential candidates. The retained candidate will be trained for wind turbine operation and maintenance by TUGLIQ technical team. TUGLIQ wishes to take this opportunity to establish and maintain ties with local communities, and to develop partnerships which could be renewed if new wind turbine projects are implemented in Nunavik. The same mitigation measures implemented during the construction phase will be applied during the operational phase to facilitate the integration of the Inuit employee into his new working environment.

6.4.1.3 Dismantling Phase

Work performed during the eventual dismantling of the projected wind turbines will be performed by contractors. As it is projected for the construction phase, TUGLIQ will favour businesses owned (partially or totally) by local (Salluit and Kangiqsujuaq) and regional (Nunavik) interests, and qualified with the required expertise, during contract awarding. Once again, this will favour job creation and will maximize economic benefits among local and regional communities.

Besides, mitigation measures will be implemented to limit lifestyle modification for the Inuit employees during the dismantling phase.

6.4.1.4 Mitigation measures

Enhancement measures (Table 6-21) will be implemented to maximize economic benefits for local and regional communities during the construction, operational, and dismantling phases. In addition, mitigation measures will also be implemented to facilitate the integration of Inuit workers hired during the different phases of the project (Table 6-21)

[33] Transport Katinniq Inc. is already providing road transportation for Glencore Canada and CRI as part of the operation of their mining complexes south of Deception Bay.

Table 6-21: Enhancement and mitigation measures to favuor economic benefits and employment among Inuit communities of Nunavik

Nº	Enhancement and mitigation measures
ECO1	Preferential hiring of Inuit workers.
ECO2	To award contracts during the construction, operational and dismantling phases, favour local businesses (in the Salluit and Kangiqsujuaq communities) or Nunavik-based businesses with the competence for the tasks requested in the call for tenders procedure, before making requests to companies based elsewhere in Québec or abroad.
ECO3	During the operational phase, favour hiring of a local Inuit worker (from the Kangiqsujuaq or Salluit community) or another Nunavik community to work on the operation and maintenance of the proposed wind turbines.
ECO4	Integrate Inuit workers by explaining the different living conditions and rules on the NNiP site, and the different programs accessible. All of these measures are found in Schedule 7 of the Nunavik Nickel Agreement[A] (see measures MOE1 to MOE10 presented in Schedule 7 of this Agreement).

[A]: The Nunavik Nickel Agreement establishes the list of mitigation measures for which application was upon agreed between CRI and their Inuit partners in the context of the development of the NNiP.

6.4.1.5 Residual Impact

Impacts related to job creation as well as local, regional and provincial economic benefits will be felt during the construction, operational and dismantling phases of the project. The duration will be long. The extent of the impact will be regional, as many Inuit communities of Nunavik could be concerned by the benefits. The intensity of the impact would be medium as the job creation within local and regional communities will be limited. **Therefore, the residual impact associated with job creation and to local, regional, and provincial economic benefits is rated major and positive** (Table 6-22).

Lifestyle modification will not affect the entire local and regional communities but will rather be felt by the Inuit workers employed for the project. The duration of this impact will be long, as it will be felt during the construction, operational and dismantling phases of the project. However, a greater number of workers might be affected during the construction and dismantling phases. Mitigation measures will be implemented to facilitate the integration of Inuit employees into their new working environment. The extent of the impact will be limited (impact will only be felt by the hired Inuit workers) and its intensity will be low. The **importance of residual impact concerning lifestyle modification for Inuit workers is rated minor** (Table 6-22).

Table 6-22: Description of the importance of the residual impact of the project on the economy and employment

Component	Development phase	Description of the impact	Enhancement / Mitigation measures	Intensity	Extent	Duration	Importance of the residual impact
Economy and employment	Construction Operational Dismantling	Job creation and local, regional and provincial economic impacts.	ECO1, EC02 and ECO3	Medium	Regional	Long	Major (positive)
		Change in the lifestyle of Inuit employees	ECO4	Low	Limited	Long	Minor

6.4.2 Inuit land use and occupancy

6.4.2.1 Construction Phase

According to the information collected during the present study, the closest area frequented by Inuit users from the area of the proposed work is Lac Rocbrune, sitting a little more than 3 km east and southeast of projected wind turbines. It is possible that noise generated by the work carried out during the construction phase could be perceived at this place. If so, it could annoy the Inuit users performing fishing activities in the southern portion of the lake. However projected increase in noise will be very low (< 1 decibel) and will be more noticeable in the northern portion of the lake (see section 6.4.5, for more details concerning noise increase). Furthermore, as lac Rocbrune is located a little more than 3 km from the projected works area, it is unlikely that Inuit users visiting the place would be affected by dust and vibrations generated by construction work.

Inuit users from Kangiqsujuaq practicing activities in other sectors of the local study area, such as the two unnamed lakes located south-east of lac Rocbrune (ice fishing and open water fishing), lac Vicenza and the unnamed lake located west of it (ice fishing and open water fishing), as well as lac Wakeham (ptarmigan and caribou hunting), will be located at a good distance from the area of proposed work (more than 10 km for the closest lake) and won't be affected by noise, dust nor vibrations generated by construction work.

Inuit users[34] travelling along the access road between Deception Bay and Raglan mine[35] and conducting activities in the vicinities of this road might be affected by the increase in truck traffic during the construction phase. A slight noise increase is projected along the road due to the increase in truck circulation. However, the increase in truck circulation will be low considering the present use of the road. In fact, 2 to 4 additional truck transits will occur on the road each day at the height of the construction phase, while around 35 transits are currently performed each day for CRI and Glencore Canada mining operations. The few additional daily transits won't have a significant impact on the intensity of truck circulation and the noise it generates. Besides, oversized load transportation (for wind turbine components) will most certainly cause intermittent disturbances of circulation along the access road (traffic slow-downs and/or temporary interruptions), which could annoy the Inuit users of the road. However, wide loads of transportation transits along the road linking Deception Bay to Raglan mine are planned to be conducted during the month of July, when Inuit users are less likely to be present in the vicinities or along the access road.

It is possible that Inuit users practicing activities within or near Deception Bay might be affected by maritime transportation related to the construction phase. However, maritime transportation of material, machinery and equipment needed during that phase will be carried out by regular maritime transports which are already planned by CRI for its mining operations and thus be subjected to the current rules and mitigation measures concerning maritime transportation within Deception Bay.

Besides, all the Inuit users travelling or practicing activities within the local study area (essentially users from Kangiqsujuaq, according to the information collected during the present study), will see the cranes that will be used to erect the two projected wind turbines (as well as partially constructed wind turbines). This visual disruption of the landscape will mostly be visible to the Inuit users standing at less than 10 km of the area of the proposed work, so essentially by those who will visit the southern portion of Lac Rocbrune. Cranes and partially constructed wind turbines will be less visible within a 10 to 23 km radius, and the visibility of these structures will be even lower (almost non-existent) from the sectors located at more than 23 km of distance (see section 6.4.6 for more details concerning visual effects on the landscape). It is also important to mention that the cranes required to help with the erection of the wind turbines will be in place during summertime and at the beginning of fall. It turns out that the areas visited by Inuit users located the closest to the projected works area are mostly frequented between the months of December and May.

[34] According to the information collected during the present study, it is primarily people from Salluit, but sometimes, could also be people from Kangiqsujuaq.

[35] Among the 3 access roads affected by the present project, this road is the only one where Inuit users are allowed to travel.

6.4.2.2 Operational Phase

During the operational phase, noise generated by the wind turbines won't be audible within the sectors frequented by Inuit users of Kangiqsujuaq and Salluit. As a matter of fact, the expected increase of noise around lac Rocbrune (the closest sector from the projected wind turbines to be visited by Inuit users) will be too low to be noticeable (< 1 decibel) (see section 6.4.5 for more details concerning that subject). Therefore, this means that there won't be any noise increase in other areas visited by Inuit users and located at a greater distance from the wind turbines. Besides, no truck transportation is planned during the operational phase, which means that no noise increase is projected along the access roads.

Wind turbines will be visible to Inuit users visiting the local study area. As is expected for the cranes during the construction phase, visual disturbance caused by the presence of the two projected wind turbines will be mostly perceptible by the users standing less than 10 km from the structures, so essentially by those who will visit the southern portion of lac Rocbrune. Wind turbine visibility will decrease as you move away from them, and then will be low from the areas located at more than 10 km and less than 23 km of distance, and very low (if not insignificant) at more than 23 km of distance (see section 6.4.6 for more details concerning that subject).

The presence of the projected wind turbines in the landscape, will not only cause a visual disturbance. The two structures could also become visual landmarks for Inuit land users travelling in the area. At least, this is what a Kangiqsujuaq land user mentioned during a public consultation activity held in the community in September 2022 (see section 4). This user stated that he is already benefiting from the presence of the two wind turbines installed in Raglan mine, which are providing him guidance while he is travelling the area with a snowmobile. He is then expecting the same from the two projected wind turbines that could be implemented near the Expo site. The land user even suggested making the wind turbines more visible by painting them with a bright colour.

6.4.2.3 Dismantling Phase

At the end of their useful life, the projected wind turbines will be dismantled, which will essentially lead to the same impacts as those expected for the construction phase. Consequently, noise generated by various dismantling work could be audible at Lac Rocbrune, causing a disturbance for the Inuit users visiting that place. Furthermore, the increase of truck circulation on the access road linking Deception Bay to Raglan mine, noticeably wide load transportation, could cause annoyance for the Inuit users travelling on the road or practicing activities nearby. It is important to note that the dismantling of the projected wind turbine would probably happen during the dismantling of the Expo mining site operated by CRI. Noise generated by the first dismantling would then interweave with the second.

As it is expected for the construction phase, all the Inuit users visiting the local study area will see the cranes used for the dismantling of the two wind turbines. This visual disturbance of the landscape will mostly be perceived by the Inuit users standing at less than 10 km from the projected works area, so essentially by those who will be practicing activities on the southern portion of Lac Rocbrune. The cranes will be less and less visible as you move away from them (see section 6.4.6).

Following their dismantling, the wind turbines will disappear from the landscape. This could be a positive experience for some Inuit users, but also a negative one for others, as the two structures may become landmarks for users to orient themselves as they travel through the territory. If so, their disappearance would have a negative impact on their land use.

6.4.2.4 Mitigation Measures

The implementation of mitigation measures will reduce the impacts of the construction, operation and dismantling of the two proposed wind turbines on the Inuit land use and occupancy. This will be done by :

- informing the people of the communities of Salluit and Kangiqsujuaq of the work carried out on the territory concerned by the present project.
- maintaining access and circulation on the territory concerned as much as possible.
- ensuring the safety of Inuit users of the territory concerned.
- putting in place measures to limit the effects of marine transportation on the activities that may be carried out in Deception Bay.
- taking actions to limit the noise generated during the construction and dismantling phases.
- limiting the use of the territory by non-Aboriginal workers involved in the construction, operational, and dismantling of the proposed wind turbines.

Table 6-23 describes all the proposed mitigation measures.

Table 6-23: Mitigation measures to minimize impacts on Inuit land use and occupancy

Nº	Mitigation Measures
LAU1	Inform the populations and the landholding corporations of the villages of Salluit and Kangiqsujuaq about the extent and schedule of the projected work, and the potential dangers for the users during the construction, operational and dismantling phases. Maintain contact with the landholding corporations of the two villages during all the phases of the project to enable them to identify eventual problems concerning land use by people in their communities.
LAU2	During the construction and dismantling phases, install signs mentioning the presence of traffic lanes or works area to inform the Inuit users who could travel or engage in activities in the sector.
LAU3	Maintain the accessibility of lakes and other portions of the territory used by the Salluit and Kangiqsujuaq Inuit users near the access roads and the works area during the construction and dismantling phases.
LAU4	In case traffic must be hindered temporarily or permanently on trails used by Inuit users, provide for bypass routes or new safe travel routes in concert with the Salluit and Kangiqsujuaq communities. Inform the population of the Salluit and Kangiqsujuaq communities of the path of these bypass routes or new travel routes.
LAU5	During all the construction, operational and dismantling phases, regularly inform the workers of the potential presence of Inuit users in the territory concerned, particularly along the access roads used.
LAU6	Comply with the mitigation measures concerning navigation in Deception Bay presented in Schedule 7 of the Nunavik Nickel Agreement[A] (see measures TRC2 to TRC10 presented in Schedule 7 of this agreement).
LAU7	Do not deploy measures facilitating sport fishing by the workers working during the construction, operational or dismantling phases of the proposed wind turbines.
LAU8	Comply with the prohibition of firearms possession imposed on the workers working on the CRI sites (except with a special authorization for protection against polar bears), with the goal of limiting the sport hunting activities practised by the workers working in the construction, operational or dismantling phases of the projected wind turbines.
NOI1	Conduct a preliminary and regular inspection of the machinery and equipment used to ensure their good conditions and good working order (not to generate excessive noise).
NOI2	Limit machinery traffic in the works areas.
NOI3	Isolate the main noise sources, if possible, with absorbent material during the construction and dismantling phases.

[A]: The Nunavik Nickel Agreement establishes the list of mitigation measures for which application was agreed upon between CRI and their Inuit partners in the context of the development of the NNiP.

6.4.2.5 Residual impact

During the construction phase, the noise generated by the work, the temporary disruption of transportation on the road linking Deception Bay to the Raglan mine and the visual impact of the cranes used to erect the two planned wind turbines will cause inconvenience to Inuit users of the territories concerned. This number of users is limited, however, since it does not include the entire population of the communities of Kangiqsujuaq and Salluit. Mitigation measures will be put in place to inform the population of the two communities of the scope and duration of the work and to ensure the safety of Inuit users practicing activities near the projected works area and travelling along the access roads. Measures will also be put in place to limit the effect of the presence of non-Aboriginal workers on the territory and to limit noise production during the work. In addition, the impacts related to noise and visual aspects will diminish as one moves away from the work area. Thus, the noise produced will probably only be perceptible by users frequenting the closest sectors (essentially lac Rocbrune). Finally, the same measures as those already put in place by CRI to limit the effects of marine transportation on the activities practiced by Inuit users in Deception Bay will be applied. For all these reasons, the intensity of the impact is considered low and its extent is local. Furthermore, the construction phase will last less than a year and will take place mainly during the summer and fall periods, whereas the sectors frequented by the Inuit within the local study area and along the access road leading to Deception Bay are more frequented during the winter and spring periods. The duration of the impact will therefore be short. **The importance of the residual impact of the construction phase on the Inuit land use and occupancy is then considered minor** (Table 6-24).

During the operational period, the presence of the wind turbines will have a visual impact on Inuit users of the nearby areas. However, this situation could become an advantage for certain users who could use the wind turbines as a landmark when travelling on the territory. On the other hand, the low level of noise produced by the wind turbines and the low number of employees present on the territory to ensure their operation and maintenance are not likely to have an impact on the Inuit land use and occupancy. Thus, the intensity of the impact will be low and its extent local. The duration of the impact will be long, as it will be felt throughout the life of the projected wind turbines. **The importance of the residual impact during the operational phase is therefore considered to be medium** (Table 6-24).

During the dismantling phase, the apprehended impacts on Inuit land use and occupancy will be identical to those identified for the construction phase and the importance of the residual impact is therefore considered minor for the same reasons (Table 6-24).

Table 6-24: Description of the importance of the residual impact of the project on Inuit land use and occupancy

Component	Development phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance residual impact
Inuit land use and occupancy	Construction and Dismantling	Noise from work and heavy traffic. Temporary change in traffic on access roads. Visual impact of cranes used for wind turbine erection and dismantling. Marine transportation in Deception Bay.	LAU1 to LAU8 NOI1 to NOI3	Minor	Local	Short	Minor
	Operational	Visual impact of wind turbines (Both negative and positive effects)	None	Minor	Local	Long	Medium

6.4.3 Non-Aboriginal land use and occupancy

6.4.3.1 Construction Phase

Pingualuit National Park

It is unlikely that users of Pingualuit National Park will be affected by construction activities. The northern boundary of the park is approximately 12 km from the projected works area. Users of this portion of the park will not be affected by the dust, vibrations and noise generated by the construction. The cranes that will be used to erect the two proposed wind turbines may be visible from this location. However, they will be located more than 10 km away and will therefore only be partially and slightly visible (see section 6.4.6).

Moreover, the most frequented places in the park, such as the Pingaluk Lake crater and the Sangummaaluk and Paarutivik camps, are located nearly 30 km from the projected works area. It is therefore excluded that the users who go there will be affected by the noise generated by the work carried out during the construction phase. On the other hand, park users could potentially see the cranes that will be used to assemble the two projected wind turbines when the weather conditions are optimal. However, considering that the projected works area is approximately 30 km away from the park's most popular sites, the visual impact will be negligible (see section 6.4.6).

Finally, it should be noted that the park is mainly visited during winter (January to May) and summer (July to September) periods. The construction phase is planned to take place between May and November 2023. If it turns out that the cranes used to erect the wind turbines can be seen from the park, this disturbance will occur particularly during the summer period of frequentation of the park.

Proposed Fjord-Tursukattaq Biodiversity Reserve

The proposed Fjord-Tursukattaq Biodiversity Reserve is located well away from the access roads that will be used and from the works area planned for this project (i.e., almost 30 km from the proposed wind turbines). The noise produced by the passage of heavy traffic or the realization of the various works during the construction phase will not be perceptible there. Thus, no impact is anticipated during the construction phase.

Marine Transportation

The equipment, machinery and materials required for the construction of the two proposed wind turbines will be transported by sea to CRI's port facilities in Deception Bay. It is anticipated that two to three shipments will be made to transport all required materials.

Of these three mobilizations, the first transport will be from Europe to bring the wind turbine components to Deception Bay. Transportation will be done by CRI’ ship, and the route taken along the coast of Nunavik will be the same as that used for the company's current supply operations. As CRI's ship already travels to Europe to transport ore, wind turbine components will be loaded on the return trip to Deception Bay. The extra weight of the turbines may limit the loading of equipment normally carried on the ship (diesel and other cargo). In such a case, an additional trip may be required to carry some of the equipment normally carried if it cannot be loaded when the turbines are transported.

One or two additional shipments will be required to bring in machinery and equipment from southern Quebec. This freight will be transported by ship(s) using existing commercial routes that already serve CRI's port facilities during regular supply operations there. In other words, the transportation of material from southern Quebec, as well as the mobilization and demobilization of equipment and machinery, will not require the chartering of additional ships, since they will be carried out during maritime trips already planned for CRI's regular operations. No change in maritime traffic is therefore expected for these transports.

Use of Roads by Mining Companies

Materials, machinery and equipment unloaded at CRI's port facilities in Deception Bay will have to be transported to the proposed wind turbine installation site, which is located near the Expo mining site. This transportation will be done by semi-trailer trucks along the existing access roads, namely the road linking Deception Bay to the Raglan mine, the road linking the Raglan mine to the Kattiniq-Donaldson airport and the road leading to the Expo site, which intersects the road leading to the airport at km 13.

It is expected that this road transport of materials and equipment will take place during a period that will run from May to October 2023. Approximately 80 transits (round trips) of semi-trailers will have to be made to transport all the material and equipment required. Among these transits, about 20 wide load transits will have to be made by oversized freighters to transport the wind turbine components. Of the total of 80 round trips planned, about 4 or 5 should take place in March, about ten in June, about thirty in July (including the twenty or so oversized freighters planned), about fifteen in August, about ten in September, and then another 4 or 5 round trips should be made in November-December for the return of the machinery to the port facilities in Deception Bay.

All road transports during the construction phase are expected to be carried out by Transport Katinniq Inc. which is currently responsible for providing road transportation for Glencore Canada and CRI between their port facilities in Deception Bay and their respective mining complexes.

Road transportation during the construction phase will result in increased heavy traffic on the three access roads leading from Deception Bay to the area of the proposed work. This will likely require a temporary reorganization of traffic patterns on the affected roads. It should be noted, however, that Glencore Canada and CRI already have a good communication structure in place, which will greatly facilitate the planning, coordination and execution of the necessary road transits. It should also be noted that the access roads that will be used are in good condition and have several extra widths that will allow vehicles to park outside the lane when the oversized transports pass.

Use of Kattiniq-Donaldson Airport

Workers involved in the various stages of the construction phase will be flown to the Kattiniq-Donaldson Airport. These trips will be made by CRI via the company's regular flights already operating at the airport. It is not anticipated that additional flights will be required, as the number of workers required will remain relatively small throughout the construction phase:

- no more than 10 workers for the construction of the access road and the wind turbine platforms (May-June).
- no more than 15 workers for the construction of the wind turbine foundations (July-August).
- no more than 20 workers for the installation of the wind turbines (September-October).
- no more than 15 workers for the connection of the wind turbines to the CRI electrical network (October-November).
- no more than 10 workers for the commissioning of the installations (November).
- no more than 5 people for the demobilization of the equipment (December).

It should also be noted that there are no plans to fly any materials through the Kattiniq-Donaldson airport during the construction phase. Thus, only the movement of workers involved in the construction of the proposed wind turbines will result in a slight increase in the use of the Kattiniq-Donaldson airport during the construction phase.

Furthermore, the presence of cranes in the works area for the installation of the two proposed wind turbines will require Nav Canada to raise the minimum flight altitude on approach to the airport from 3,000 to 4,000 feet. The minimum flight altitude will be increased from 3,400 to 3,500 feet at the following locations: northwest approach (N62 W76), southwest approach (N60 W76), northeast approach (N62 W68) and southeast approach (N60 W68).

Wildlife Harvesting by Non-Aboriginal Users

If they are again authorized by the MFFP to fish in the vicinity of km 4 of the Deception Bay Road or on Lac du Bombardier, the Glencore Canada and CRI workers will be quite far from the area of the proposed work. They will therefore not be affected by dust and vibration from the various activities during the construction phase. It is possible that CRI workers who go fishing at lac du Bombardier may perceive the noise generated during the construction phase since this lake is less than 4 km from the area of the proposed work and is frequented in July and August when the construction work will take place. It should be noted, however, that the area is already affected by noise from nearby heavy transportation and mining activities. The noise generated by the construction work carried out as part of this project will therefore not be very noticeable to sport fishers (see section 6.4.5).

Non-Aboriginal users practicing fishing activities in Pingualuit National Park are unlikely to be affected by construction activities. In fact, the closest frequented fishing site is located on Lac Saint-Germain, a little more than 15 km southwest of the works area. Non-Aboriginal users who go there will therefore not be inconvenienced by the dust, vibrations or noise produced during the construction work. The cranes that will be used to erect the two proposed wind turbines may be partially visible from Lac Saint-Germain. However, they will be located more than 10 km away, which means that the visual impact of their presence will be low at this location (see section 6.4.6). It should also be noted that fishing in Lac Saint-Germain is done during the winter period, from January to May. However, the construction phase will begin in May and end in November. Thus, most of the activities of the construction phase will occur outside the period when Lac St-Germain is frequented.

6.4.3.2 Operational Phase

Pingualuit National Park

During the operational phase, the noise generated by the proposed wind turbines will not be perceptible from the park. The impact will therefore be essentially visual since the wind turbines will be visible or partially visible from various sectors of the park. Lac Saint-Germain, the closest park attraction to the proposed wind turbine site, is located more than 10 km from the park. The visual impact of the wind turbines will therefore be low at this location. The most frequented places in the park, such as the Pingaluk Lake crater and the Sangummaaluk and Paarutivik camps, are located nearly 30 km from the proposed wind turbines, which means that the visual impact will be negligible at these locations (see section 6.4.6).

In addition, the visibility beacons installed on the wind turbines to avoid collisions with aircraft during periods of darkness will be visible from a good distance and may be perceived by visitors of the park. These flashing lights could therefore contribute to a certain amount of "light pollution" in the national park during the operational phase, which would be added to the already slightly perceptible lighting from the mining sites operated by CRI (see section 6.4.6).

Proposed Fjord-Tursukattaq Biodiversity Reserve

No impacts are anticipated for the proposed Fjord-Tursukattaq Biodiversity Reserve during the operational phasesince it is located at a good distance (almost 30 km from the proposed wind turbines). The noise produced by the wind turbines during their operation will not be perceptible and their visual impact on potential visitors to the reserve will be negligible.

Marine Transportation

No marine transportation related to the operation of the proposed wind turbines is planned during the operational phase.

Use of Roads by Mining Companies

No heavy traffic related to the operation of the proposed wind turbines will be required on the access roads during the operational phase.

Besides, the presence of the proposed wind turbines is not expected to affect the telecommunications systems in the area of the Expo site. In fact, two wind turbines similar to those planned in the present project have been installed by TUGLIQ near the Raglan mine and have been in operation for several years. It appears that their presence has had no impact on the telecommunications in the vicinity. Since the two wind turbines planned for the project will be located in an environment similar to that of the wind turbines in operated by TUGLIQ in the vicinity of the Raglan mine[36], it can be assumed that their presence will not affect the telecommunications systems operated by the users of the access roads in the vicinity of the Expo site, nor those used by the Kattiniq-Donaldson airport.

Use of Kattiniq-Donaldson Airport

Only a few air travels via the Kattiniq-Donaldson airport are anticipated in relation to the operation of the proposed wind turbines during the operational phase.

Tasks related to the routine maintenance and operation of the two proposed wind turbines may be performed by two TUGLIQ employees already assigned to the maintenance of the wind turbines at the Raglan mine. It is also possible that TUGLIQ will hire two new technicians specifically assigned to the maintenance and operation of the two proposed wind turbines at the Expo site. In both cases, the TUGLIQ technicians will travel to the site via the regular CRI flights already serving the Kattiniq-Donaldson airport. Therefore, the transportation of these two to four employees will not have a significant impact on airport usage. It is also possible that an additional employee (preferably an Inuit employee from Nunavik) could be hired by TUGLIQ to assist the other technicians. If so, he or she would travel via one of the three weekly flights already in use for the transportation of Glencore Canada and CRI Inuit employees.

Once a year, more extensive maintenance will be performed by the manufacturer of the two proposed wind turbines. This maintenance will require the air travel of one person, which will travel via one of CRI's weekly flights already operating at the airport. Thus, the few additional air trips required for the operation and maintenance of the proposed wind turbines during their operation will not affect the use of the Kattiniq-Donaldson airport.

Furthermore, as mentioned above, the presence of the proposed wind turbines is not expected to affect telecommunications systems. Therefore, no disruption of telecommunications at the Kattiniq-Donaldson Airport is expected. It should be noted that the only impact predicted by Nav Canada regarding the presence of the two proposed wind turbines is the increase in the minimum flight altitude on approach to the airport from 3,400 feet to 3,500 feet at the following locations: northwest approach (N62 W76), southwest approach (N60 W76), northeast approach (N62 W68) and southeast approach (N60 W68).

Wildlife Harvesting by Non-Aboriginal Users

During the operational phase, it is not expected that the operation nor the maintenance of the proposed wind turbines will have an impact on the practice of wildlife harvesting activities by non-Aboriginal users. In fact, although the wind turbines may produce noise during their operation, it will not be perceptible to CRI workers who could practice fishing activities at Lac du Bombardier (located approximately 3.5 km from the wind turbines).

Moreover, no travel other than that carried out in the context of mining operations is or will be authorized by CRI on the territory concerned by the NNiP. No other hunting or fishing activities will therefore be carried out in the vicinity of the wind turbines during their operation.

[36] The wind turbines developed by TUGLIQ Energy in the vicinity of the Raglan mine are located approximately 20 km northwest of the area planned for the development of the proposed wind turbines at the Expo site.

6.4.3.3 Dismantling Phase

Pingualuit National Park

During the dismantling of the wind turbines, the cranes required could be visible from certain areas of the park. This would be in the northern portion of the park, which is closer to the site planned for the installation of the proposed wind turbines. However, the visual impact will be low given the remoteness of the location. It will also be negligible in the most frequented areas of the park, such as the Pingaluk Lake crater and the Sangummaaluk and Paarutivik camps, which are well away (nearly 30 km). Following their dismantling, the wind turbines will disappear from the landscape. The visual impact that they could have on visitors of the park during the operational phase will no longer be present.

Fjord-Tursukattaq proposed biodiversity reserve

No impacts on this proposed biodiversity reserve are anticipated during the dismantling phase.

Marine Transportation

During the dismantling phase, the wind turbines will be dismantled and then moved to other locations by the sea. It can therefore be expected that the number of marine transits required will be the same as during the construction phase. Thus, two to three shipments of material, machinery and equipment could be required. It is important to mention here that the eventual dismantling of the wind turbines would probably take place at the same time as the various CRI mining complexes are also dismantled. Thus, the marine transportation required for the dismantling of the wind turbines would be combined with that related to the dismantling of the mining complexes.

Use of Access Roads by Mining Companies

During the dismantling phase, the use of existing roads for transporting materials and machinery can be expected to be similar to what is planned for the construction phase, i.e., approximately 80 semi-trailer trucks round trips, including about 20 oversized transportations. As with marine transportation, these road transits will take place at the same time as those carried out as part of the dismantling of the various CRI mining complexes on the NNiP.

Use of the Kattiniq-Donaldson Airport

During the dismantling of the wind turbines, one would expect that the number of employees required to do this work would be equivalent to the number of employees expected during the various stages of the construction phase. In reality, however, the number of employees required to dismantle the wind turbines could be slightly lower since several workers already on site to dismantle the CRI facilities could be assigned to the dismantling of the wind turbines. Thus, only a few TUGLIQ employees could go on-site to supervise the various stages of dismantling. These few workers will travel to the site via flights already scheduled by CRI. There will therefore be no increased pressure on the Kattiniq-Donaldson airport.

Wildlife Harvesting by Non-Aboriginal Users

During the dismantling phase, CRI workers would no longer engage in any wildlife harvesting activities near the affected areas, as the decommissioning of the turbines would likely occur at the same time as the decommissioning of the Expo mining site, which would then have ceased all operations. Thus, the vast majority of the company's workers would have left the site and the few people still on site would essentially be working to dismantle the existing infrastructures.

Non-Aboriginal users who practice fishing activities in the Pingualuit National Park will be at a good distance from the areas affected by the dismantling work and will therefore not be bothered by the dust, vibrations or noise produced. It should also be noted that sport fishing activities in the park take place mainly from January to May, whereas the various work activities during the dismantling phase are likely to be carried out between May and December.

6.4.3.4 Mitigation Measures

The implementation of mitigation measures will reduce the impacts of the construction, operation and dismantling of the two proposed wind turbines on non-Aboriginal land use and occupancy. This will be done in particular by:

- Informing Glencore Canada, Canadian Royalties Inc. and Kattinniq Transport Inc. of planned transportation on the various access roads during the construction and dismantling phases.
- Maintaining as much as possible regular circulation on the various access roads used.
- Ensuring the safety of the various users of the affected access roads and of the workers present in the vicinity of the works area.
- Taking action to limit noise generation during the construction and dismantling phases.
- Informing the Pingualuit National Park authorities of the scope and schedule of the work during the construction and dismantling phases.

Table 6-25 describes the set of proposed mitigation measures.

Table 6-25: Mitigation measures to minimize impacts on non-Aboriginal land use and occupancy

Nº	Mitigation Measures
LAU9	Inform the various users of the access roads taken (Glencore Canada, Canadian Royalties and Transport Katinniq) of the number of heavy transport trips planned on these roads and their schedule during the construction and dismantling phases. Maintain contact with the different users throughout the construction and dismantling phases to enable them to identify eventual problems and ensure good coordination of the various trips made on the roads.
LAU10	During the construction and dismantling phases, install signs mentioning the presence of traffic lanes or works areas near the work to inform the mining company employees who could travel or engage in activities in the sector.
LAU11	Inform the management of Pingualuit National Park of the scope and schedule of the work planned during the construction and dismantling phases. Maintain contact with the park authorities throughout the construction, operational and dismantling phases to enable them to identify eventual problems and make the necessary corrections.
NOI1	Conduct a preliminary and regular inspection of the machinery and equipment used to ensure their good conditions and good working order (not to generate excessive noise).
NOI2	Limit machinery traffic in the works areas.
NOI3	Isolate the main noise sources, if possible, with absorbent material during the construction and dismantling phases.

6.4.3.5 Residual impact

During the construction phase, maritime transportation may increase very slightly in Deception Bay (maximum of 1 additional shipment possible), but this will not result in increased pressure on the CRI port infrastructure. Heavy traffic will increase slightly on access roads and may be disrupted on a few occasions due to the movement of oversized freighters. However, the good communication that currently prevails between the various road users will ensure that these movements are well coordinated and that the safety of the various road users is maintained. Some workers will transit through the Kattiniq-Donaldson airport throughout the construction phase via flights already scheduled by CRI. This will not result in increased pressure on the airport. In terms of wildlife harvesting, only CRI workers fishing at Lac du Bombardier are likely to be affected by the noise generated by the construction work. It should be noted, however, that this area is already affected by noise from heavy traffic and nearby mining activities. Visitors of Pingualuit National Park who practice fishing activities at Lac Saint-Germain could be able to see the cranes that will be used to erect the wind turbines, which will be at odds with the natural appearance of the site. However, this visual disturbance will be minimal given its distance (> 10 km). Finally, it should be noted that no impact is expected on the proposed Fjord-Tursukattaq Biodiversity Reserve.

For all the components of non-Aboriginal land use and occupancy, the intensity of the impact during the construction phase will be low (for the reasons mentioned above), the extent will be local and the duration short. **The importance of the residual impact is therefore considered minor for the construction phase** (Table 6-26).

During the operational phase, no marine transportation or heavy hauling on access roads is anticipated. There will therefore be no impact on these two aspects of non-Aboriginal land use and occupancy. Furthermore, only a few workers required for the operation and maintenance of the proposed wind turbines will transit through the Kattiniq-Donaldson airport via flights already planned by CRI, which will not result in increased pressure on the airport. The presence of the two proposed wind turbines will, however, result in an increase of the minimum flight altitude on approach to the airport from 3,400 to 3,500 feet. Again, this minor change will not disrupt airport operations. In terms of wildlife harvesting, CRI workers who may be fishing at Lac du Bombardier will not be affected by the presence of the wind turbines, as they will not perceive the noise they produce. No impact is therefore to be expected concerning this aspect non-Aboriginal land use and occupancy. Furthermore, no impact is expected on the proposed Fjord-Tursukattaq Biodiversity Reserve during the operational phase.

In fact, the only non-Aboriginal users likely to be affected by the presence of the wind turbines are the visitors of the Pingualuit National Park, who may see the two structures (totally or partially). The presence of the two wind turbines will be in contrast with the natural aspect of the surrounding landscape. However, it should be noted that the visual impact of the turbines will be low in the northern portion of the park (such as at Lac Saint-Germain) and negligible in the vicinity of the park's most visited attractions (such as Pingaluk Lake crater). The light pollution caused by the presence of the wind turbines, particularly by the flashing night beacons, will have a more marked effect on the landscape (see section 6.4.6). Overall, the intensity of the impact of the presence of the turbines on the users of Pingualuit National Park will be low, the extent will be local, and the duration of the impact will be long. **The importance of this residual impact is therefore considered to be medium during the operational phase** (Table 6-26).

During the dismantling phase, the impacts on the various components of the non-Aboriginal land use and occupancy will be more or less the same as during the construction period. Thus, for all of them (except for the planned Fjord-Tursukattaq Biodiversity Reserve, for which there will be no impact), the intensity of the impact will be low, the extent local or limited and the duration short. **The importance of the residual impact during the dismantling phase will therefore be minor** (Table 6-26).

Table 6-26: Description of the importance of the residual impact of the project on non-Aboriginal land use and occupancy

Component	Development phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance residual impact
Non-Aboriginal land use and occupancy	Construction Dismantling	Possible slight increase in marine transportation in Deception Bay (possibility of 1 additional trip).	None	Minor	Local	Short	Minor
		Temporary change in traffic on access roads.	LAU9 LAU10	Medium	Local	Short	
		Slight increase in the use of Kattiniq-Donaldson Airport.	None.	Low	Limited	Short	
		Disturbance of wildlife harvesting activities due to work noise.	NOI1 to NOI3 LAU11	Low	Limited	Short	
		Visual impact of cranes used in wind turbine erection and dismantling for users of Pingualuit National Park.	LAU11	Low	Limited	Short	
	Operational	Raising the minimum flying altitude at the airport approach.	None	Low	Limited	Long	Minor
		Visual impact of wind turbines for users of Pingualuit National Park.	None	Medium	Local	Long	Medium

6.4.4 Archaeology

6.4.4.1 Construction phase

Within the works area, the surface soil stripping and the displacement of surface topsoil resulting from the access road construction and the excavation of the wind turbine footings could directly impact archaeological resources present in the affected area.

However, no significant archaeological resources attributed to a traditional Inuit occupation were observed by AECOM's archaeologist within the impacted areas of the project. The stage 2 onsite cultural resources assessment resulted in the discovery of a contemporaneous occupation possibly dating from the mining prospecting period. The remnants of rusted steel cans used for food storage dating from the second half of the 20th century and the presence of numerous small rock mounds, less than two feet in height, used to hold in place what seems to be wooden survey stakes, were the main artifacts observed within the works area. Furthermore, the closest known archaeological sites are located more than five kilometres away from the works area.

It can be stated that the cultural heritage value or interest of the works area has been sufficiently documented and no further archaeological assessment of the area is required. Should previously undocumented archaeological resources be discovered, TUGLIQ Energy or its contractors must ensure the protection of the cultural resource by ceasing any further works. More so, in accordance with article 74 of the Cultural Heritage Act (L.R.Q., P-9.002, 2011, chap. B 4) the discovery of the archaeological site must be declared to the Minister without delay. Construction work may continue if the archaeological resource is not affected and remain protected from further destruction.

6.4.4.2 Operational phase

No impact on the archaeological resources is expected during the operational phase since no activities related to this phase are susceptible to affecting archaeological sites or assets.

6.4.4.3 Dismantling phase

No archaeological resources should be affected during the dismantling phase since the totality of the works will be done in areas already affected by the construction phase. If the dismantling phase should disturb areas located outside the previously affected areas, the possibility of disturbing archaeological resources remains almost insignificant since no archaeological assets were observed during the assessment of the cultural resources within the study area

6.4.4.4 Mitigation measures

If significant archaeological resources are discovered during the work that was not observed during the cultural heritage assessment realized in the summer of 2022, the mitigation measure ARC1 is to be implemented (Table 6-27)

Table 6-27: Mitigation measures to minimize the impact on the archaeological resources

Nº	Mitigation measures
ARC1	If archaeological resources are discovered, work managers are to be immediately informed and the work must be stopped. Measures to protect the resources are to be implemented and Quebec's Ministry of Culture and Communications is to be informed of the discovery.

6.4.4.5 Residual impact

Considering the low possibility of encountering archaeological resources within the scope of this project, the intensity of the impact on the archaeological resources during the construction and dismantling phases is considered low, or even nonexistent since no significant resources were encountered during the heritage assessment. If significant archaeological resources are affected during the work, though improbable, the extent of the impact would be limited and the resulting perturbation would be permanent, which would result in a long-lasting impact. **The importance of the residual impact on the archaeology would then be considered minor (Table 6-28).** However, the possibility of finding archaeological resources of significance during the construction phase is practically nil.

No impact on archaeological resources is expected during the operational phase

Table 6-28: Importance of the residual impact of the project on archaeological resources

Component	Development phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance of the residual impact
Archaeology	Construction Dismantling	Discovery of significant archaeological or historical remains during work	ARC1	Low	Limited	Long	Minor
	Operational	None	None	N/A	N/A	N/A	N/A

N/A*: Non applicable*

6.4.5 Noise Climate

6.4.5.1 Construction Phase

During the construction phase (planned from May to November 2023), the noise sources will be essentially related to the machinery used to carry out the construction work. The most critical period will be during the preparation of the foundations of the wind turbines (from the beginning of July to August) when there is a total of approximately ten vehicles and equipment on site. It is assumed that these noise sources will be operating at full load, 10 minutes per hour, throughout the day from 7:00 a.m. to 7:00 p.m. Appendix L presents the construction phase noise simulations performed for this study and Figure 2 in this appendix illustrates the simulated noise levels around the construction area.

Heavy traffic will increase slightly on the various access roads used during the construction phase, i.e., the road linking Deception Bay to the Raglan mine (current number of crossings: approximately 13,000 per year, or an average of 36 crossings per day), the road linking the Raglan mine to the Kattiniq-Donaldson airport, and the road leading to the Expo mine site (current number of crossings: approximately 6,000 per year, or an average of 16 crossings per day). Trucks will be required to transport equipment and materials during construction activities. It is estimated that there will be a maximum of 160 additional vehicle trips (approximately 80 round trips) on these access roads, spread relatively evenly throughout the construction phase (scheduled for May to November 2023). We are talking about 1 to 2 additional trucks per day on the roads (i.e. 2 to 4 passes), which is not significant in terms of an increase in road noise levels.

6.4.5.2 Operational Phase

During the operational phase, the noise sources will come from the two projected wind turbines, which may operate simultaneously. A wind turbine emits aerodynamic noise due to the friction of the blades in the air and the friction of the air on the tower, and mechanical noise due to the operation of the mechanical elements contained in the rotor. Appendix L presents the operational noise simulations performed for this study, and Figures 3 and 5 in this appendix illustrate the simulated noise levels around the two proposed wind turbines.

6.4.5.3 Dismantling Phase

During the dismantling phase of the wind turbines, the noise produced will be similar to what is expected during the construction phase.

6.4.5.4 Mitigation measures

Mitigation measures will be implemented during the construction and dismantling phases to limit the noise generated by the work. These measures are presented in Table 6-29. No mitigation measures related to noise are planned for the operational phase.

Table 6-29: Mitigation measures to minimize noise impacts

Nº	Mitigation Measures
NOI1	Conduct a preliminary and regular inspection of the machinery and equipment used to ensure their good conditions and good working order (not to generate excessive noise).
NOI2	Limit machinery traffic in the work areas.
NOI3	Isolate the main noise sources, if possible, with absorbent material during the construction and dismantling phases.

6.4.5.5 Residual Impact

According to the MELCC instruction note (2006), the sound levels not to be exceeded for sensitive receptors R1 (Lac du Bombardier) and R2 (Lac Rocbrune), associated with land intended for residential areas, are 45 dBA during the day and 40 dBA at night. For receptor R3 (Expo site workers' camp), the level not to be exceeded is 55 dBA during the day and 50 dBA at night since it is a residential area in an industrial zone. At all three receptors, noise levels from construction activities are expected to meet the criteria set out by the MELCC. Noise increases over the existing ambient noise will all be less than 1 dBA (see Table 6-30). Therefore, the intensity of the impact is considered low, if not insignificant, the extent of the impact will be limited and its duration short. **The importance of the residual impact on the noise climate is therefore considered minor, if not insignificant, during the construction phase.**

Table 6-30: Noise levels at sensitive receptors compared to MELCC criteria (construction phase)

Sensitive receptor	Equivalent noise related to the company's activities [(1)] (dBA)	MELCC noise criteria (dBA)			Noise increase due to proposed activities (dBA) [(5)]
		Initial ambient noise [(2)] (dBA)	Maximum level allowed [(3)]	Criteria used [(4)]	
Daytime (between 7 a.m. and 7 p.m.)					
R1, Lac du Bombardier	17,8	34,4	55	55	0,094
R2, Lac Rocbrune	24,4	34,4	55	55	0,041
R3, Expo site (workers' camp)	24,8	44,9	55	55	0,042

(1) Noise corresponding to the assessment sound level (LAr 1h= LAr 12h). Details of the calculations are presented in the noise sector study in Appendix L.

(2) Value corresponding to the maximum permitted level taken from section 2.1.1 of the noise sector study and presented in Appendix L.

(3) Criterion selected in accordance with the "Guidelines for Noise Levels from an Industrial Construction Site (MELCC, March 2015)" corresponding to the higher of the residual noise or the maximum permitted level.

(4) 10*LOG(10^(Noise from all sources (dBA)/10)+10^(Ambient noise(dBA)/10)) - Ambient noise (dBA).

In the operational phase, noise levels at all sensitive receptors will be below the MELCC instruction memorandum criteria or around existing ambient noise levels. Noise increases over existing ambient noise will all be less than 1 dBA (see Table 6-31). Therefore, the intensity of the impact will be low to insignificant, the extent of the impact will be one-time, and the duration will be long. **The importance of the residual impact on the noise climate is therefore considered minor, if not insignificant, in the operational phase.**

Table 6-31: Noise levels at sensitive receptors compared to MELCC criteria (operational phase)

Sensitive receptor	Equivalent noise related to the company's activities (1) (dBA)	MELCC noise criteria (dBA)			Noise increase due to proposed activities (dBA) (5)
		Initial ambient noise (2) (dBA)	Maximum level allowed (3)	Criteria used (4)	
Daytime (between 7 a.m. and 7 p.m.)					
R1, Lac du Bombardier	15,6	34,4	45	45	0,057
R2, Lac Rocbrune	22,2	34,4	45	45	0,25
R3, Expo site (workers' camp)	22,8	44,9	55	55	0,027
Nighttime (between 7 p.m. and 7 a.m.)					
R1, Lac du Bombardier	15,6	28,8	40	40	0,20
R2, Lac Rocbrune	22,2	28,8	40	40	0,86
R3, Expo site (workers' camp)	22,8	33,6	50	50	0,38

(1) Noise corresponding to the assessment sound level (LAr 1h= LAr 12h). Details of the calculations are presented in the noise sector study in Appendix L.

(2) Value corresponding to the maximum permitted level taken from section 2.1.1 of the noise sector study and presented in Appendix L.

(3) Criterion selected in accordance with the "Guidelines for Noise Levels from an Industrial Construction Site (MELCC, March 2015)" corresponding to the higher of the residual noise or the maximum permitted level.

(4) 10*LOG(10^(Noise from all sources (dBA)/10)+10^(Ambient noise(dBA)/10)) - Ambient noise (dBA).

During the dismantling phase, the noise impacts will be similar to those anticipated for the construction phase. The intensity of the impact will be low, the extent is limited and the duration is short. **The importance of the residual impact during the dismantling phase is therefore considered minor, if not insignificant (Table 6-32).**

Table 6-32: Description of the significance of the residual impact of the project on the noise climate

Component	Development phase	Description of the impact	Mitigation measures	Intensity	Extent	Duration	Importance residual impact
Noise Climate	Construction Dismantling	Noise disturbance due to the increase in the noise level during construction and dismantling work.	NOI1/AIR6 NOI2 NOI3	Low	Limited	Short	Minor
	Operational	Noise disturbance due to the operation of wind turbines.	None	Low	Limited	Long	Minor

6.4.6 Landscape

6.4.6.1 Construction phase

The different stages of the construction phase such as the creation of the access road, the building of the platforms, as well as the erection of the wind turbines, will involve the presence of machinery, such as cranes, concrete mixers, and others, which will occupy a significant place in the landscape during the work and will negatively affect the natural landscape. However, this visual impact will be of short duration since it will only last during the construction phase, scheduled from May to November 2023.

6.4.6.2 Operational phase

Visibility in the landscape - Visual access areas

The study area encompasses four different types of visual access areas. These were developed based on influential zone parameters considered in landscape visibility assessments, site topography using the Digital Terrain Model (DTM), a published study by Hill et al. (2001), and the United Kingdom Government Wind Turbine Visibility Guide (DTI, 2005).

Foreground visual access area

A radius of 2 km or less from the works area. Observer types are mobile and permanent observers. There are no valued landscape sites in this foreground area. Users who may occasionally pass through this area will be significantly impacted by the presence of the wind turbines.

Medium plane visual access area

A radius of 2 to 10 km from the works area. Observer types are mobile and permanent observers. There are two main valued sites in this area, these are the lac du Bombardier site and the lac Rocbrune site. Inuit users of the lac Rocbrune site will be affected, as well as non-Aboriginal users of the lac du Bombardier site. The valued sites in this area will be moderately impacted by the presence of wind turbines.

Background visual access area

A radius of 10 to 23 km from the works area. Observer types are mobile observers and temporary observers (located in the Pingualuit National Park). There are two main valued sites in this area, the lac Gindeau site and the lac Saint-Germain site. Three valued secondary sites are also located in this area, namely the site south of lac Rocbrune, the km 13 road, and the lac Méquillon site. Users affected will be those travelling to the Kattiniq-Donaldson airport as well as Inuit users fishing at lac Vicenza and at the three unnamed lakes located west or further north of it. Valued sites within this area will be minimally impacted by the presence of the wind turbines.

Negligible visual access area

A radius of 23 km and more from the work area. Observer types are mobile observers and temporary observers (located in the Pingualuit National Park). There is one main valued site in this area which is the Pingualuk Lake crater. This site will be minimally impacted by the presence of wind turbines.

The degree of visibility is used to determine the intensity of the impact on the landscape as detailed in Table 6-33.

Table 6-33: Intensity of impact on landscape according to visual access areas

Visual access areas	Intensity of impact
Foreground (< 2 km)	Major
Medium plane (2 to 10 km)	Medium
Background (10 to 23 km)	Minor
Negligible (> 23 km)	Negligible

Visibility of wind turbines in the landscape

Map 6-1 provides an analysis of the areas from which the proposed wind turbines will be visible in the landscape. Made with a geographic information system (GIS) software, the visibility analysis map is based on three main parameters: the digital terrain model (topography), the size of the proposed wind turbines (turbine positioning and height of 120 m), and a viewing height equivalent to human eyesight. The result is represented by the area identified in red on the map. The degree of visibility of the wind turbines depends on variable elements such as weather conditions, luminosity, and observation times.

Map 6-1 also correlates the valued landscape sites with the areas of visibility of the proposed wind turbines. Thus, based on the visual access areas defined in this section and with the visibility analysis of the wind turbines, the turbines will be highly visible in the limited study area and will be moderately to lowly visible in the local study area. They will be negligibly visible from the more distant valued sites, including Pingualuk Lake, beyond the boundaries of the local study area.

Light pollution

Light pollution is analyzed to evaluate the changes in the landscape caused by the night lighting resulting from the implementation of the projected wind turbines. According to the environmental monitoring report carried out by CRI (Canadian Royalties Inc., 2022), the observation of light pollution in the Pingualuit National Park between 6:30 p.m. and 10:00 p.m. indicates that lights from the industrial and mining complex at the Expo site are visible to the naked eye from a vantage point about 30 km south of the Expo site, near the crater of Pingualuk Lake, and some of them are visible from the photos taken at this vantage point. It was also found that the lights from the Expo site blend in with the starlight and have a low visual impact on the luminous landscape. The wind turbines will each have two flashing white lights, white during the day and red at night. The visibility of these lights at night will be higher than during the day. During the day, the white lights of the turbines will blend in with the colour of the turbines, the colour of the sky and sun, and the light of the Expo site, so the impact is considered low. At night, the lights will be much more visible since they will be red and flashing, which will contrast with the environment. The impact will be tangible since it could affect the "Dark Sky Preserve" accreditation that Pingualuit National Park wishes to obtain, but this impact will not compromise any usage of the park.

6.4.6.3 Dismantling phase

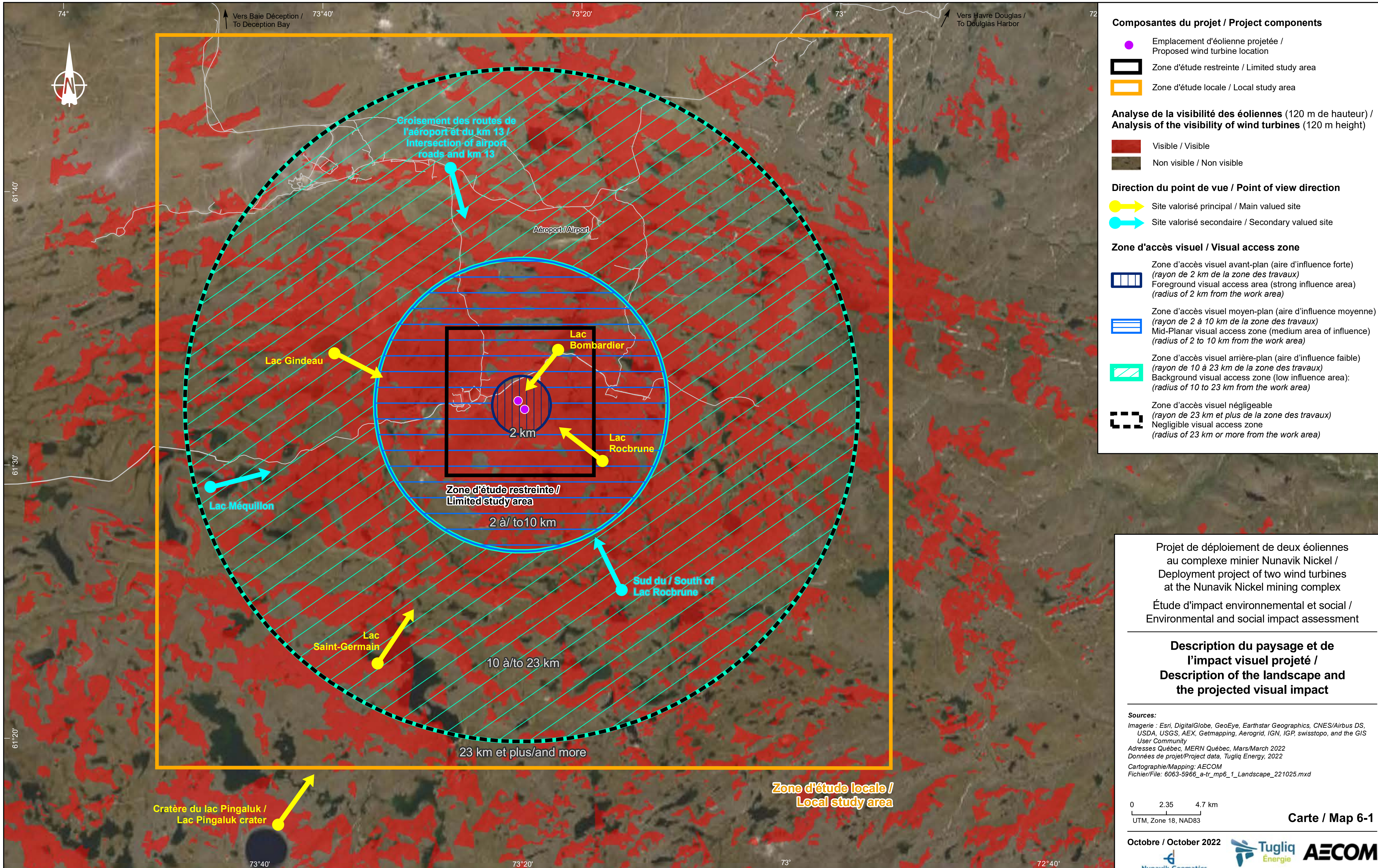
The dismantling phase will lead to impacts similar to those projected for the construction phase and therefore visual impact on the landscape will be of a limited extent and of short duration.

6.4.6.4 Mitigation measures

Possible mitigation measures in the landscape are limited. The characteristics of the landscape do not allow for the proposal of reasonable mitigation measures adapted to the environment. The tundra-like vegetation does not allow for the planting of trees to hide the wind turbines in the landscape. The addition of built features at key viewing sites to conceal the wind turbines from view would be possible but would result in disfiguring the existing landscape. Therefore, no landscape mitigation measures are proposed for this project.

6.4.6.5 Residual impact

For the construction and dismantling phases, it is expected that the visual impact caused by the presence of machinery in the landscape will be slightly felt at a distance of more than 2 km from the work area. The intensity of the impact will therefore be low, the extent limited and the duration short. **The importance of the impact on the landscape is therefore considered minor for the construction and dismantling phases** (Table 6-34).



74°
73°40'
73°20'
73°
Vers Baie Déception / To Deception Bay
Vers Havre Douglas / To Douglas Harbor
61°40'
61°30'
61°20'
72°40'
N
Croisement des routes de l'aéroport et du km 13 / Intersection of airport roads and km 13
Aéroport / Airport
Lac Gindeau
Lac Bombardier
Lac Rocbrune
2 km
Lac Méquillon
Zone d'étude restreinte / Limited study area
2 à/ to10 km
Sud du / South of Lac Rocbrune
Lac Saint-Germain
10 à/to 23 km
23 km et plus/and more
Cratère du lac Pingaluk / Lac Pingaluk crater
Zone d'étude locale / Local study area
Composantes du projet / Project components
Emplacement d'éolienne projetée / Proposed wind turbine location
Zone d'étude restreinte / Limited study area
Zone d'étude locale / Local study area
Analyse de la visibilité des éoliennes (120 m de hauteur) / Analysis of the visibility of wind turbines (120 m height)
Visible / Visible
Non visible / Non visible
Direction du point de vue / Point of view direction
Site valorisé principal / Main valued site
Site valorisé secondaire / Secondary valued site
Zone d'accès visuel / Visual access zone
Zone d'accès visuel avant-plan (aire d'influence forte) (rayon de 2 km de la zone des travaux) Foreground visual access area (strong influence area) (radius of 2 km from the work area)
Zone d'accès visuel moyen-plan (aire d'influence moyenne) (rayon de 2 à 10 km de la zone des travaux) Mid-Planar visual access zone (medium area of influence) (radius of 2 to 10 km from the work area)
Zone d'accès visuel arrière-plan (aire d'influence faible) (rayon de 10 à 23 km de la zone des travaux) Background visual access zone (low influence area): (radius of 10 to 23 km from the work area)
Zone d'accès visuel négligeable (rayon de 23 km et plus de la zone des travaux) Negligible visual access zone (radius of 23 km or more from the work area)
Projet de déploiement de deux éoliennes au complexe minier Nunavik Nickel / Deployment project of two wind turbines at the Nunavik Nickel mining complex
Étude d'impact environnemental et social / Environmental and social impact assessment
Description du paysage et de l'impact visuel projeté / Description of the landscape and the projected visual impact
Sources:
Imagerie : Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Adresses Québec, MERN Québec, Mars/March 2022
Données de projet/Project data, Tugliq Energy, 2022
Cartographie/Mapping: AECOM
Fichier/File: 6063-5966_a-tr_mp6_1_Landscape_221025.mxd
0 2.35 4.7 km
UTM, Zone 18, NAD83
Carte / Map 6-1
Octobre / October 2022
Nunavik Geomatics
Tugliq Énergie
AECOM

During the operational phase, most of the identified valued sites will be located at a good distance from the wind turbines, either in the background visual access area (between 10 and 23 km away from the works area) or even further away, from which the visibility of the wind turbines will be low or negligible. The intensity of the visual impact from these sites will therefore be low to negligible. Depending on the case, the extent is considered limited or local, since the number of users frequenting these different sites is relatively low. The duration of the impact is considered long. **The importance of the impact on the landscape at these valued sites is therefore considered minor during the operational phase** (Table 6-34).

On the other hand, for the medium-plane visual access area in which lac du Bombardier and lac Rocbrune sites are located, the visibility of the wind turbines will be moderate. The intensity of the visual impact will therefore be medium. The extent will be limited or local, because a limited number of users will be affected by this impact, and the duration will be long. **The importance of the impact on the landscape for these two valued sites is therefore considered to be medium during the operational phase** (Table 6-34).

In terms of light pollution, the impact will be of medium intensity, since it could affect the "dark sky preserve" accreditation that Pingualuit National Park wishes to obtain, and its extent will be limited mainly to park users (between 150 and 250 visitors per year). However, its duration will be long, as it will correspond to the entire life of the wind turbines. **The importance of the impact of light pollution is therefore considered to be medium during the operational phase** (Table 6-34).

Table 6-34: Description of the importance of the residual impact of the project on the landscape

<table>
<tr><th>Component</th><th>Development phase</th><th>Description of the impact</th><th>Mitigation measures</th><th>Intensity</th><th>Extent</th><th>Duration</th><th>Importance of the residual impact</th></tr>
<tr><td rowspan="4">Landscape</td><td>Construction and Dismantling</td><td>Visibility of wind turbines in primary and secondary valued sites</td><td>N/A</td><td>Low</td><td>Limited</td><td>Short</td><td>Medium</td></tr>
<tr><td rowspan="3">Operational</td><td>Visibility of wind turbines in the Valued Sites of Bombardier Lake and Rocbrune Lake</td><td>N/A</td><td>Medium</td><td>Limited</td><td>Long</td><td>Medium</td></tr>
<tr><td>Visibility of wind turbines in the other Valued Sites</td><td>N/A</td><td>Low to negligible (according to the valued site)</td><td>Limited to Local (according to the valued site)</td><td>Long</td><td>Minor</td></tr>
<tr><td>"Light pollution" at night due to the presence of flashing beacons on wind turbines</td><td>N/A</td><td>Medium</td><td>Limited</td><td>Long</td><td>Medium</td></tr>
</table>

N/A*: Non-applicable*

6.5 Impact Assessment

Tables 6-35 to 6-37 present a summary of the projected impacts and mitigation measures proposed for this project, respectively for the physical, biological and human environments.

Comprehensively, all the residual impacts of the project on the physical and biological environments are considered of minor importance. Concerning the human environment, most of the residual impacts are considered of minor importance, except for some impacts that are considered of medium importance (in the case of visual impacts) or major and positive importance (in the case of job creation and local, regional and provincial economic impacts).

Table 6-35: Assessment of Impacts and Mitigation Measures for the Physical Environment

Component	Development phase	Description of the impact	Mitigation measures	Importance of the residual impact
Air quality	Construction Dismantling	Increase in airborne dust and atmospheric pollutant and greenhouse gas (GHG) emissions	AIR1 to AIR7	Minor
	Operational		AIR1 AIR3 to AIR6	Minor
Soil quality	Construction Dismantling	Risk of soil contamination and dispersion in the environment	AIR6 SOIL1 to SOIL16	Minor
	Operational		AIR6 SOIL1 to SOIL4 SOIL14	Minor
Water quality	Construction Dismantling	Risk of surface water contamination and dispersion in the environment	WATER1 to WATER4 AIR6 SOIL1 to SOIL8 SOIL12 to SOIL16	Minor
	Operational		AIR6 SOIL1 to SOIL4 SOIL14	Minor Minor
	Construction Dismantling	Modification of the flow pattern and the sedimentary regime during the work	HSR1, SOIL6 SOIL12, SOIL16	Minor
	Operational	None	None	N.A.
No.	**Mitigation measures for the physical environment***			
AIR1	Avoid leaving internal combustion vehicles and equipment idling needlessly.			
AIR2	Spread dust suppressant (calcium chloride or water) on the access roads in dry and windy weather. The moistening frequency will be adjusted according to the weather conditions and the dust emissions observed.			
AIR3	Use machinery meeting the Environment and Climate Change Canada emission standards for road and off-road vehicles.			
AIR4	Limit handling of materials in periods of high winds to reduce dust emissions.			
AIR5	Use generators and equipment with low contaminant emissions.			

Table 6-35: Assessment of Impacts and Mitigation Measures for the Physical Environment (cont'd)

No.	Mitigation measures for the physical environment*
AIR6	Conduct regular preliminary inspections of machinery and equipment to ensure they are in good condition and good working order.
AIR7	Use sealed and standard trucks covered with a tarp, depending on the needs, to limit airborne dispersion of fine particulate matter.
SOIL1	Apply the CRI prevention and emergency preparedness plan in case of a spill and make emergency recovery kits for petroleum products and hazardous materials easily accessible at all times, in accordance with the laws and regulations in force.
SOIL2	Perform general maintenance and fuel supply for machinery at the places identified by the site supervisor. Storage of petroleum products and maintenance, refueling and cleaning of machinery and equipment must be done over 30 m from a watercourse or a wetland, on a site developed for this purpose where no risk of contamination of soil, surface water and groundwater exists.
SOIL3	Place the receptacles containing hydrocarbons and other hazardous products in a bin or between berms with the capacity to collect 110% of the stored reserve.
SOIL4	Use fuel transfer equipment equipped with automatic valves detecting leaks.
SOIL5	Divert the runoff water from the work areas, exposed soil and erodible slopes to stabilized facilities or locations, ensuring that it flows slowly on the surface. Runoff water in the work areas must be contained, sampled and treated, if required.
SOIL6	Contain heavy machinery traffic on preferred routes within the work area.
SOIL7	Avoid performing work in heavy rain periods to minimize leaching of soil and dispersion of sediments.
SOIL8	Proceed, as the work progresses, with cleaning of the site (removal of materials and provisional facilities, removal of waste and washwater to the authorized storage or disposal sites).
SOIL9	Reuse the excavated oil directly on the site as much as possible for backfilling and disposal of the excess soil offsite. These excess materials will be managed by the mine according to their usual process.
SOIL10	Take the necessary precautions during temporary storage of accidentally contaminated soil (as the case may be) to avoid contamination of the underlying and adjacent soil, by at least: (1) segregating the soils according to their contamination level and the stratigraphy observed; (2) storing the soil on an impermeable cover (geotextile) and covering it, or storing it in any other type of hermetic containment system. The covers must be fastened solidly to prevent them from being lifted by the wind.
SOIL11	The soils presenting signs of contamination must not be piled with soils not presenting these signs. They must be managed offsite according to the excavated contaminated soil management grid of the MELCC policy (disposal at a site authorized by the MELCC at a technical landfill site, as the case may be).
SOIL12	Avoid leaving soil stripped and exposed to atmospheric agents.
SOIL13	Restore the job site areas rapidly at the end of the work.
SOIL14	Report any spill with environmental consequences to the following authorities: Environment Canada Environmental Emergency Response (1-866-283-2333) and Urgence Environnement in Québec (1-866-694-5454); recover the contaminated materials, as applicable, and dispose of them with a company approved by the MELCC.
SOIL15	Take precautions to avoid any accidental spill near a hole during drilling and recover the escaped residual products, as applicable.
SOIL16	During earth moving in steep-sloped areas, stabilize the bottom of the ditches as the work proceeds, using well-drained granular materials, and proceed with rock ballasting.

Tableau 6-35 : Assessment of Impacts and Mitigation Measures for the Physical Environment (cont'd)

No.	Mitigation measures for the physical environment*
WATER1	The surplus concrete from the cement mixers and concrete pumps must be poured into a contained enclosure. The concrete residues must be managed with the construction waste.
WATER2	The wash water from the concrete mixers must be collected in a leakproof pond developed to avoid any flow into the environment.
WATER3	Dispose of excavated materials to limit the dispersion of suspended particulate matter as much as possible.
WATER4	During construction of access roads and wind turbine platforms, all the work located near a watercourse, a wetland or a site that could lead to significant runoff (steep slope) must be circumscribed (where required) with sediment barriers to avoid the transport of sediments via surface water. The sediment barriers must remain efficient during heavy rain periods.
HSR1	Reuse the stones removed during the grading work to stabilize the depression areas and ruts.

* AIR: air quality, SOIL: soil quality, WATER: water quality, HSR: hydraulic and sedimentary regime

Table 6-36: Assessment of Impacts and Mitigation Measures for the Biological Environment

Component	Development phase	Description of the impact	Mitigation measures	Importance of the residual impact
Flora of terrestrial environments and wetlands	Construction Operational Dismantling	Losses of area in terrestrial environments (9.08 ha) and wetlands (0.05 ha) and losses of ecological functions for the environments affected.	VEG1, VEG2, VEG3	Minor
		Risk of trampling of vegetation by personnel or machinery, deposit of dust on vegetation, and risk of contamination of neighbouring natural environments.	VEG1, VEG2, VEG3, AIR2, AIR6, SOIL1, SOIL2 and SOIL3	
Avian fauna	Construction Dismantling	Disturbance of avian fauna by noise, presence of machinery and workers.	VEG1, VEG2, AVF1	Minor
		Permanent loss of habitats due to development of infrastructures.	VEG1 to VEG3, AVF1	
	Operational	Risk of collision with wind turbine structures and blades **(see table footnote).**	AVF2 **(see note)**	
		Disturbance of avian wildlife by the presence of wind turbines, noise and vibrations and maintenance work.	VEG1, AVF2	
Caribou and other mammals	Construction Dismantling	Disturbance of several species, including caribou, by work noise. Possibility of injuring or killing an animal during road movements.	AIR6, VEG1, LAM1 to LAM4	Minor
	Operational	Disturbance of several species, including caribou, by wind turbine noise. Possibility of injuring or killing an animal during road movements.	AIR6, VEG1, LAM1 to LAM4	

No.	Mitigation measures for the biological environment*
VEG1	Prevent machinery traffic outside the limits of the work areas (except with special authorization).
VEG2	Protect the habitats on the edge of the work areas.
VEG3	Limit the extent of soil stripping to the strict minimum necessary during the work.
AVF1	Produce an inventory of the areas to be stripped 5 days before the work if the work must be performed between mid-May and the end of July, to ensure active nests are not destroyed. Follow the inventory protocol indicated in the *Plant life and wildlife protection plan* that will be submitted by CRI to the authorities for approval in 2022. The inventory will be produced by qualified personnel, particularly CRI environmental technicians and a biologist. If the presence of an active nest is noted, mark the location and protect it until flight (nesting species such as Snow Bunting) or departure of the nestlings (nesting species such as Willow Ptarmigan).
AVF2	Monitor the mortality of avian fauna and adjust the mitigation measures accordingly (e.g. schedule shutdown of wind turbines during the critical periods for birds).
LAM1	Sensitize the workers, particularly at the approach of the calving period, to the risks of disturbance for caribou and appropriate behaviours.

Tableau 6-36 : Assessment of Impacts and Mitigation Measures for the Biological Environment (cont'd)

No	Mitigation measures for the biological environment*
LAM2	Mobile equipment and vehicles must yield the right of way to wildlife such as caribou.
LAM3	Do not honk at caribou or adopt behaviour that would be stressful for them.
LAM4	Avoid any direct movement of equipment (including ATVs, snowmobiles or helicopters) and people toward caribou observed near work areas or access roads.
LAM5	In the event that a bat collision with a wind turbine is confirmed during the operational phase, the start-up protocol will be reviewed to increase their speed without jeopardizing the equipment.

* VEG: vegetation (flora), AVF: avian fauna, LAM: land mammals

Note: An avian fauna protection system was integrated into the wind turbines during the project design phase. This mitigation measure is therefore an integral part of the project and is not repeated in this list of mitigation measures. This system will allow programming of the wind turbines to protect avian fauna from collision risks, by defining conditions for which the wind turbines will be shut down (for example, according to certain weather conditions, during the birds' peak migration period or based on a known risk for avian fauna).

Table 6-37: Assessment of Impacts and Mitigation Measures for the Human Environment

Component	Development phase	Description of the impact	Mitigation measures	Importance of the residual impact
Economy and employment	Construction Operational Dismantling	Job creation and local, regional and provincial economic impacts.	ECO1, EC02, ECO3	Major (positive)
		Change in the lifestyle of Inuit employees.	ECO4	Minor
Inuit land use and occupancy	Construction Dismantling	Noise from work and heavy traffic. Temporary change in traffic on access roads. Visual impact of cranes used for wind turbine erection and dismantling. Marine transportation in Deception Bay.	LAU1 to LAU8 NOI1 to NOI3	Minor
	Operational	Visual impact of wind turbines (both negative and positive effect)	None	Medium
Non-Native land use and occupancy	Construction Dismantling	Possible slight increase in marine transportation in Deception Bay (possibility of 1 additional trip).	None	Minor
		Temporary change in traffic on access roads.	LAU9 LAU10	
		Slight increase in use of Kattiniq-Donaldson Airport.	None.	
		Disturbance of wildlife harvesting activities due to work noise.	NOI1 to NOI3 LAU11	
		Visual impact of cranes used in wind turbine erection and dismantling for users of Pingualuit National Park.	LAU11	
	Operational	Raising the minimum flying altitude at the airport approach.	None	
		Visual impact of wind turbines for users of Pingualuit National Park.	None	Medium
Archaeology	Construction Dismantling	Update of archaeological or historical vestiges during the work.	ARC1	Minor
	Operational	None	None	N.A.
Noise climate	Construction Dismantling	Noise disturbance due to the increase in the noise level during construction and dismantling work.	NOI1/AIR6 NOI2 NOI3	Minor
	Operational	Noise disturbance due to operation of wind turbines.	None	
Landscape	Construction Dismantling	Visibility of wind turbines on the valued principal and secondary sites.	None	Minor
	Operational	Visibility of wind turbines on the values sites of Lac du Bombardier and Lac Rocbrune (< 10 km distance)	None	Medium
		Visibility of wind turbines on the other valued sites (> 10 km distance)	None	Minor
		Nocturnal “light pollution” due to the presence of flashing beacons on the wind turbines.	None	Medium

Tableau 6-37: Assessment of Impacts and Mitigation Measures for the Human Environment (cont'd)

Nº	Mesures d'atténuation pour le milieu humain*
ECO1	Preferential hiring of Inuit workers.
ECO2	To award contracts during the construction, operational and dismantling phases, favour local businesses (in the Salluit and Kangiqsujuaq communities) or Nunavik-based businesses with the competence for the tasks requested in the call for tenders procedure, before making requests to companies based elsewhere in Québec or abroad.
ECO3	During the operational phase, favour hiring of a local Inuit worker (from the Kangiqsujuaq or Salluit community) or another Nunavik community to work on operation and maintenance of the proposed wind turbines.
ECO4	Integrate Inuit workers by explaining the different living conditions and rules on the NNiP site, and the different programs accessible. All of these measures are found in Schedule 7 of the Nunavik Nickel Agreement[A] (see measures MOE1 to MOE10 presented in Schedule 7 of this Agreement).
LAU1	Inform the populations and the landholding corporations of the villages of Salluit and Kangiqsujuaq about the extent and schedule of the projected work, and the potential dangers for the users during the construction, operational and dismantling phases. Maintain contact with the landholding corporations of the two villages during all the phases of the project to enable them to identify eventual problems concerning land use by people in their communities.
LAU2	During the construction and dismantling phases, install signs mentioning the presence of traffic lanes or work areas to inform the Inuit users who could travel or engage in activities in the sector.
LAU3	Maintain the accessibility of lakes and other portions of the territory used by the Salluit and Kangiqsujuaq Inuit users near the access roads and the work area during the construction and dismantling phases.
LAU4	In case traffic must be hindered temporarily or permanently on trails used by Inuit users, provide for bypass routes or new safe travel routes in concert with the Salluit and Kangiqsujuaq communities. Inform the population of the Salluit and Kangiqsujuaq communities of the path of these bypass routes or new travel routes.
LAU5	During all the construction, operational and dismantling phases, regularly inform the workers of the potential presence of Inuit users in the territory concerned, particularly along the access roads used.
LAU6	Comply with the mitigation measures concerning navigation in Deception Bay presented in Schedule 7 of the Nunavik Nickel Agreement[A] (see measures TRC2 to TRC10 presented in Schedule 7 of this agreement).
LAU7	Do not deploy measures facilitating sport fishing by the workers working during the construction, operational or dismantling phases of the proposed wind turbines.
LAU8	Comply with the prohibition of firearms possession imposed on the workers working on the CRI sites (except with a special authorization for protection against polar bears), with the goal of limiting the sport hunting activities practised by the workers working in the construction, operational or dismantling phases of the projected wind turbines.
LAU9	Inform the various users of the access roads taken (Glencore Canada, Canadian Royalties and Kattiniq Transport) of the number of heavy transport trips planned on these roads and their schedule during the construction and dismantling phases. Maintain contact with the different users throughout the construction and dismantling phases to enable them to identify eventual problems and ensure good coordination of the various trips made on the roads.
LAU10	During the construction and dismantling phases, install signs mentioning the presence of traffic lanes or work areas near the work to inform the mining company employees who could travel or engage in activities in the sector.
LAU11	Inform the management of Pingualuit National Park of the scope and schedule of the work planned during the construction and dismantling phases. Maintain contact with the park authorities throughout the construction, operational and dismantling phases to enable them to identify eventual problems and make the necessary corrections.

Tableau 6-37: Assessment of Impacts and Mitigation Measures for the Human Environment (cont'd)

Nº	Mesures d'atténuation pour le milieu humain*
NOI1	Conduct a preliminary and regular inspection of the machinery and equipment used to ensure their good conditions and good working order (not to generate excessive noise).
NOI2	Limit machinery traffic in the work areas.
NOI3	Isolate the main noise sources, if possible, with absorbent material during the construction and dismantling phases.
ARC1	If archaeological vestiges are discovered, the person responsible for the work will be notified immediately and measures will be taken to protect the site. After this, the Ministère de la Culture et des Communications du Québec (MCC) will have to be informed.

* ECO: economy and employment, LAU: land use, NOI: noise climate, ARC: archaeology

A: The Nunavik Nickel Agreement establishes the list of mitigation measures for which application was agreed between CRI and their Inuit partners in the context of development of the NNiP.

6.6 Cumulative Impacts

This section evaluates the wind energy project's contribution to the cumulative impacts on the valued components of the environment (VCE) of the territory concerned. The cumulative impacts are defined in general terms, such as changes suffered by the environment due to a combined action with other past, present and future actions. The cumulative impacts therefore result from the combined effects of this project and those arising from other activities (past, present or future) taking place in the territory concerned. These cumulative effects may occur over a certain time period and a certain distance from the project.

The assessment of the cumulative effects therefore involves:

- Identifying the VCEs to be considered in the analysis of the cumulative effects;
- Identifying and justifying the spatial and temporal limits of the analysis, based on the intrinsic characteristics of the VCEs and their distribution;
- Identifying the other past, present or future activities in the territory considered that may affect these same VCEs;
- Determining whether the effects of the project concerned on another VCE accrue with the effects of the other activities;
- Determining whether the combined effects of the project concerned and the other activities risk causing a current or future material change to the VCEs and whether additional mitigation measures should be deployed.

6.6.1 Identification of the VCEs Considered

The VCEs considered for the assessment of the cumulative impacts arise from the six environmental and social issues identified in section 1.6 of this report. These VCEs are as follows:

- Conservation and protection of wetlands and water environments;
- Protection of avian and terrestrial fauna;
- Land use by the Inuit communities;
- The landscape;
- Socioeconomic impacts;
- Reduction of greenhouse gas (GHG) emissions.

In the case of avian and terrestrial fauna, the species or species groups that are considered as VCEs for the analysis of the cumulative effects in the context of this study are those presenting an increased risk of disturbance or collision with wind turbines or road vehicles and those having special importance for Inuit subsistence activities. Thus the following species groups were selected for analysis:

- waterfowl (particularly snow goose and Canada goose),
- birds of prey,
- and caribou.

6.6.2 Identification and Justification of the Spatial and Temporal Limits of the Analysis

The spatial limits considered for this analysis are those of the extended study area, because all this territory is visited and used by the Inuit communities of the neighbouring villages (Salluit and Kangiqsujuaq). This territory is also visited by Leaf River Herd (TRAF) caribou and by several migratory bird species, such as snow goose and Canada goose, in different periods of the year.

Concerning the temporal limits of the analysis, given that the mining activities in the territory began in 1997 with the start of production of the Raglan Mine[37] and that this territory was previously very little developed, a period of 25 years is therefore considered for past activities. Concerning future activities, the anticipated period of operation of the CRI mineral deposit extends at least to 2032, according to the current information, but the mining activities eventually could extend beyond this period if the operation of the new mineral deposits were to be authorized in the territory in the future. For the purposes of this analysis, the lifecycle of the proposed wind turbines is considered as the time limit for the future activities, namely a maximum operating period of 25 years.

6.6.3 Identification of Past, Present and Future Activities That Could Affect the VCEs

6.6.3.1 Mining Activities

The main activity practised in the territory concerned by this project is undoubtedly mining activity. Two companies are active in the extended study area, Glencore Canada, which operates the Raglan Mine, and Canadian Royalties (CRI), which currently operates various mineral deposits in the territory of the NNiP and plans to develop others over the next few years. The mining activities particularly involve the deployment of infrastructure (industrial and mine sites, access roads, telecommunications towers, etc.) and operations for ore extraction and preliminary processing, energy production (diesel-powered generators, wind turbines at the Raglan Mine), heavy transportation on the territory's access roads, air transportation (via Kattiniq-Donaldson Airport) and marine transportation (via the port infrastructure of the two companies in Deception Bay). These are all factors likely to cause cumulative effects on the different VCEs considered in the course of this analysis.

6.6.3.2 Tourism Activities

Tourism activity is much less important than mining activity in the extended study area. It essentially takes place in Pingualuit National Park, which welcomes between 150 and 250 visitors a year, as mentioned in section 5.4. Tourism activities could contribute to the cumulative effects on some of the VCEs identified for this analysis.

6.6.4 Determination of the Cumulative Impacts on the Various VCEs

6.6.4.1 Conservation and Protection of Wetlands and Water Environments

The wetlands and water environments in Nunavik have considerable importance for avian fauna, particularly waterfowl, and for mammals, including caribou. During the design phase of this project, the route of the access road to be developed in the work area was optimized to minimize its encroachment on the wetlands and water environments as much as possible (see section 2.3 of this report). The project's planned encroachment on the wetlands is therefore very small, reaching only 0.05 ha (500 m^2). Moreover, no permanent watercourse will be directly affected by the performance of the work.

In comparison, the development and operation of the new mineral deposits planned by CRI in the extended study area over the next ten years, should translate into a loss of wetlands between 28.37 and 29.98 ha, depending on the variant that will be selected, for the Ivakkak UG (MFFP local office), Méquillon MFFP UG2, Nanaujaq UG and

[37] https://www.nrcan.gc.ca/science-data/science-research/earth-sciences/earth-sciences-resources/earth-sciences-federal-programs/raglan-mine-quebec/8814

Expo South projects (AECOM and CRI, 2022). This will be added to the losses of wetlands and water environments already incurred previously in the first development phases of the NNIP mining complex, or about 77 ha[38], which are also added to the losses generated by the development of the Raglan mining complex in the Kattiniq region.

The cumulative impact of the TUGLIQ wind energy project on the losses of wetlands and water environments (0.05 ha) thus can be considered negligible compared to the impacts attributable to the mining projects (past, present and future) in the extended study area (> 100 ha for the NNiP only). Thus, the cumulative impact of this wind energy project on the wetlands and water environments of the study area is considered **negligible, and even insignificant**.

6.6.4.2 Protection of Avian Fauna

As mentioned previously, the analysis of the cumulative effects on avian fauna is geared to the species groups presenting an increased risk of disturbance or collision with the wind turbines and/or having special importance for Inuit subsistence activities (waterfowl and birds of prey).

The Raglan Mine wind farm, located about 20 km northwest of the Expo site, contains two wind turbines identical to those planned for this project and which have been operated respectively since 2014 and 2018. However, the data available from the environmental follow-ups performed in 2015, 2016, 2017 and 2019 does not report any bird mortality for this wind farm according to the carcass searches conducted in the course of these follow-ups (Glencore Canada, 2016; 2017, 2018; 2020).

Moreover, the peripheral environment of the site planned for implementation of the proposed wind turbines is already a disturbed and noisy environment due to the various mining and industrial activities carried on in the local study area (NNiP and Raglan Mine). Truck and machinery traffic is very present in the territory and this situation will increase even further over the next ten years with the development and operation of the new mineral deposits planned by CRI in the local study area (Ivakkak UG, Méquillon UG2, Nanaujaq UG and Expo South projects). However, the importance of the residual impact on avian fauna caused by the development of these new mineral deposits is considered minor due to the fact that birds are mobile animals capable of temporarily avoiding the disturbance areas (AECOM and CRI, 2022). In addition, birds can easily use untouched replacement habitats near the sites impacted by the mining activities, due to the low bird densities observed and the great availability of similar habitats in the Nunavik regional landscape (AECOM and CRI, 2022).

The knowledge derived from Inuit traditional knowledge and land use also provides important information on the impacts observed on avian fauna in the study area. The President of Nunaturlik Landholding Corporation of Kangiqsujuaq, Mr. Lukasi Pilurtuut, particularly mentioned that he has not noticed notable changes in the population sizes, behaviour or nesting areas of birds of prey and waterfowl in the past decade, except for the greater abundance of snow geese and snowy owls in the Kattiniq region; this situation has been observable for about 7 to 10 years. These observations tend to show that the mining and wind energy activities practised in Kattiniq's territory do not seem to have adversely affected avian fauna and that some species, such as snow goose and snowy owl, could even be more abundant in this territory than what was previously observed.

This knowledge derived from Inuit traditional knowledge therefore substantiates the impact assessment done in the context of this wind energy project, and in the course of the development projects of new mineral deposits planned by CRI in the extended study area (Ivakkak UG, Méquillon UG2, Nanaujaq UG and Expo South projects), namely that the residual impact of the various mining and wind energy projects on avian fauna is considered low intensity and of minor importance. Cumulatively, even adding the effects of each mining and wind energy project in the region, the cumulative impact remains low intensity and of minor importance, because these projects do not call into question the integrity of the bird populations concerned in the territory and do not affect the abundance and distribution of the bird species concerned.

Thus, the cumulative impact of this wind energy project on avian fauna in the study area is considered **minor**.

[38] C. Cossette, AECOM, 2022

6.6.4.3 Protection of Terrestrial Fauna

The Leaf River Herd (LRH) caribou are subject to several disturbing factors throughout their territory during their migratory cycle, particularly the following factors:

- Development of road networks and road traffic, particularly for mining activities;
- Increase in the number of predators;
- Climate change;
- Diseases and parasites;
- Availability of food;
- Increase in mineral exploration and mining in the North;
- Hunting;
- Hydroelectric and wind energy development.

Concerning climate change, several studies point out that it can alter the caribou distribution patterns in northern environments and affect their survival due to the greater predation pressure that may occur. At the present time, the main caribou predators continue to be wolves and black bears (COSEWIC, 2017). It is currently assumed that climate change could considerably reduce the ecological niche of migratory caribou, including the LRH, over the next few decades (Yannic et al. 2014 in Plante, 2020), and thus lead to an additive effect of habitat loss associated with anthropogenic development. This further even more greatly justifies the necessity to apply the mitigation measures mentioned in this impact assessment, because they could lead to better resilience of the herd to climate change (Bauduin et al. 2018 in Plante, 2020).

The increase in exploration and mining of mineral resources in the northern regions increasingly contributes to fragmentation of caribou migration routes, which could result in longer trips during migration and thus cause a greater energy expenditure for access to food resources. The COSEWIC also pointed out that the current global impact of the threats is considered “very high to high” in the case of the Eastern migratory population, which includes the LRH, due to the addition of factors adversely affecting caribou. These main adverse factors would be mining operations and the roads associated with this activity (increases access to hunting territories and the risks of disturbance and collisions), the increase in fires and the alteration of vegetation associated with climate change.

Parasites are frequent in caribou and can even affect their fertility. According to the forecasts, climate change will probably alter certain host-parasite relationships (COSEWIC, 2017), which could cause additional effects on the LRH caribou population.

Concerning hunting by Inuit, no particular problem is envisioned because, since 2018, caribou hunting has been prohibited for non-Natives. Hunting is now performed only for the Inuit subsistence diet.

These different effects, taken separately, have more or less significant impacts on caribou, but cumulative with each other, they may result in significant impacts on the population size of the LRH and its geographic distribution. Figures 5-11 to 5-14, presented in section 5.3.8 of this study, tend to show that few caribou seem to have visited Kattiniq region over the past few years (2018 to 2021), compared to the migration routes more abundantly used west and east of this territory, which suggests that the mining activities in the study area (Raglan Mine and NNiP) would have a relatively significant cumulative impact on the distribution of this species.

Compared to the impacts attributable to the mining projects (past, present and future) in the extended study area, the additional impact on caribou attributable to the TUGLIQ wind energy project thus can be considered minor, and even insignificant. Indeed, given the significant disturbance already caused by the current mining activities, it is unlikely that the construction and operation of the two proposed wind turbines will induce additional significant behavioural changes, because the vast majority of caribou already avoid the study area.

Thus, the cumulative impact of this wind energy project on caribou in the study area is considered **minor.**

6.6.4.4 Inuit Land Use

Mining activity has had the effects of limiting the extent of the territory used by the people of Salluit and Kangiqsujuaq,[39] in addition to causing certain annoyances for users travelling near the mine sites (noise, odours of diesel fumes, alteration of the landscape). This limitation of use could increase in scope with the projected expansion of CRI mining activities over the next 10 years in the territory covered by the NNiP (Ivakkak UG, Méquillon UG2, Nanaujaq UG and Expo South projects).

On the other hand, mining activity has indirectly facilitated access to certain portions of the territory for the people of Salluit, who can now benefit from an access road to travel between Deception Bay and the vicinity of Lac Duquet and Lac Françoys-Malherbe. Tourism activity has contributed to facilitate visitation of the territory by Kangiqsujuaq users. This has been done, in particular, by the creation of a winter access corridor between the northern village of Kangiqsujuaq and Pingualuit National Park, but also thanks to the construction and regular maintenance of camps serving both the park visitors and the people of Kangiqsujuaq.

This project will have no effect on the extent of the territory visited by the people of Salluit and Kangiqsujuaq, because it will be implemented in a sector that is already no longer accessible due to the nearby mining activities (Expo site). In fact, the only impact of the presence of the wind turbines on Inuit land use will be visual. The two wind turbines will contrast with the natural appearance of the ambient landscape, which could be perceived negatively by some users. However, the presence of wind turbines could also present advantages, because they may serve as reference points for people travelling in the territory, as is already the case for the two wind turbines currently operated by TUGLIQ at the Raglan Mine.

Thus, the cumulative impact of this project on Inuit land use in the study area is considered **minor.**

6.6.4.5 Landscape

Mining activities already have a significant impact on the region's landscape, whether by the development and operation of the various mine sites, or by construction of roads, port infrastructure, an airport, various buildings, telecommunications towers and wind turbines (wind farm operated at the Raglan Mine). These impacts on the landscape could also increase in scope with the projected expansion of CRI mining activities over the next 10 years in the territory covered by the NNiP (Ivakkak UG, Méquillon UG2, Nanaujaq UG and Expo South projects).

Tourism activity has had a minor impact on the landscape. This is essentially related to the creation of hiking trails, construction of camps, temporary shelters and reception buildings in Pingaluit National Park, and the deployment of a winter access corridor between the park and the northern village of Kangiqsujuaq.

This project will contribute to amplify the impact on the landscape, because the two wind turbines will clash with the region's natural appearance. Moreover, the lights produced by the flashing beacons installed on the two structures will have a notable effect on the light pollution felt by the users of Pingualuit National Park, particularly during the night.

Consequently, the cumulative impact of this project on the landscape in the study area is considered of **medium** importance.

[39] Use of most of the roads developed by the mining companies is prohibited and it is also prohibited to approach within a certain distance of the mining facilities.

6.6.4.6 Socioeconomic Impacts

Over the past 25 years, mining activity has generated many jobs in the local communities and in the region, in addition to offering business opportunities for certain companies, including Transport Kattiniq Inc. and Nunavik Construction. In addition, Glencore Canada and CRI pay royalties to the northern villages of Salluit and Kangiqsujuaq. Parallel to this, Pingualuit National Park also employs people from the Kangiqsujuaq community on permanent, temporary or casual basis.

This project will make it possible to offer new business opportunities to local and regional companies, consolidate or create jobs for these companies, particularly during the construction phase, and possibly allow training and employment of a person from the local communities in the operational phase.

Thus, the cumulative impact on employment and the economy of the local and regional communities is considered **major and positive**.

6.6.4.7 Reduction of Greenhouse Gas (GHG) Emissions

Carrying out the project as a whole (construction, operational and dismantling phases) will generate GHG emissions estimated at a total of 327 tonnes of CO_2 equivalent (see Table 3-9 in section 3.4 of this study).

On the other hand, the implementation of this wind farm with two wind turbines will allow elimination of consumption of more than 5 million litres of diesel on an annual basis and thus avoid annual emissions of 14,096 tonnes of CO_2 equivalent, for an annual reduction of 10.5% of the current GHG emissions of the CRI mining complex. Over a 25-year lifecycle of these wind turbines, this represents an overall reduction of GHG emissions of more than 350,000 tonnes of CO_2 equivalent.

This reduction of GHG emissions is added to the reductions already effective at the Raglan Mine, where two identical wind turbines have already been operated by TUGLIQ for a few years. Thus, combining the effects of these two wind farms, this will represent a reduction of more than 28,000 tonnes of CO_2 equivalent per year in the territory or about 700,000 tonnes over a 25-year lifecycle.

To this could be added the eventual subsequent wind farm expansion phases that TUGLIQ could carry out in the next few years, both at the Raglan Mine (possibility of 3 additional wind turbines) and at the Expo mine site (possibility of 2 additional wind turbines), which would allow at least the doubling of the GHG reductions anticipated in the future. Consequently, the resulting cumulative impact is **major and positive** and could continue to multiply in the future with the eventual deployment of new wind turbines in the territory of Nunavik, which will be extremely beneficial in the context of the fight against climate change.

6.6.4.8 Balance of the Wind Farm Project's Cumulative Impacts on VCEs

Table 6-38 presents the balance of this project's cumulative impacts on the VCEs of the territory concerned. Comprehensively, the overall cumulative adverse impacts are considered **minor**, except for the cumulative impacts on the landscape, which are considered of **medium** importance. Moreover, **positive and major** cumulative impacts are expected on the employment and economy of hte local and regional communities, and on the reduction of GHG emissions.

Table 6-38: Balance of the Wind Farm Project's Cumulative Impacts on VCEs in the Extended Study Area

Valued component of the environment (VCE)	Importance of the cumulative impact of the wind farm project
Wetlands and water environments	Negligible, and even insignificant
Avian fauna	Minor
Terrestrial fauna	Minor
Land use by Inuit communities	Minor
Landscape	Medium
Socioeconomic impacts	Positive and major
Greenhouse gas (GHG) emissions	Positive and major

7 Accident Risk Management and Preliminary Emergency Preparedness Plan

For TUGLIQ Energy, occupational health, safety and wellness and environmental protection are essential principles for an efficient and healthy work environment. TUGLIQ therefore undertakes to promote a corporate culture in this direction and to require compliance with the laws, standards, regulations and good practices applicable in the matter.

Thus, TUGLIQ Energy undertakes to:

- promote a healthy and safe work environment for everyone, including its employees, contractors, partners, collaborators and customers, but also including any stakeholder (communities, ecosystems, etc.);
- involve its employees and contractors in the processes related to occupational health and safety;
- comply with any applicable regulations pertaining to occupational health and safety and protection of the environment and ecosystems;
- excel in identifying the risks (operational or other) and apply preventive and mitigation measures to maintain a safe environment for all;
- work continuously to improve and update its internal processes in risk management, occupational health and safety and OHS documentation;
- keep currently informed on legislative, regulatory and normative updates in occupational health and safety and environmental protection.

The emergency preparedness plan, provided in Appendix M, is the one currently in place for operation of the wind turbines at the Raglan Mine. It will be adapted in the context of construction of the wind farm at the Expo site and will be effective from the beginning of construction of the project. It will be reviewed annually and, as needed, reassessed after an intervention. Canadian Royalties Inc. will ensure that employees and subcontractors comply with said plan. The following actions are an integral part thereof:

- protection of the population, Canadian Royalties Inc. personnel, the property and the environment against the impacts that potentially may be caused by a failure of the wind farms, by the establishment and application of the emergency preparedness plan;
- identification, through clear signage, of the location of the wind turbines and the substations, in order to limit the accident risks;
- compliance with the occupational health and safety standards (appropriate training of workers for risky work, mobile communications systems, working in two-person teams as needed, etc.);
- emergency response training provided to wind farm subcontractors and operators, during the three (3) phases of the project, to be able to respond in the event of a failure or an accident;
- good communication with the media and the general public to ensure protection of the personnel, the population and the environment in case of emergency.

It is important to specify that the emergency preparedness plan shared in Appendix M, specific to the Raglan wind farm project, concern a hydrogen storage system, a technology that will not be used at the Expo mining complex. However, the approaches to follow in case of emergency on the wind turbines or the lithium-ion battery storage system are similar.

For TUGLIQ, health, safety and protection of the environment and the stakeholders are absolute priorities on which no compromise is acceptable. Operational excellence therefore depends on excellence in occupational health and safety. TUGLIQ Energy's emergency preparedness plan is part of this mindset: it identifies the steps and approaches to be performed in case of emergency, so as to minimize the impacts of such a situation and rectify the situation as soon as possible, in order to ensure business continuity.

8 Environmental Surveillance and Monitoring Program

8.1 Environmental Surveillance

Environmental surveillance pursued during project realisation will consist of ensuring that environmental commitments and obligations are respected. The aim is to verify the integration of the proposed attenuation measures and TUGLIQ's commitments to the project and to ensure that laws, regulations, and other environmental edicts from the various governmental authorities are respected. This will be applied to current plans and specifications as well as to subcontractors.

One of the surveillance program activities will be to ensure that all required authorizations and permits for the realisation of the project are completed and that all authorizations and permits are received before starting work on a site.

Site meetings will be organized before the start of each of the major stages of project construction. Copies of the authorizations and permits will be given to site managers to ensure that work will respect the provisions of the environmental authorities. These meetings will also inform and provide site awareness to workers regarding environmental and safety provisions that will need to be respected throughout the work and the overall operation of surveillance activities. Furthermore, to ensure that approved attenuation measures are applied during work on the project, mandatory work site training will take place before and during operations to ensure that site workers understand environmental and security requirements. Finally, weekly meetings will take place during operations to identify specific problems and formulate appropriate solutions.

TUGLIQ will be responsible for environmental surveillance which will be realized in collaboration with CRI's Environmental Service. Attenuation measures will be rigorously applied during operations. Generally, the environmental surveillance monitor will regularly visit work sites and take note of the rigorous application of the commitments, obligations, attenuation measures, and other prescriptions from the participants. He will also evaluate the quality and efficacy of the applied measures and note all observed non-conformities. He will ensure the efficacy of the measures and, when needed, inform managers and propose alternative protection measures. An environmental surveillance form will allow site monitors to follow the application of attenuation measures. All incidents will be noted on this form and the monitor will indicate the following information:

- The nature of the incident
- Applied interventions
- The efficacy of the interventions. A follow-up will be done in the days after the application of corrective interventions

During construction, a weekly surveillance report will be prepared which will include photographs to facilitate comprehension of the observed non-conformities and the corrective measures applied. Weekly, or when required by non-conformities, surveillance forms will be handed over to the site monitor. These reports can be posted on the company's website for consultation by people from the communities. At the end of operations, a report will be transmitted to the concerned authorities.

"As built" plans will be prepared and transmitted as needed to regional and provincial authorities once operations are completed as well as realized end-of-life (dismantlement phase) restoration plans.

8.2 Environmental monitoring

The goal of the environmental monitoring program proposed by the promoter is to verify the accuracy of certain impact assessments and the efficacy of intended attenuation measures in this impact study. The current program also aims to better evaluate impacts for which uncertainty still exists, primarily regarding the use of the proposed wind turbine site by peregrine falcons during nesting and feeding activities as well as by other birds of prey during spring and fall migrations. All monitoring results will be compiled in an environmental monitoring report that will be made accessible to Inuit communities on the company's website.

An active peregrine falcon nest was confirmed approximately 16km from the nearest wind turbine for the present project. Wind turbine projects subject to the process for environmental impact assessment and evaluation must perform a telemetry survey if nesting falcons are present inside of a 20km radius according to MFFP protocols (MRNF, 2008). This protocol also requires an evaluation of the migration of birds of prey in the spring and fall. Given that the delays for the current impact assessment didn't allow the realization of these inventories before the submission of the report, it was agreed to delay these studies during the environmental monitoring phase of the project. The monitoring program presented below aims to reduce as close to zero as possible avian mortality associated with the project.

It should be noted that the environmental monitoring done since 2015 at Raglan's wind turbines has reported no avian mortalities (Glencore Canada, 2016; 2017, 2018; 2020) and that this wind farm is identical to the one proposed in this study and that it is located approximately 20 km north-west in similar avian migratory corridors. Furthermore, inventories of nest sites for birds of prey for Raglan revealed the presence of a peregrine falcon nest at the limit of the 20 km radius of the wind farm (SNC-Lavalin, 2008).

8.2.1 Monitoring of avian fauna

8.2.1.1 Telemetry monitoring of peregrine falcons

TUGLIQ is committed to providing the funds required by the MFFP to perform telemetry monitoring of a peregrine falcon nesting in the cliffs located approximately 16 km south of the proposed wind farm. This monitoring will provide knowledge regarding this species' home range since it is designated a vulnerable species. This species has however obtained an S4 ranking during the most recent evaluation of its status, indicating that it is considered abundant and not in danger, but that conservation issues remain (Dumas et coll., 2022).

Therefore, the MFFP will communicate as soon as possible with TUGLIQ to discuss planning and deployment to capture a falcon in proximity to the nesting site identified in the current study. They will install an emitter to identify the most frequented flight corridors around the proposed wind farm and if the operation of the wind farm should be modified based on environmental usage by the falcon.

8.2.1.2 Supplemental monitoring of the spring and fall migration

In the fall of 2022, the first inventory of the fall migration for birds of prey and waterfowl was done in the sector using a modified MRNF (2008) protocol. A collaboration was established with technical staff from CRI's Environmental Service to maximise observation time in the sector where conditions are not always favorable. Specialists at the MFFP could not validate this protocol before deployment of the field teams because of the too short delay available and the required responsiveness of the group to reach the site. Many tests of observations and methods were done in the field to propose protocols adapted to the northern latitudes and to monitor all of the fall migration period.

Therefore, to complete the description of the environment started in the fall of 2022, monitoring of the migration of birds of prey and waterfowl will also be done in the spring and fall of 2023. This monitoring will require discussion beforehand with the MFFP to agree on the best procedures to adequately document environmental use during the migration of avian fauna. Adapting the MFFP (2008) protocols to northern latitudes will be required for this project since they were designed with southern regions in mind.

8.2.2 Monitoring of bird mortality

Regarding wind farm projects, the MELCC has minimal requirements for the monitoring of bird and chiropteran mortality during the operation of the projects (MDDEFP, 2013). However, given the absence of chiropterans at the study site, no monitoring of bat mortality around the site is proposed. If observations of chiropterans were confirmed near the site, or if carcasses are catalogued during bird mortality monitoring, bat monitoring will then be put into place.

Monitoring specific to bird mortality aims to evaluate the number and species of birds potentially killed by the presence or operation of wind turbines. This monitoring must cover the entirety of the period for which birds are active around the site.

8.2.2.1 Monitoring program by carcass searches

To evaluate mortality rates, four factors will be considered:

- The number of carcasses found near the wind turbines
- The persistence of the carcasses on the ground (number of days)
- Efficacy of the observers to detect carcasses (in %)
- Portion of the parcel inventoried (in %)

This monitoring will be performed alternately by technicians from Canadian Royalties and TUGLIQ, depending on their presence on the site. The detailed monitoring program will be submitted to the MFFP for approval before monitoring starts. The following paragraphs present the broad lines of the monitoring specific to avian mortality.

As indicated in the *Protocole de suivi des mortalités d'oiseaux et de chiroptères dans le cadre de projets d'implantation d'éoliennes au Québec* (MDDEFP, 2013), both wind turbines will be part of the monitoring program. The monitoring will be done during the first three years of operation of the wind farm and afterward every 10 years, unless a problem is identified causing the monitoring to be done at shorter intervals.

<u>Carcass Searches</u>

The search for carcasses will be done during three periods, namely the spring and fall migrations and the nesting period, for all species present in Nunavik. Figure 8-1 shows the proposed calendar for carcass searches. Note that all bird carcasses found outside of these periods and/or outside the described parcels will be compiled in the same manner.

Table 8-1: Calendrier de recherche de carcasses d'oiseau

Week	April				May				June				July				August				September				October			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Birds of prey																												
Migrating birds																												

Note: Dates in green indicate a search during the spring migration, dates in grey during nesting, and dates in blue during the fall migration.

For the carcass searches, it is recommended in the protocol to examine a parcel that is 80 m square, centered on the turbine (MDDEFP, 2013), which corresponds to the proposed dimensions of the platforms. Given the strong predominant winds from the west, northwest, and southwest, we propose to extend the width of the parcel eastwards to 80 m instead of 40 m from the center of the turbine. This will only be done to the east of the turbine. This is proposed to prevent the missing carcasses that could be carried outside the standard parcel by strong winds.

Carcass searches will be done using transects 5 m apart, visually inspecting approximately 2.5 m to each side of the transect, in such a way as to cover the entire parcel. Search time should be about 75 minutes per parcel for a single observer. However, given security rules in Nunavik because of the potential presence of predators, namely polar bears, two observers will always be present. As such, the parcel will be examined more rapidly. The search for carcasses will be done during periods of migration and nesting at a frequency determined in concert with specialists from the MFFP. When a carcass is observed the following information will be noted:

- Name of the observer
- A photograph of the carcass
- Identification with a reference number
- Identification of the species, age (growth stage), and sex where possible
- Potential cause of mortality
- Condition of the carcass according to three categories (intact, partially deteriorated, or deteriorated)
- Date and time of the discovery
- Number of the turbine
- Distance of the carcass perpendicular to the transect, azimuth, and distance from the turbine
- GPS coordinates
- Vegetation coverage according to the annex of the mortality monitoring protocol (MDDEFP, 2013)

On the carcass search form, the meteorological conditions will also be noted as well as the percentage of the parcel inventoried. Normally, the percentage should always be 100%. The discovery of a dead or wounded bird of prey will be declared to a game warden by communicating with SOS BRACONNAGE at 1-800-463-2191. Discovery of a dead or wounded species that is, or is susceptible of being, designated threatened or vulnerable will be declared to the regional MFFP office by email within 24 hours. The carcass will then be frozen.

Test of persistence on the ground

A test persistence to determine the average number of days a carcass remains in the parcel will be done every three months according to the indications of the protocol. This test will be adapted to the realities of Nordic environments since the collection of carcasses is not easy in such remote locations. A modification of the established MDDEFP (2013) protocol is therefore envisaged.

Test of the efficacy of the observers

A test of the efficacy of the observers when searching for carcasses will be done every two months during the periods indicated in Figure 8-1. This test, done without the knowledge of the observers, aims to verify the capacity of the observers to find objects (carcasses) in the natural environment during the visits of the parcels.

As such, with the tests of persistence and observation efficacy, it is possible to modify the frequency of the monitoring by bringing them closer together or by applying a correction factor to the number of carcasses found.

8.2.2.2 Adapting the avian fauna protection system as a function of the monitoring results

The results of the avian fauna monitoring will allow rapid adjustments to the operation of the wind turbines if a particular problem is observed for birds. Indeed, the wind turbines will be equipped with a system to protect avian fauna limiting mortalities caused by collisions, thanks to sensors integrated into the blades.

If a carcass of a protected species is found (peregrine falcon or bald eagle) during the monitoring, discussions will rapidly be undertaken with the MFFP, and actions will be taken by TUGLIQ to program a stoppage of the wind turbines should this be needed. The objective is to cause the least mortalities possible to avian fauna, in particular to protected species.

8.2.3 Monitoring of site use by fauna

A few questions were raised during public consultations regarding the effects on birds and fauna. Monitoring of bird mortality is detailed in the preceding point (8.2.2). Concerning the use of the environment by fauna, four site visits have been proposed during the first year of operation of the wind farm to determine the use by fauna (feces, regurgitated pellets, browsing, direct observations) and to document the behaviour of animals related to the presence of the wind farm. The results will be compared to observations made during inventories in 2022. The results will be discussed with the MFFP and a decision about the frequency of this monitoring will be made by the latter.

8.2.4 Monitoring of changes in greenhouse gases

An annual assessment of GHG emissions produced by the construction, operation, and dismantling of the wind farm will be produced by TUGLIQ. This assessment will present, during operation, the green energy produced by the wind farm in relation to the GHGs produced by the mining complex and the quantity of GHGs removed from the northern environment during their operation.

8.2.5 Monitoring of light pollution and visual impacts

A monitoring program for light pollution is already in place within the environmental monitoring activities undertaken by CRI in the context of the exploitation of mine sites of the NNiP. It aims to determine the impact of light pollution created by mining activities within Pingualuit National Parc. The impact of adding two wind turbines on light pollution will therefore be integrated into the existing monitoring activities. It could furthermore be improved to include multiple viewpoints within Pingualuit National Parc and document the visual impacts of the project both during the day and at night.

8.3 Sharing of information with local communities

The consultations with representatives of the communities of Salluit and Kangiqsujuaq demonstrated that they wished to be informed of the results of the different monitoring studies that could be done in the context of the current project. In response to this request, TUGLIQ will transmit the results of the different environmental surveillance activities associated with the construction phase and the environmental monitoring associated with exploitation to the elected officials of the two northern villages, as well as to representatives of the respective landholding corporations. At the same time, each of the local representatives will be invited to transmit comments, questions, or preoccupations to TUGLIQ.

Further, as mentioned before, the surveillance and environmental monitoring reports will be made accessible to the Inuit communities on the company’s website.

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