CREE DEVELOPMENT CORPORATION

LA GRANDE ALLIANCE

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PRE-FEASIBILITY STUDY – PHASES II & III – TRANSPORTATION INFRASTRUCTURE

REPORT NO.2 - SOCIO-ENVIRONMENTAL SURVEY

Final Version

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MAAMUU

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REPORT NO.2 - SOCIO-ENVIRONMENTAL SURVEY

PRESENTED TO:

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1 INTRODUCTION & CONTEXT

1.1 LA GRANDE ALLIANCE

La Grande Alliance refers to the *Memorandum of Understanding (MOU) on the Cree-Québec Sustainable Infrastructure Program in Eeyou Istchee Baie-James*, signed between the Cree Nation Government (CNG) and the Government of Québec on February 17, 2020. The purpose of the MOU is to provide a framework for Cree local and regional entities to work closely with relevant Québec government ministries to connect, develop and protect the territory of the Eeyou Istchee Baie-James region of northern Québec in an inclusive and participatory manner. The main objective of La Grande Alliance is to build a promising program for the strategic, predictable, and sustainable development of the territory over a 30-year time horizon.

La Grande Alliance consists of four avenues of future development – transportation infrastructure, communication, electrification, and protection – to devise a roadmap that takes into consideration innovative economic and technical opportunities and/or constraints, as defined by communities, land users and other relevant groups.

The Eeyou Istchee Baie-James region is rich in natural resources. However, historical development of these resources has resulted in projects often thrusted upon Indigenous and non-Indigenous communities alike, for whom the only option was to react. This scenario makes land use planning very challenging for communities and government officials, strategic transportation or energy infrastructure planning ambiguous for public services and government ministries, and investment by promoters of development projects risky and uncertain.

The link between transportation, communication and energy infrastructure and the potential for development is undeniable. The key, however, is to ensure that such infrastructure does not occur in environmentally or culturally sensitive areas. This is essential to avoid potential conflicts between development and the communities where this infrastructure is proposed to be built. Conversely, providing communities with the opportunity to contribute to the conception, planning, deliberation and evaluation of infrastructure, hand in hand with protection of some natural areas, has the potential for shaping the territory in an empowering way that brings long-term predictability to the region. In turn, this allows communities to plan their growth more easily, resources for protecting environment and wildlife to be deployed more efficiently, land use planners to work with more certainty, and investment by promoters and developers to be more secure.

The following report deals specifically with the transportation infrastructure component envisioned through the MOU.

1.1.1 THE CLIENT – CREE DEVELOPMENT CORPORATION

In conformity with the MOU, the CNG has mandated the Cree Development Corporation (CDC) to conduct a series of studies to examine the economic, technical, and socio-environmental aspects of a series of proposed large transportation infrastructures envisioned over three phases spread over 30 years.

The CDC is the modernization of the James Bay Native Development Corporation, created through the *James Bay and Northern Québec Agreement* (JBNQA) to "assist, promote and encourage the creation, diversification or development of businesses, resources, properties and industries within the territory with a view to stimulating maximum economic opportunities for Cree people and contributing to their general economic well-being". Following the signature of La Grande Alliance MOU, the CNG mandated the CDC to carry out the Infrastructure Studies, part of which are the subject of this report.

1.1.2 PRECURSORS TO LA GRANDE ALLIANCE

The Agreements presented below allow the reader to better situate the MOU within the current legal framework in place in the region.

THE JAMES BAY AND NORTHERN QUÉBEC AGREEMENT

The JBNQA was signed on November 11, 1975, by the Government of Québec, the Government of Canada, Hydro-Québec, the Grand Council of the Crees of Québec and the Northern Québec Inuit Association. Described by many as the "first modern treaty", the JBNQA created a new legal and, eventually, constitutional framework for, among other things, local self-governance, land management, protection of the traditional Cree way of life as well as for the relationship between Québec and the Indigenous peoples of the James Bay and Northern Québec region. It was the foundation on which Crees laid over 80 subsequent agreements, regarding Cree rights, communities' self-governance and subsequent development of the territory.

THE PAIX DES BRAVES

The *Agreement respecting a new relationship between the Cree Nation and the Government of* Québec (better known and herein referred to as *Paix des Braves),* signed in February 2002 is a Nation-to-Nation Agreement between the Government of Québec and the Crees of Québec. The Agreement is not meant to replace the JBNQA, but rather to build a "development model based on the principles of sustainable development, partnership and respect for the traditional way of life of the Crees, as well as on a long-term economic development strategy, principles which are in conformity with (its) provisions." The Agreement includes specific modalities with regards to mining, forestry, and hydroelectric development on the territory, seen as the three sectors driving the regional economy at the time of signing. Furthermore, the Agreement is meant to provide greater autonomy to the Crees in the manner in which communities will develop in the future. Henceforth, development occurring on Cree traditional lands requires meaningful participation of the Crees at multiple levels, as well as benefit sharing frameworks that see Crees as more than simple stakeholders.

OTHER GOVERNMENT POLICIES

In addition to the Agreements presented above, the Northern Action Plan, proposed by the Government of Québec in May 2011, is a 25-year economic development program for the northern regions of Québec based on "sustainable development" which is intended to focus on the construction of transportation infrastructure, mining, and the development of renewable energy projects.

1.2 TRANSPORTATION INFRASTRUCTURE STUDY

The following components were the initial transportation infrastructures considered as part of the studies:

PHASE I (1-5 YEARS)[1] (THE PHASE I IS STUDIED BY OTHERS)

- **Roadway: Upgrading and paving of the community access roads** for Waskaganish, Eastmain, Wemindji and Nemaska.
- **Railway: Matagami to Rupert**

  A proposed railway line following, as much as possible, the Billy-Diamond Highway (BDH) starting from the town of Matagami to the km 257 of the BDH (Rupert River Bridge).
- **Railway: Grevet to Chapais**

  A return to service for the decommissioned railway line between Grevet (Lebel-sur-Quévillon) and Chapais (approximate distance of 147 km).

PHASE II (6-15 YEARS)

- **Railway: Rupert to La Grande**

  A proposed railway alignment following, as much as possible, that of the Billy-Diamond Highway (BDH) starting at km 257 (after the Rupert River Bridge, which is the junction point with the railway alignment developed by the Phase I consultant) all the way to La Grande River. The Phase II railway alignment extends over an approximate distance of 340 km.
- **Route 167: upgrading & extension to the Trans-Taiga Road**

  Upgrading and paving of the section from the Mistissini community access road to the Stornoway Renard Mine access road over an approximate distance of 204 km;

  Extension towards north to connect with the Trans-Taiga Road near km 408, over an approximate distance of 172 km.
- **Road: La Grande to Whapmagoostui/Kuujjuarapik**

  A proposed road corridor connecting Chisasibi community access road and Whapmagoostui/Kuujjuarapik, over an approximate distance of 207 km.

PHASE III (16-30 YEARS)

- **Railway: La Grande to Whapmagoostui/Kuujjuarapik**

  A railway which follows, as much as possible, the projected road leading to Whapmagoostui/Kuujjuarapik (from the junction with the Phase II railway alignment). The Phase III railway alignment extends over an approximate distance of 219 km.
- **Port at Whapmagoostui/Kuujjuarapik**

  A deep-water port along the Kuujjuarapik coastline between the Great Whale River's mouth and the entrance of the Manitounuk Strait.

[1] All dates indicated herein are hypothetical and would begin as of the start of the construction period. This therefore does not include all pre-project phases, most notably the Environmental and Social Impact Assessment that would be required if the infrastructures are pursued.

1.2.1 STUDY VISION AND APPROACH

The studies found herein have put **local communities at the centre of the transportation infrastructure development process. This way of working, initially proposed by the CDC, strives to shift the dominant paradigm away from natural resources as the main lever of development, towards community development. Natural resource development remains a vital element to this equation but is no longer the sole driver. In this sense, La Grande Alliance goes beyond a standard regional transportation plan but rather proposes a new model** for how the Cree and the Jamesian populations can work together to sustainably develop the existing network, thereby allowing the movement of natural resources in a manner that promotes the betterment of all.

The Feasibility Studies attempt to seek out and understand ways in which the proposed transportation infrastructures can improve the communities' quality of life. Transportation corridors are explored with the utmost respect for the land, its inhabitants, and Cree heritage. In this sense, the study fully embraces the concept of sustainable development, such that the infrastructures under study can only proceed if they are feasible from a technical, environmental, and economic perspective. Furthermore, it is understood that, to proceed, the proposed infrastructures will require the social acceptability of all communities in the region.

The Client's requirement to involve Cree and Jamesian communities at such an early stage of development reflects their requirement that local stakeholders be actively involved in the planning and management of land and economic development in Eeyou Istchee. The organization understands that Eeyou Istchee is extremely rich in natural resources, but firmly believes that it must not be seen simply as a source of raw materials for resource exploitation. The CDC is clear that development of the territory must be in accordance with traditional customs and founded on values of respect and gratitude to the land. Finally, it rejects the idea that infrastructure development and environmental protection are opposing, but rather are both key to harmonious development of a territory and its people.

1.2.2 STUDY OBJECTIVES

Understanding the value created through the development of an inclusive and comprehensive infrastructure program will generate stability and allow communities to better access opportunities associated with various aspects of regional development. The challenges and uncertainty created by climate change and geopolitical instability make community participation even more critical.

Therefore, several study objectives have been developed:

1. To better understand the implications, risks, and opportunities related to the various infrastructures contemplated in the study;
2. To maximize connections between communities and the main drivers of economic development in the region, throughout the territory;
3. To identify transportation corridors that concentrate the development footprint, so as to limit environmental impacts elsewhere, in a manner that is in harmony with other land use activities on the territory;
4. To minimize the emission of harmful greenhouse gases in the construction, operation and use of future infrastructure developments on the territory;
5. To identify opportunities to create meaningful jobs for the inhabitants;
6. To understand how to balance infrastructure development with environmental protection as well as the preservation and enhancement of Cree culture for the benefit of future generations.

Although an Opportunity Study was not previously carried out, CDC has included, as part of this mandate, the need to better define the purpose of the studied infrastructures in the three phases of La Grande Alliance Study.

1.2.3 CONTEXT OF THE STUDY

For thousands of years, the Crees of Eeyou Istchee have lived off the land through hunting, fishing, and trapping. This large territory of 450,000 km² is now inhabited by around 22,000 people divided mostly in ten[2] Cree communities, five of which are located along the east coast of James and Hudson Bays: Waskaganish, Eastmain, Wemindji, Chisasibi and Whapmagoostui. The remaining five are inland communities: Waswanipi, Nemaska, Oujé-Bougoumou, Mistissini, and Washaw Sibi. Whapmagoostui is currently the only community not yet accessible by road.

The gap between the social and economic conditions of Indigenous and non-Indigenous people in Québec continues to be a major social problem. Issues continue to be insufficient housing, chronic unemployment and underemployment, low formal education levels and a flawed and heavily biased justice system. To combat these problems, many communities are implementing strategies that emphasize self-governance, autonomy, history, culture, spirituality, and identity. In this sense, many Crees believe that true economic development must grow from these elements and cannot be in opposition to them.

Changing climatic conditions, rapid demographic growth, and a growing interest in the resource potential in northern territories are all exerting pressure on Cree communities. Today's choices will no doubt influence the lives of future generations.

The Feasibility Studies are carried out in each community within the study area utilizing a network of Grande Alliance Community Information Officers (CIO). CIOs have been appointed by their communities to act as the local antennas of La Grande Alliance, to ensure participation and engagement in the studies, and to confirm that issues and concerns raised by Cree communities are heard and addressed in the studies. These positions are funded through the CDC.

Jamesian communities, for their part, are relatively newcomers to the territory. However, recent governance agreements signed between them and the Crees show that they form an integral part of the territory and have an important voice in its future development. Although La Grande Alliance Transportation Infrastructure Feasibility Studies are a Cree initiative, the CDC has made it clear that any discussions about future programs need to include Jamesian communities and their concerns. The study therefore assumes that a successful program will require the active support of these communities as well. To this end, communications have been established with each of the Jamesian communities within the broad study area through their respective municipal administrations.

1.2.4 PHASES II AND III PRE-FEASIBILITY STUDY MANDATE

The CDC has mandated WSP in May 2021 to study the Whapmagoostui/Kuujjuarapik proposed road, the Route 167 upgrade and extension as well as the railway to be located along the Billy-Diamond Highway, from KM 257 to KM 544, then on to Whapmagoostui/Kuujjuarapik, following, as much as possible the same alignment of these roads. WSP and its Cree partners, Maamuu Consultants, Mishtuk Corporation and EnviroCree, share the vision of La Grande Alliance as the promise of a future shaped by the Crees for the Crees of the Eeyou Istchee Baie-James region.

This study aims to:

1. Consult previous analyses on the territory;
2. Document the current market conditions and forecast market for La Grande Alliance infrastructure program;
3. Initiate a sustained effort of communication, collaboration, and engagement;
4. Document the existing social and environmental aspects that could benefit and/or be impacted;

[2] An eleventh community, known as "MoCreebec" is composed of JBNQA Cree beneficiaries who live on the west side of James Bay, mostly in Moose Factory and Moosonee, Ontario.

5 Developed proposed infrastructures in accordance with social and environmental aspects;
6 Assess the technical feasibility of the proposed infrastructure;
7 Assess the risks and the financial viability of the proposed infrastructure;
8 Report and provide recommendations in a final report.

This Study will examine the possibility of implementing the specified transportation infrastructures to meet the needs of Cree and non-Indigenous residents in the short, medium, and long-term in the Eeyou Istchee territory.

1.2.5 STUDY AREA

As shown on Figure 1-1, the study area is located within the territory of the Eeyou Istchee James Bay region of northern Quebec. The study area is divided in three zones:

- Study Area 1 (SA1): Billy-Diamond Highway Railway – Rupert – La Grande;
- Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik;
- Study Area 3 (SA3): Route 167 - Renard Mine – Trans-Taiga Road.

It is to be noted that these study areas are slightly different that the ones described in La Grande Alliance MOU, thus, to suit the proposed infrastructures scope.

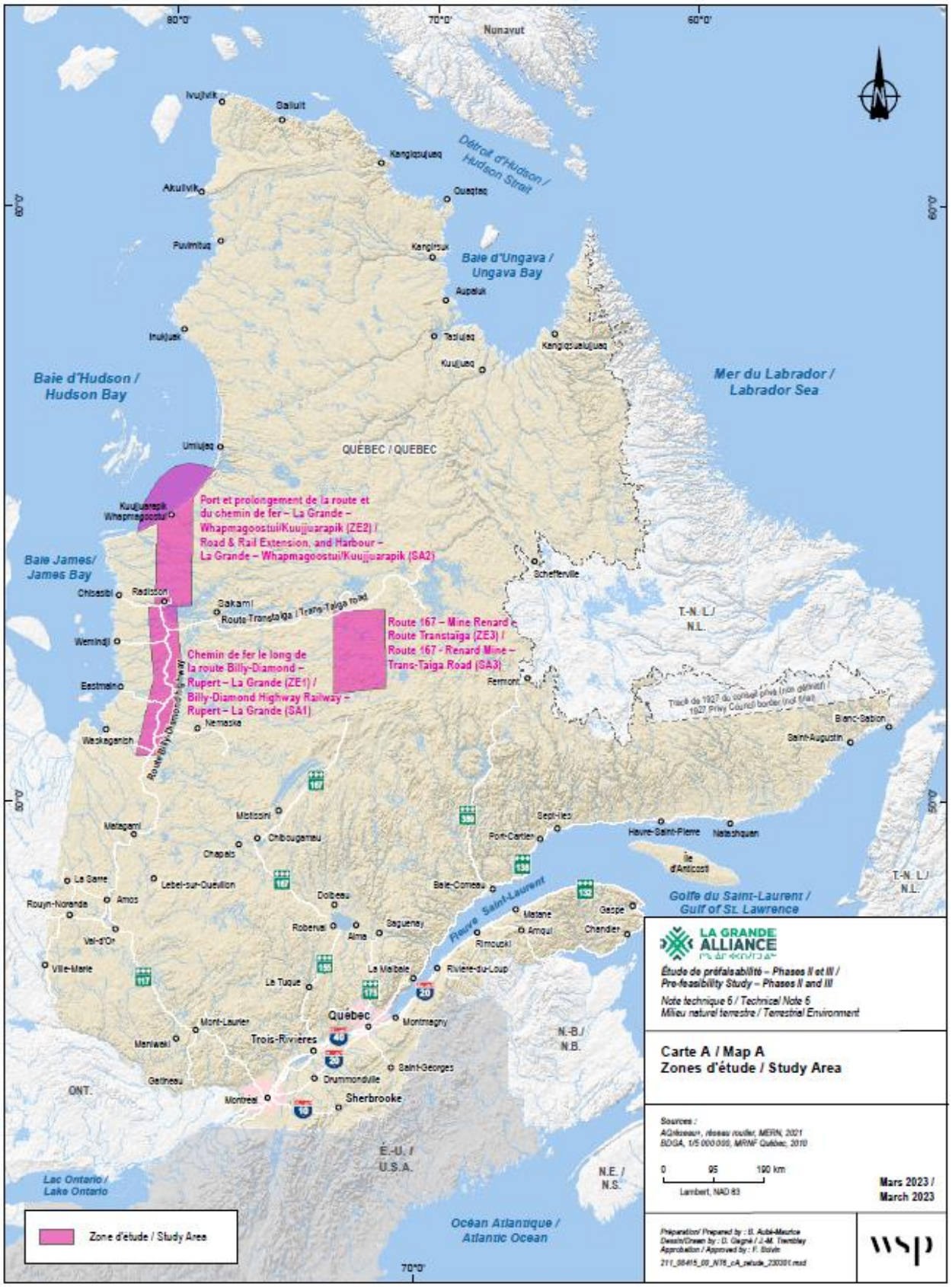

Figure 1-1 Study area

1.3 REPORT NO. 2 OBJECTIVES

In addition to presenting a wide variety of social and environmental parameters that will influence the design as well as being potentially impacted by the project, La Grande Alliance Phases II and III Pre-Feasibility includes a very *innovative approach* of consulting and engaging with the territory users prior to the technical design phase of the proposed infrastructures. This allows their input into the project as early as possible, whilst benefiting from their tremendous knowledge of the territory, its resources, and additional environmental considerations.

The purpose of the Socio-Environmental Survey is:

1. To initiate a sustained effort of communication, collaboration, engagement and responsiveness to the concerns and expectations of the population;
2. To document the existing social and environmental aspects that could influence, benefit and/or be impacted by the development of the proposed transportation infrastructures by:
   - Compiling and validating existing data with stakeholders through direct engagement with the Community Information Officers (CIOs). Information is systematically reviewed to evaluate both their veracity and relevance to the current context;
   - Identifying all areas for which there is currently insufficient data and published information to inform recommendations for additional site sampling campaign and future community engagement strategies.

These objectives need to specifically take into consideration protected areas on the territory (Figure 1-2).

The assessment of social acceptability is a fundamental objective of La Grande Alliance. Previous developments in the territory of Eeyou Istchee Bay James have all given rise to debates that have led to some divisions within or between Cree and Jamesian communities. That division has left its mark, both physically on the territory and emotionally in the collective memory of individuals and communities, as well as cumulative impacts that interact with each other at various scales. Before contemplating new projects, people are anxious to learn from the past, and to avoid past errors. It is this concern to do things differently that is sought in the framework of this study, the importance of documenting and considering the social, cultural, and historical context of the communities with regard to the developments envisaged in the framework of La Grande Alliance.

The notion of social acceptability must consider the idea that building consensus takes time and is unlikely to be achieved. Rather, the goal must be a sustained effort of communication, collaboration, engagement and responsiveness to the concerns and expectations of the population. It requires privileging dialogue to build a relationship of trust and mutual respect between all stakeholders. The Community Information Officers (CIOs) of the Cree communities, the resource persons in each Jamesian municipality or locality, the study Liaison Officers, and the rest of the WSP/Maamuu consulting team are key to the assessment of social acceptability which, it should be noted, is in constant evolution.

The Pre-Feasibility Study is a preliminary stage and therefore represents a crucial opportunity to lay the foundations of this relationship, as well as a recognition that the population can influence the design decisions in a positive manner, through the process of sharing their local reality (needs, knowledge, opportunities, concerns, etc.).

WSP and its Liaison Officer implemented the following processes as part of the study:

- Sustained communication and coordination with Cree communities, via the CIO, as well as engagement in each Jamesian municipality or locality;
- Engagement that is politically neutral, impartial and transparent at all stages (e.g., data collection tools, data compilation, data analysis, data validation and sharing of results);
- Participation of local experts in discussions and integration of shared knowledge in the development of recommendations and measures, which in turn was shared with technical teams;
- Consideration and integration of concerns and expectations in the development of possible mitigation measures as well as modifications to proposed corridors;

- Communications between the client and stakeholders based on mechanisms of neutrality, impartiality and transparency throughout the studies, in plain and accessible language to meet public expectations of being informed and listened to without judgement;
- Validation and feedback on information shared and its incorporation into project design;
- Rigorous record keeping for all exchanges and incorporation of comments from Cree experts and CIOs in an effort to strengthen the relationship of trust with communities.

The methodology implemented by the WSP social team, and the Liaison Officer consisted of a literature review and data collection with Cree and Jamesian residents of the region.

Regarding data collection with Cree communities, three subgroups were targeted:

- Cree land users (tallymen and other Cree experts) of the traplines located within the corridors under study;
- Specific groups or associations, both locally and regionally, such as the Elders' Council, the Youth Council and the Cree Trappers' Association;
- The general public.

In the Jamesian municipalities or localities, two subgroups were targeted:

- The public;
- Stakeholder groups and associations.

The WSP social team and the liaison officer implemented specific engagement and consultation activities for the different groups engaged. WSP would like to acknowledge and thank the outstanding collaboration of the CIOs who greatly contributed to the successful completion of engagement activities listed below, as well as the various Maamuu Cree associates mobilized in each of the Cree communities visited. Representatives of the Jamesian municipalities or localities also greatly contributed to the successful completion of engagement activities.

Given the multidisciplinary nature of the information, this current report has been conceived and presented to provide two levels of information:

- The report itself is a summary of the pertinent points and issues raised during each Study stage;
- The technical notes in the appendices provide a detailed methodology according to each discipline, the results of data collection, details, calculations, regulatory references, etc., necessary for a thorough understanding of each of the subjects addressed in the report.

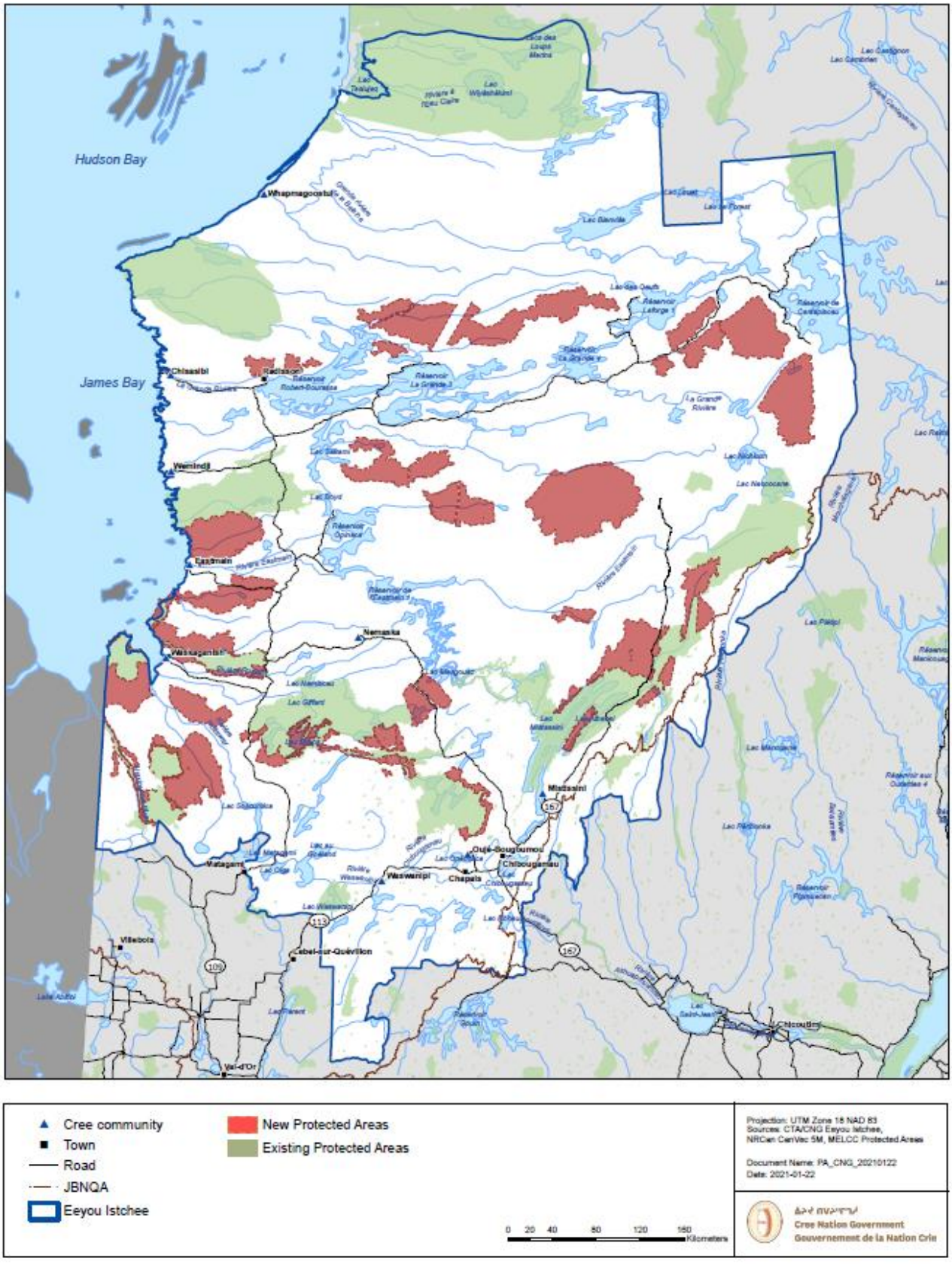

Figure 1-2 Protected areas

2 MARKET SURVEY MAIN CONCLUSIONS

The Market Study was a joint exercice between WSP and phase I external consultant. The purpose of this Report 1 is to:

1. Document presents the market analysis;
2. Forecast market conditions for all components of La Grande Alliance proposed infrastructure program.

The more specific goals of the market study include:

- To assess the economic needs of the region relating to the proposed infrastructure, detailing regional economic sectors that could use the new infrastructure to foster economic growth;
- To provide a detailed socioeconomic profile of the Eeyou Istchee Baie-James region, including Cree and Jamesian communities, economic sectors, projects and outlook;
- To assess market potential and forecast freight, passenger traffic and revenue for the different transport infrastructures;
- To consult and interview potential users and communities to determine their current and future needs;
- To assess and propose means to enhance regional impacts given the expected demographic, social and economic growths with and without La Grande Alliance infrastructure program:
  - Analyze the strategic development opportunities related to La Grande Alliance infrastructure program, considering Protected Areas, culture, communications, energy, human resources;
  - Project population and economic growth on the territory over a given time horizon;
  - Project vehicle traffic of the status quo without La Grande Alliance proposed infrastructure, as well as the traffic of La Grande Alliance proposed infrastructure components.

The study area is a remote area in Northern Quebec. The territory of Eeyou Istchee Baie-James is vast, the climate is harsh and the distances between communities are significant, making the cost of transportation and therefore the cost of living very high.

Overall, most stakeholders have expressed the view that the existing transportation infrastructure is obsolete and needs to be upgraded, and that future socio-economic development in the Northern Quebec region relies greatly on the efficiency of the transportation infrastructure.

TRANSPORT NETWORK

In terms of road transportation, the Billy Diamond Highway and the Route du Nord constitute the road networks' backbone. From this backbone, the access roads are vital linkd that connect all communities except the northernmost communities in the study area (Whapmagoostui and Kuujjuarapik). These roads are used to provide supplies to the people living and working in the Eeyou Istchee James Bay region, to transport equipment and materials to Hydro-Québec power stations and to mining sites as well as to ship harvested lumber and exploited mining concentrates to the south.

Air transportation, for its part, plays an important role in serving the northernmost communities, particularly regarding perishable foodstuffs, as well as for emergency evacuation for patients requiring medical care, either to the hospital in Chisasibi or to the large urban centers in the south (Val d'Or or Montreal). Air transportation services to the region are mainly provided by Air Creebec and Air Inuit, but airfares for personal travel remain prohibitively high. Seven Cree communities currently have an airport nearby, but the lack of air support services coupled with limited length runways make the further development of air transportation difficult. Helicopters are usually used for activities related to exploration and development of forestry, mining, and hydroelectric resources, while a combination of helicopters and small seaplanes (beavers) are now used for the transportation of trappers to their trapping grounds, and of hunters and fishermen to the outfitters of the region.

Regarding rail transportation, Canadian National Railway (CN) provides services to Matagami and Chibougamau, but the quantity shipped by rail is relatively low compared to road, due in large part to higher cost of transportation. The multimodal transhipment recently built next to the town of Matagami is currently expanding, and another one is currently planned next to Chibougamau. Both are expected to increase volume of goods transported by rail to and from the region.

Maritime transportation is fundamental for supplying Nunavik communities further. Freight is transported to all of the ports in James Bay and Hudson Bay as much as four times per year from a base located in Moosonee. Full warehousing facilities located in Wemindji and Chisasibi facilitate connexions with various smaller-scale community port infrastructures located in the study area.

SOCIO-DEMOGRAPHY AND COMMUNITIES

The study area is home to approximately 32,000 inhabitants, more than half of which are Cree. The Cree population can be characterized as young and rapidly growing, in comparison with the non-Cree population that is significantly older and decreasing. It is believed that this trend will continue to hold over the next decades. The education level amongst Cree-aged 15 and over has improved considerably over the last few decades, with 49 % now holding a high-school diploma.

The creation of the Cree Board of Health and Social Services of James Bay (CBHSSJB) in 1978, as per Section 14 of the JBNQA, has led to a full range of healthcare services available to the Cree population, which has greatly increased their quality of life. Although full-time hunting and trapping remains a very important economic sector for a proportion of the Cree population, the overall participation of the active population in the labour market has risen significantly since the signing fo the JBNQA. Today, most working Crees are employed in the public services sector. As the economy of Northern Quebec relies mainly on the extraction of resources, whether these be hydroelectric production, mining or forestry, many Cree companies and entrepreneurs have been established to support these sectors, resulting in a Cree workforce that is more skilled today compared to 20 years ago. However, the cyclical nature of mining and the boom-bust nature of hydroelectricity (i.e. many jobs in construction and comparably little in operations) have had undesirable negative impacts on the sustainability of Cree businesses in these sectors.

The lack of housing development projects is probably the greatest economic issue facing both Cree and Non-Cree communities in the study area. On the one hand, this has resulted in overcrowding in many Cree homes, while on the other hand it has been a clear constraint to attracting new residents to the region. Insufficient funding and high transportation costs, particularly for the northernmost communities, are the key factors limiting housing developments in the region.

With a young, growing and more skilled labour force, it is expected that over the next few years the Crees will have an increasing impact on the the economic dynamics of the region. In particular, the strong development of capacity in the construction and transportation sectors, will result in their playing a major role in future infrastructure development projects.

ECONOMY

Hydroelectricity, mining and forestry form the backbone of the Eeyou Istchee economy. These sectors create a significant number of jobs and economic opportunities for both Cree and Non-Cree communities in the study area. The demand for increased and improved transportation infrastructure will therefore continue to grow in the future. Hydro-Quebec's existing infrastructure, most notably their power-generating turbines, are expected to reach the end of their useful life in the coming decades, resulting in a need to ensure that the existing network, built largely for this sector, is able to accommodate the resulting increase in demand.

The region is also rich in mineral deposits, of which several are currently at the project appraisal phase, with a large number of exploration projects that has grown significantly in recent years, and this more specifically related to lithium deposits.

Finally, the forestry sector is an export-oriented manufacturing industry, with many companies located in the southern part of the study area. Exploitation activities are expected to remain relatively low but stable due to numerous factors such as travel costs, difficult environmental conditions and existing regulations.

Construction is a very important and stable sector for the local economy in all communities in the region,and tends to grow in periods of high growth from the mining and electricity sectors, in terms of labour, equipment and materials. Housing development remains important in communities but small relative to the regional economy. Access roads prevent local housing economy to be integrated with regional projects. Cree workers, entrepreneurs and companies have a strong and proven record in the construction sector.

In particular, the Cree Construction and Development Corporation (CCDC) has a strong reputation in numerous fields such as civil engineering, roads, and buildings. However, the Eeyou Istchee territory is large and communities remain far apart and poorly served by the existing network. This severely limits economic integration, limiting the number of companies providing goods and services crucial for procurement for this industry, resulting in a large amount of financial capital leaving the region. Nevertheless, some important exceptions include Gestion ADC, which provides food services and logistics to many businesses operating in the region, Kepa Transport, which provides transportation services of goods, equipment and materials and Petronor, which specializes in the transport of petroleum products. Goods procurement for the communities of Whapmagoostui and Kuujjuarapik is coordinated by Fédération des coopératives du Nouveau-Québec.

The tourism sector in the study area is small but growing. For many years, Hydro-Québec's LG-1 and LG-2 power stations located near Chisasibi have attracted many visitors in the summer. Cree cultural tourism is a growing sector, with each community offering visitors a wide range of unique traditional activities to experience. Nevertheless, this sector continues to be limited due to the poor transportation network and the high price of flying up from the south.

TRAFFIC AND REVENUE FORECASTS

The demographic projections indicate that a sustained increase in local travel needs for both passenger and freight demand will be substantial over the next 20 years and beyond. The results of the Market Survey reveal that the medium-term development of several lithium-related mining sites within the study area, the intensity of passenger and freight transportation related to several Hydro-Québec installations as part of the La Grande Complex would justify upgrading the transportation infrastructures.

Traffic forecasts tend to show that the freight traffic would amount realistically to a bracket between 600,000 and 900,000 Metric Tonnes Per Annum (MTPA). If the Duncan Lake major iron ore project came on line, potential traffic on the Billy-Diamond Highway along the Phase II corridor (Rupert-La-Grande) and the Phase I corridor (Matagami-Rupert River) will increase nearly ten-fold. Furthermore, such a large project would greatly affect the economics of the potential road (Phase I) and rail (Phase III) corridor northwards to Whapmagoostui/Kuujjuarapik, as well as the potential seaport in that community (Phase III).

Future traffic forecasts on the proposed infrastructure are subject to uncertainty and unpredictability, notably because of the difficulty to predict future international economic conditions. For sectors such as mining and, to a lesser extent, forestry, regional and national actors have little to no control over these conditions which tend to determine the financial feasibility of major projects. The feasibility of these projects are therefore both influenced by and can be an influence to the justification for infrastructure such as a railway or a deep-sea port in the region.

LA GRANDE ALLIANCE OPPORTUNITY

The demand for transportation can take the form of individuals' need to travel for school, work, leisure, or services. It also takes the form of businesses and companies offering services or goods in the region. Infrastructure improvements will likely stimulate activity and induce demand by increasing an area's attractiveness as well as improving connectivity between communities. This, in turn, induces investment that subsequently stimulates increased productivity.

The proposed infrastructures are an opportunity to position the Cree population by creating targeted programs to ensure the growing population has access to job opportunities these would create. These opportunities will originate firstly from the construction of La Grande Alliance infrastructure and then from the induced construction projects

associated with the augmented attractiveness of the area. Secondly, opportunities will be associated with the operations and maintenance of the infrastructure as well as the other induced developed activities. Lastly, benefits will come from secondary induced activities associated with the increased attractiveness of an area better serviced by an improved transportation network. Both employees and employers can develop highly skilled competencies through increased economic integration and hence a cumulative causation effect.

Hence, La Grande Alliance program with its multiple components will not only address the current issues related to transportation such as decreased greenhouse gas emissions, improved road safety and accessibility as well as a reduction in transportation costs, but can also induce many latent opportunities for both the population living in the area and the companies offering goods and services. Clearly, the proposed La Grande Alliance program will increase the supply side of transportation to a great extent.

Although the evaluation of potential demand as part of this study was found to be weak relative to the foreseen costs of such infrastructure, La Grande Alliance the development could be seen as a strategic investment to position the Cree population in the management of their land and the resources they hold.

If a proposed infrastructure is approved to be developed, the key will no doubt be for it to be done in a manner that closely involves local communities, entities, entrepreneurs and companies, in conformity with the JBNQA, thus making the proposed infrastructures socially, economically, and culturally viable both during the construction and operation phases.

3 COMPARABLE PROJECTS

The objective of identifying comparable projects is to set up a database that will serve as a benchmark for the upcoming various infrastructure components that will be developed as part of this pre-feasibility study. Refer to Technical Note 1 for more detailed information on comparison with the proposed La Grande Alliance Phase II and Phase III.

Comparable infrastructures were selected based on the similarity/relevance to those criteria:

- Design Parameters;
- Construction Cost and Financing;
- Operations and Maintenance;
- Impact on the Environment;
- Economic and Land Use Impact;
- Other.

The following sections are organized based on the three infrastructure types such as Road, Railway, and Port infrastructure. The intention is to build the database including the following key elements:

- Availability of information;
- Word progression and schedule;
- Elements of interest.

3.1 ROADS

We have compiled a list of roads that already exist or are under development to serve the northern isolated areas. Since La Grande Alliance already includes serving land users and existing communities, we have disregarded projects that are roads solely serving mining and forestry industries functional vehicle transportation needs.

Therefore, the retained projects are in Canada, on First Nations lands and meant to accommodate both passenger and commercial vehicles.

1. Inuvik to Tuktoyaktuk Highway;
2. Billy Diamond Highway Road Rehabilitation;
3. Route 167 Extension to the Otish Mountains.

3.2 RAILWAY

The retained projects are from a list of railways that already exist or are under development to serve the northern isolated areas serving mainly industrial needs:

1. Tshiuetin Rail Transport;
2. Quebec North Shore and Labrador Railway (Qns&L);
3. Arcelor Mittal Mining Railway;
4. Alaska – Alberta Railway.

3.3 PORTS

We have compiled a list of facilities that already exist in different parts of the world (mainly in the North). Since it is also part of the pre-feasibility study to define the type of the future port facility, we have compiled a list of 29 projects that have different vocations to provide perspectives on the type and scope of facilities that can be developed within the framework of La Grande Alliance.

- Deception Bay Port (Northern Quebec)
- Voisey's Bay Mine Wharf (Newfoundland and Labrador)
- Milne Inlet Ore Dock (Nunavut)
- Steensby Bay (Proposed) (Nunavut)
- Yamal LNG (Sabetta Seaport, Russia)
- Arctic LNG 2 (2023) (Russia)
- Varandey (Russia)
- Ikerasaarsuk Wharf (Greenland)
- Hay River Wharf (Northwest Territories)
- Moraine Bay Wharf (Northwest Territories)
- Simpson Islands (Northwest Territories)
- Pond Inlet (Nunavut)
- Pangnirtung Wharf (Northwest Territories)
- Salluit (Proposed) (Nunavik)
- Port of Churchill (Manitoba)
- Port of Murmansk (Russia)
- Nuuk Port and Harbour (Greenland)
- Port of Ilulissat (Greenland)
- Pevek (Russia)
- Tiksi (Russia)
- Igarka (Russia)
- Dudinka (Russia)
- Seaport of Vitino (Russia)
- Port of Arkhangelsk (Russia)
- Novy Port (Russia)
- Port of Tuktoyaktuk (Proposed) (Northwest Territories)
- Iqaluit Port (2022) (Nunavut)
- Port of Kirkenes (Norway)
- Nanisivik Naval Facility (Nunavut)

Refer to Technical Note 1 for more detailed information.

4 LEGAL AND REGULATORY CONTEXT

The legal and regulatory context applicable to the territory of Phases II and III of La Grande Alliance proposed transportation infrastructure is defined by the James Bay and Northern Quebec Agreement (JBNQA) (sections 22 and 23), which specifies the environmental and social evaluation process, specifically to protect the environment as well as the natural resources culturally valued by the Cree and Inuit people, their societies, and communities in relation to development activities affecting the territory. The land regime is a determining element of land use. It provides for the division of the territory into Category I, II and III lands. The management of the State's domain in the James Bay territory stems from the application of the Agreement and determines the applicable regulations.

If the proposed infrastructures (all or separately) are deemed valuable by the communities, then the project would, in the next stage, be subject to the environmental assessment procedures set out in the provincial *Environment Quality Act* (EQA) and those set out in the federal *Impact Assessment Act* (IAA). In fact, the environmental and social impact assessment procedure responds to the premises of the JBNQA (sections 22 and 23) and the EQA at the provincial level, while the impact assessment process at the federal level responds to those of the EIA in terms of federal jurisdiction. Although the two procedures are similar, there are specific features to each.

In addition to the environmental assessment, provincial laws and regulations require authorizations and permits for the disturbance of wetlands and waterways, threatened or vulnerable species, wildlife habitats, work in State-owned forests or interventions in protected areas. Several of the applicable regulations also dictate the standards to be respected. The same applies to laws and regulations under federal jurisdiction. They apply to endangered species, fish and fish habitat, migratory birds, and the protection of the navigable character of water bodies or rivers.

The simultaneous application of federal and provincial environmental procedures in the territory of Eeyou Istchee - James Bay for transportation infrastructure projects complicates project planning and extends the time required for environmental impact assessment and permits procedures. In addition, the components are part of various territorial realities and involve the necessary participation and consideration of Cree, Inuit and non-Indigenous communities. In this regard, the design of the components must, from the outset, consider this diversity by respecting all territorial realities and minimize the loss of natural areas, wildlife and plant species, or fish habitat.

Refer to Technical Note 2 for more detailed information.

5 LAND USE

To understand the various forms of land use in the vicinity of the transportation infrastructure proposed as part of Phases II and III of La Grande Alliance. Engagement sessions were held with Cree land users for traplines found within a defined corridor around the various components, as well as group sessions with Jamesians[3]. In addition, a compilation of all titles and servitudes within the study area was completed.

Information presented herein highlights the results of documentary research and interviews, as well as other considerations and recommendations. It should be noted that some information compiled is not presented in this report, due to its sensitive nature (e.g. harvesting areas) or to protect the privacy of individuals (e.g. family camps). This information is subject to confidentiality agreements, which will be passed on to the Client, the Cree Development Corporation (CDC), to be used in future phases if this is deemed desirable. Furthermore, Inuit communities were not involved at this stage as this remains a Cree initiative that may not be extended beyond this study. However, if any study components overlapping Inuit territory are pursued, such as the proposed small craft harbour, or the road and railway from La Grande to Whapmagoostui/Kuujjuarapik, engagement with Inuit communities would be initiated immediately in subsequent steps.

This specific approach of involving consultation with the territory users prior to the design phase is innovative. The objective is to feed the technical team with all the information gathered through this engagement process in order that the development of the proposed infrastructures alignment is done in respect with the territory (refer to Report 3). This innovative approach also includes an ongoing engagement process with Cree land users to collect and document their feedback on the proposed technical alignments (refer to Report 4).

The engagement exercise allowed to identify the various forms of land use, the titles and servitudes within the study area. As shown on the Figure 1-1, the study area is located within the territory of the Eeyou Istchee Baie-James region of northern Québec. The study area is divided in three zones:

- Study Area 1 (SA1): Railway along the Billy-Diamond Highway – Rupert – La Grande;
- Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik;
- Study Area 3 (SA3): Route 167 Extension - Renard Mine – Trans-Taiga Road.

It is to be noted that these study areas are slightly different that the ones described in La Grande Alliance MOU, thus, to suit the proposed infrastructures scope. Notably, and for numerous reasons not necessarily cited in the report, the proposed road connecting the Trans-Taiga to Schefferville was dropped from the study in its early stages.

5.1 STUDY AREA 1 (SA1): RAILWAY ALONG THE BILLY-DIAMOND HIGHWAY– RUPERT – LA GRANDE

This Study Area (SA1) is composed of 33 traplines, namely eight traplines from Waskaganish, one from Nemaska, nine from Eastmain, ten from Wemindji and five from Chisasibi. Except for one trapline in Wemindj, all the tallymen (or main user of traplines) were interviewed. The Study Team recorded the following information in this Study Area:

- Extensive Land use along the railroad corridor, particularly for spring and fall hunts;
- Total of five Protected Areas (three existing and two projected located in the Waskaganish, Eastmain and Wemindji traditional territories);
- 85 occupation leases (40 vacation leases and two outfitting leases, located mostly in the northern part of the Study Area, on Chisasibi traplines);

[3] In addition to the land users, Cree and Jamesian stakeholders have also been met; please refer to appendices for detailed list.

- Almost 9000 mining claims distributed along the alignment, but mainly concentrated in the centre, around the Eastmain traditional territory;
- Total of 182 Cree camps (93 main camps, 67 old camps, 18 secondary camps, three planned camps and one cultural camp);
- Three groups of camps on the shores of culturally significant lakes are located near the projected railway alignment between km 282 and 296 of the Billy-Diamond Highway;
- Numerous goose and moose hunting areas; beaver streams and lodges; spawning and fishing sites, caribou and black bear habitat (for more details on the Quebec government's strategy regarding the caribou, see section 8 of Technical Note 6);
- Numerous water sources;
- Presence of Snowmobile trails;
- High value commercial mushroom harvesting sites.

This area is the foreseen location for the proposed 340 km railway infrastructures Rupert to La Grande. The main concerns and comments raised by the Cree Land Users about the railway are summarized here:

- Facilitate land exploitation by non-Natives and be of little benefit to the Crees themselves in terms of land use;
- Increased pollution, dust and noise from construction of the railway and operations of the train;
- Impacts on wildlife and Cree harvesting activities;
- Impacts on Cree camps.

Note that following the proposed technical alignment, Cree land users concerns and comments will be revisited and documented (refer to report 4).

5.2 STUDY AREA 2 (SA2): ROAD AND RAIL EXTENSION, AND HARBOUR - LA GRANDE – WHAPMAGOOSTUI/KUUJJUARAPIK

This Study Area 2 (SA2) is composed of 19 traplines, 11 from Chisasibi and eight from Whapmagoostui. All trapline representatives, except one from Chisasibi were met. It should be noted that the overall understanding of the study among land users was minimal, such that it took a good amount of time to brief participants on the objectives and desired outcomes prior to collecting information. Within Study area 2, the Study Team recorded the following highlights:

- Because no transportation infrastructure was ever developed in most of this area, the presence of Highly Sensitive Areas (HSA) were identified out of the interviews with land users. According to participants, these areas are particularly sensitive to environmental impacts, and therefore should be avoided as much as possible when developing the corridor alignment;
- Two "Territorial Reserves for Protected Area Purposes"[4] (Chisasibi and Whapmagoostui territories);
- Intensive activities pursued at the mouth of the Great Whale River including goose hunting in the northern area;
- Intensive use of the Hudson Bay for hunting, fishing and recreational activities by community members near the community of Whapmagoostui/Kuujjuarapik;
- 25 leases, mostly for commercial purposes and residences near Radisson as well as one (1) outfitting lease;
- Relatively few mining claims were found;

[4] Territories that have received specific recognition while awaiting legal protected status to be assigned to them. Their priority objective is the conservation of nature (MELCFP, 2022).

- Nunavik Inuit Marine Land Claim area with a Protected Area representing an Ecological Interest Zone;
- Total of 49 camps (28 main camps, 10 old camps, seven secondary camps, one planned camp and one cultural camp);
- Three Cree camps Areas (with many camps) and one area planned for a future camp along the projected road alignment. One such camp area is located along the Hudson Bay and counts with Cree and non-Cree camps, notably Inuit camps;
- Soil instability, leading to increased landslides as a result of climate change becoming increasingly hazardous;
- Numerous fishing and hunting areas identified as HSAs along the Hudson Bay shoreline;
- Presence of navigation routes and snowmobile trails throughout the study area;
- Goose, caribou, bear and beaver hunting areas throughout the study area;
- Important caribou migration corridors and porcupine habitat throughout the study area.

This area is the foreseen location for the proposed 219 km extension of the railway infrastructures from La Grande, the 207 km roadway infrastructures extension as well from La Grande and a deep-water port along the Whapmagoostui/Kuujjuarapik coastline (which was then redefined to a seasonal Small Craft Harbour). The highlights raised by Cree land users during interviews are the following:

- Opening of the territory caused by the proposed transportation corridor;
- Increase pollution, dust and noise from construction of the railway and operation of the train;
- Impacts on wildlife and Cree harvesting activities;
- Further aggravation of soil instability;
- Limited interest in the rail project for land users, resulting in a high level of resistance to accommodate this corridor in the vicinity of existing land use areas;
- Impacts of the construction of the harbour on wildlife, most notably on fish and birds;
- Increased economic opportunities related to tourism development with the harbour;
- Impacts on Cree camps;
- Discussions included any potential road alignments passing through LG-1 dam and spillway. Interviews confirmed that land users concerned were very resistant to the idea of a road crossing their land and opening up this area, namely due to a high concentration of HSAs as well as a large Protected Area further north;
- The proposed road infrastructure tended to be more favourably received and considered more useful than the railroad. The overall familiarity of rail was low relative to roads among interviewees;
- Possibility of passenger rail service for land users as a means to build broader social acceptance;
- A northern harbour location seems to be the most appropriate for most land users, although several community members practice goose hunting in the area; this impact would require appropriate mitigation.

Note that following the technical proposed alignments, those Cree land users concerns and comments will be revisited and documented (refer to report 4).

5.3 STUDY AREA 3 (SA3): ROAD 167 REFECTION AND EXTENSION - RENARD MINE – TRANS-TAIGA ROAD

This Study Area 3 (SA3) is composed of 12 traplines, namely 11 traplines from Mistissini and one trapline from Chisasibi. Interviews were conducted with all tallymen or land users. Within that study area, the following highlights have been recorded:

- Three Protected Areas and some Highly Sensitive Areas (HSA) have been identified;
- Few leases related to the Stornoway mine and two (2) outfitting leases;

- Several mining claims are located in the Study Area, mainly in the areas of Stornoway Mine and Delmas Lake;
- A total of 36 camps (17 old camps, 13 main camps, 3 planned camps, 1 secondary camp and 2 other not categorized camps);
- Presence of navigation routes and snowmobile trails;
- Presence of caribou (woodland and migratory), moose habitats and hunting activities.

This area is the foreseen location for the proposed upgrading of the existing Route 167 over 204 km and the 172 km road extension from the Stornoway Renard Mine access road to the Trans-Taiga. The Cree land users concerns and comments that were raised during interviews about the proposed infrastructures are as followed:

- Users are generally in favor of the potential extension project, mainly due to the ease of access to their territory that the road would provide;
- Potential impacts to wildlife: the presence of caribou herds and habitat (both woodland and migratory) as well as moose habitat (for more details on the Quebec government's strategy regarding the caribou, see section 8 of Technical Note 6);
- Potential impacts to Cree camps;
- Potential impacts on existing areas of activity, notably along the road to Renard Mine;
- Potential impacts on moose hunting areas;
- Potential disturbance of navigation routes and snowmobile trails.

Note that following the proposed technical alignment, those Cree land users concerns and comments will be revisited and documented (refer to report 4).

5.4 GENERAL COMMENTS

In addition to the information presented above, interviews about the different Study Areas allowed land users to describe historical changes in key species' distribution and abundance on their respected territories, which they usually associate with climate change. These changes have had important effects on hunting, fishing, and trapping activities. However, the most important impact of climate change on land users activities is the change in the ice cover which significantly limits winter travel by snowmobile, which in turn modifies the timing of harvesting while limiting the area available for hunting and the overall ability to practice certain traditional activities. Some land users interviewed therefore perceived year-round access roads as important to counter these negative impacts of climate change on traditional practices.

In addition to the potential positive impacts of increased access, land users understand that proposed transportation infrastructure is an important vector for land use change, which can brings with it potentially negative repercussions. Indeed, the creation of access allows a greater number of people, both Natives and non-Natives, to come to the territory. Furthermore, because a healthy environment is necessary for the continuation of the Cree way of life and culture, pollution related to the construction and operation of the infrastructures is a major concern, as well as future mining development that roads and railways may facilitate.

For all the reasons cited above, most Crees interviewed expect to be continually engaged, listened to, and involved in development projects on their traplines, so that the territory is managed with all necessary considerations for Cree values and identity.

Finally, it is recommended that, should La Grande Alliance continue in future phases (Feasibility phase or ESIA), strong relationships with land users continue to be developed, such as maintaining the role of the Liaison Officer and the network of CIOs.

It should be noted that the Cree land users' further recommendations about the transportation alignments on their traplines are presented in Technical Note 17.

Refer to Technical Note 3 for more detailed information.

6 ARCHAEOLOGY & CULTURAL HERITAGE SURVEY

The section provides a summary of all known heritage sites, identifies Areas of Heritage Interest (AHI) where site concentrations and values are highest and assesses the archaeological potential of a planned road corridor between La Grande and Whapmagoostui/Kuujjuarapik. This effort will provide information for the preventive management of heritage sites when planning future steps of La Grande Alliance. Heritage sites notably include funerary and spiritual sites, historical campsites, harvesting areas, portages, and archaeological sites, occupied mostly by Indigenous Peoples.

A total of 221 sites have been recorded within the study area and its four proposed transportation corridors. All known sites are located on land, but maritime and underwater sites may also be present in coastal, riverine and lacustrine environments. This resource can be described very succinctly as highly valuable, but poorly investigated.

AHIs highlight the most sensitive areas of Eeyou Istchee under study, where the proposed infrastructures present a higher risk of impact over heritage places. Ten have been identified throughout the area under study. They concentrate near Whapmagoostui and inland from Wemindji. Most AHIs near Whapmagoostui also hold human burials, which are the most sensitive of all cultural sites. However, the breath of research is uneven across this vast territory. Research thus remains insufficient to accurately define the limits of the sensitive areas and more accurate data may help propose more specific recommendations.

Also, absence of sites or of AHIs in parts of the study area may not necessarily mean that it has low or no heritage value. This apparent void may simply be consequent to a lack of data. That is particularly striking in the marine and estuarine environments of the Hudson Bay coast, where traffic may have been notable during the fur trade era. Additional research may thus help refine current AHIs, as well as defining other sites and AHIs across the study area. Such effort will especially be important over impacted areas of La Grande Alliance, to accurately assess the risk of impact and propose specific avoidance, mitigation, and compensation strategies.

Credits: François Guindon)

Figure 6-1 Quarry of Mistassini quartzite (or Rogers Quarry) on top of Colline Blanche

Credits: Aanischaaukamikw Cree Cultural Institute and Cree Nation Government

Figure 6-2 The Sanders Pond site (EhGo-1) under excavation dated to the Archaic ca 4200 BP

A total of 1,422 zones of archaeological potential has been identified within the planned road corridor. Most of the area, however, has nil to low potential, due to extensive disturbances, other unfavourable attributes, or few favourable attributes. The rest comprises 550 zones with moderate and 218 with high archaeological potential. These zones are sensitive because they could hold traces of past Indigenous occupation, including the Inuit, Paleo-Inuit, Eeyouch and their ancestors. Traces of non-Indigenous activity may also be found in this northernmost portion of the study area due to the proximity of a former Hudson's Bay Company trade post.

Measures of avoidance and mitigation have been proposed on sites of moderate to high value and zones of moderate to high archaeological potential. On sites with low value and zones of low to nil potential, impact risk on the archaeological heritage is considered insufficient to recommend any further mitigation.

Compensation should be considered for impacted sites with higher heritage value, but also outside of impacted areas, beyond the 40 km corridor and Areas of Heritage Interest, where places of significant heritage value may already be identified. These measures are expected to help generate support towards La Grande Alliance and possibly facilitate acceptation for other aspects of the proposed infrastructures by responding to local needs.

Refer to Technical Note 4 for more detailed information.

7 IMPACT ON COMMUNITIES IN STUDY AREA

The Study includes to identify various impacts that La Grande Alliance proposed infrastructures could have on the Cree or Jamesian communities, other than those related to land use, which are addressed in Techincal Note 3. It addresses noise, water quality, air quality, health and social, employment and waste management impacts.

Construction activities will possibly be perceptible from a great distance depending on the topography and the presence of waterways having an influence on the sound propagation. During the operational period, the noise levels will vary greatly with the passage of vehicles and trains. The main sensitive areas identified regarding noise impacts are the communities of Kuujjuarapik/Whapmagoostui and Radisson. However, dwellings, camps, and other sensitive receptors will have to be further identified once the alignment and the construction and operation activities under study are defined.

The quality of drinking water could also be affected by the proposed infrastructures. All nine Cree communities in Eeyou Istchee - James Bay have drinking water systems. Pollutants associated with the construction and operation activities of roads and railways are primarily fine particles and other substances capable of affecting water turbidity. The potential for the quality of water bodies used as a source of drinking water to be affected is influenced by the distance between the activity site (including the operating roads) and a water body. Good construction practices and design techniques can mitigate or avoid these impacts.

Air quality would be affected in some areas due to the various air pollutants emitted during the construction and operation phases of the proposed infrastructures. Motorized machinery (land, marine or rail), the use of explosives, and traffic on unpaved roads are sources of air emissions that are likely to alter air quality over time. The storage and handling of petroleum products can also be a source of volatile organic compound emissions. GHGs and global warming potentials (GWPs) are also considered in this assessment.

The health and social component could otherwise be affected by La Grande Alliance infrastructures. The literature on comparable infrastructures has identified nine impact categories, with both positive and negative effects for the Crees and Jamesians. Among these are opening of the territory and increased mobility, destabilization of local traditions and culture, and tensions in social and family relations. Actions or follow-ups related to these impacts in order to mitigate, avoid or improve them have been identified. The engagement sessions carried out in Cree and Jamesian communities, within the framework of La Grande Alliance study, have made it possible to complete this table, both for the anticipated impacts and the actions or follow-ups to be considered.

La Grande Alliance infrastructures are also likely to lead to job or contract opportunities for the Crees. However, in order to maximize the benefits, a preliminary effort must be made to provide adequate training, in particular through the creation of a training committee involving local organizations.

Finally, as these proposed infrastructures would generate significant residual waste in a northern context, optimal management is recommended, such as integrating waste management considerations at the design stage through eco-design practices; appointing a waste management manager responsible for results to ensure that objectives are met, and installing clearly identified containers for the different types of waste generated on site. In fact, the waste management hierarchy, the waste segregation, the Envision certification and the leading practices will reduce the impact of waste on the land.

Refer to Technical Note 5 for more detailed information.

8 TERRESTRIAL ENVIRONMENT

This section provides a general overview of the terrestrial natural environment crossed by the various La Grande Alliance proposed transportation infrastructures components as presented in Table 8-1.

Table 8-1 La Grande Alliance proposed Infrastructures Overview

PHASE	ACTIVITY
Phase II	A proposed 207 km road extension from La Grande to Whapmagoostui/Kuujjuarapik
	A proposed 340km railway from Rupert to La Grande
	A proposed 376km upgrade & extension of Route 167 to the Trans-Taiga Road
Phase III	A proposed 219 km rail extension from La Grande to Whapmagoostui/Kuujjuarapik
	A proposed Deepwater Port in Whapmagoostui/Kuujjuarapik (which was further redefined to a harbour, refer to Technical Note 13A)

As previously illustrated on the Figure 1-1, the study area is located within the territory of the Eeyou Istchee Baie-James region of northern Québec. The study area is divided in three zones:

- Study Area 1 (SA1): Billy-Diamond Highway Railway – Rupert – La Grande
- Study Area 2 (SA2): Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/Kuujjuarapik
- Study Area 3 (SA3): Route 167 - Renard Mine – Trans-Taiga Road.

It is to be noted that these study areas are slightly different that the ones described in La Grande Alliance MOU, thus, to suit the proposed infrastructures scope.

This terrestrial review also aims to highlight how these issues will need to be considered during the design process of the proposed infrastructures. Finally, gaps in available information are also highlighted to guide the next steps in information acquisition. It should be noted that engagement activities with local communities have also provided detailed information on natural environment in some areas including the identification of highly sensitive areas (HSAs) identified some sensitive natural sites,), which will also need to be considered in the design. Refer to Technical Note 3for more details regarding engagement with land users.

It should be noted that, during the Study, the proposed roadway of La Grande to Whapmagoostui/Kuujjuarapik was moved to the feasibility stage and thus led to additional work within Study Area 2 (SA2). A photo-interpretation of the vegetation, wetlands and watercourses was carried out over a 1-km wide corridor along the proposed alignment. In addition, a preliminary field campaign was carried out to sample vegetation, wetlands and aquatic habitats. This new information made it possible to refine our understanding of the surrounding environment and potential issues and constraints to be considered for the proposed alignment.

8.1 PHYSICAL ENVIRONMENT

The terrestrial portion of the study infrastructures is located entirely on the Canadian Shield in the Superior geological province. SA1 and SA2, located in the western part of Eeyou Istchee, runs parallel to James Bay, some 80 km inland. The northern end of SA2, however, reaches south of Hudson Bay. At its northernmost point, the area covers either side of the communities of Whapmagoostui and Kuujjuarapik. Elevation in most of SA1/SA2 fluctuates around 100 m, ranging from 0 to 250 m. The terrain forms an undulating plain that slopes slightly to the west. SA3 is located much further east, near the geographic center of Québec. This area, which is a platform punctuated by hills, is at a higher elevation, generally in the range of 400 to 600 m, and up to 800 m in the southern part of the area.

In terms of unconsolidated deposits, the three study areas present fairly distinct characteristics. SA1 is characterized by a significant presence of undifferentiated organic sediments (26% of the area), while several other types of deposits (undifferentiated till, undifferentiated bedrock, nearshore and littoral glaciomarine sediments, fine deepwater glaciomarine sediments) are relatively well represented, with proportions ranging from 10 to 20%. Bedrock outcrops in abundance in study area SA2, which is thus dominated by undifferentiated bedrock (36%). Undifferentiated till is also well represented in this area (32%).

In the case of the SA3, the vast majority of the area is characterized by undifferentiated till (85%). Granular materials with potential as a source of borrow material (e.g., proglacial outwash sediments, juxta glacial sediments, frontal moraine sediments) are found in all three zones in much lower proportions.

Regarding hydrography, the location of SA1 and SA2 near James Bay and Hudson Bay results in the presence of many major rivers that cross the study areas from east to west, including, from south to north, the Rupert, Pontax, Eastmain, Opinaca, La Grande, Piagochioui, Roggan, Vauquelin and Grande Baleine rivers. SA3 is largely devoid of large rivers, but the upstream portion of the La Grande River flows through it. Lakes are abundant throughout the area. However, they are most present in zone SA3. The presence of the Robert-Bourassa Reservoir, at the junction of zones SA1 and SA2, is also noteworthy.

Figure 8-2 Physical Environment

8.2 VEGETATION AND WETLANDS

The proposed infrastructures are located entirely within the boreal vegetation zone. In general, due to harsh climatic conditions, the plant species present are common and not considered very diversified compared to southern Québec. The vegetation is dominated by black spruce (Picea mariana). Almost the entire study area lies in the lichen spruce forest bioclimatic domain, which corresponds to sparse forest. The spruce-moss domain is also represented in the southern part of SA1, while the forest-tundra domain is present at the northern end of SA2, along Hudson Bay. The proposed infrastructuresare located north of the commercial forest boundary and the forest fire suppression zone. Except for hydroelectric reservoirs, the forest landscape in the study area has therefore been subject to very little anthropogenic influence. Large parts of the study areas have been affected by forest fires in recent decades, especially in area SA1. Field data gathered on SA2 reveals that the floral diversity is relatively poor with a total of 241 species recorded in 68 stations inventoried. No special-status plant species or invasive exotic species were identified during the inventory.

Wetlands are scattered throughout the study area. General information sources indicate that they are most abundant in SA1. However, photo-interpretation conducted in the summer of 2022 in a small portion of SA2 suggests that the proportion of wetlands is greater than expected, i.e. of the same order of magnitude as in SA1. In general, peatlands are by far the dominant wetland type in the area. Bogs are generally more widespread than fens. Other wetland types include marshes, swamps, and shallow waters colonized by aquatic plants, but these are generally much smaller than bogs and less abundant. Wetlands provide many ecological functions and habitats of interest.

With respect to rare plant species, the CDPNQ reports a total of eight records for protected plant species within the study areas, including two species of vascular flora and six species of mosses. These records are not new (> 40 years) and are almost all concentrated in a small sector along Hudson Bay. This area is of particular interest for rare or endangered plant species because of its characteristics (calcareous soils, maritime influence, shores, unstable rocky hills). In addition to this small area along Hudson Bay, the shoreline of the major rivers (e.g., Rupert, La Grande, Grande Baleine) also has some potential for rare or endangered plant species, whereas the rest of the study areas have a very low potential for these species. It should be noted that the summer 2022 field campaign did not result in the identification of any plant species of precarious status in SA2, despite an extensive inventory of plant species conducted at 68 different stations, including 8 stations located in the area along Hudson Bay, which is considered to be more suitable for these species.

Figure 8-3 Vegetation

8.3 ICHTHYOFAUNA AND FISH HABITAT

With the many lakes and rivers that criss-cross the study area, there are numerous habitats suitable for fish. In northern Quebec, the diversity of freshwater fish species decreases as one moves further north and east. The region's harsh climate influences species diversity, as well as life cycles. Freshwater fishes found in the region tend to be slow growing, late maturing and long-lived. In total, 34 fish species could potentially be found in the study area, of which 30 are confirmed or highly probable. SA1 has the highest species diversity (27 confirmed or highly probable), followed by SA2 (21 species) and SA3 (19 species). Lakes and rivers have similar communities, but species diversity is lower in small rivers. Field data gathered on SA2 reveals that the majority of the waterways surveyed are inhabited by fish (31 out of 34). Due to the generally flat topography, the streams in SA2 are slow flowing in the area of the proposed road and few impassable obstacles to fish migration were identified. Fishing and environmental DNA analysis also revealed the presence of approximately 20 fish species in the streams crossed by the proposed road.

The species of greatest interest are those that are subject to traditional or sport fishing, notably walleye (*Sander vitreus*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), lake cisco (*Coregonus artedi*), brook trout (*Salvelinus fontinalis*), northern pike (*Esox lucius*) and lake sturgeon (*Acipenser fulvescens*). Lake sturgeon is of particular interest and is found in the large rivers and lakes of SA1 and the southern limit of SA2. This species has a traditional importance for Cree communities. Lake sturgeon is protected by both provincial and federal authorities. This species, as well as the majority of fish species of interest reported in the study area, reproduce in fast-flowing water, on gravelly or rocky well-oxygenated substrates. Such sites are often located at the foot of rapids, particularly upstream of long, calm stretches. The spawning grounds used by the fish are particularly sensitive, since they tend to be less widespread and play a key role in recruitment. Furthermore, as rapids are often located where the river narrows, they tend to be selected for crossings and bridges, such that proper mitigation is key.

8.4 HERPETOFAUNA

Herpetofauna is not considered very diversified in northern Quebec. The species that are present tend to be widespread and well-adapted to the harsh climate. In the area crossed by the proposed infrastructures, nine species of amphibians are potentially present while only one species of reptile is found. However, most of these species reach the northern limit of their range within the study area. The more northerly section of SA2 has a lower diversity of amphibians and reptiles. Wetlands, lakes, watercourses and surrounding terrestrial environments are good habitats for herpetofauna. Due to its more southerly location and the particularly high abundance of wetlands, SA1 has the best potential for herpetofauna.

8.5 AVIAN FAUNA

Although the diversity of species is lower than in southern Quebec, a total of 184 bird species are likely to be found in the study area at some time during the year. These species use a variety of habitats, particularly forest and wetland environments. Of these species, 108 species have been confirmed as nesting in the region. A total of 14 species of birds classified at risk have been reported in the study area. These species include forest and open-water birds, ducks, shorebirds and raptors. In general, however, many of these species are associated with wetland or water habitats. An update of the species at risk reported in the study area will however have to be done in the next steps of the development of the proposed infrastructures, since the lists are regularly updated by both provincial and federal authorities. It should be noted that the status of certain bird species is currently under review by provincial authorities.

The largest number of bird species (159 species) is found in SA2, likely due to the presence of marine species in this area reaching Hudson Bay. It is also the only area among the three study areas with Important Bird Areas (IBAs) [Zones importantes pour la conservation des oiseaux (ZICO)], one of which is located along the Great Whale River. This area, which also includes parts of the major downstream tributaries of the River, is an important nesting area for the endangered harlequin duck (*Histrionicus histrionicus*).

8.6 MAMMALS

A total of 54 species of terrestrial mammals have been recorded in the study area, including small, fur-bearing and large mammals. These are broken down as follows: six species of bats, 17 species of small mammals, 26 species of small wildlife/fur-bearers and five species of large wildlife (including bears, which can also be considered fur-bearers). Excluding caribou (*Rangifer tarandus*), which is the subject of a separate chapter, 10 species of mammals at risk are likely to be found in at least one of the study areas, including five species of bats, three species of carnivores and two species of rodents. As stated previously, the species at risk list will have to be updated during the next steps of the development of the proposed infrastructures. The status of some mammal species that can be found in the Study Area is currently being reviewed by provincial authorities. Field data gathered on SA2 reveals several signs of large ruminants (caribou and muskox (*Ovibos moschatus*)), beavers and black bears (*Ursus americanus*) were noted in the field.

Most small species, especially small mammals and small fauna, have small home ranges. In contrast, large wildlife species and some fur-bearers sometimes occupy large territories and can move over very large distances. It is mainly these species that are likely to be affected by the infrastructures under study. Among the large wildlife species, the presence of moose (*Alces alces*) is noteworthy, since this species is popular with sport and traditional hunters. In the study areas, however, the density of this cervid is low and it is found only in the southern part of the territory.

8.7 CARIBOU

The caribou is an emblematic cervid of northern Quebec and is of traditional importance to the Cree communities. In the study area, both the migratory and forest ecotypes are found. Migratory caribou make long annual migrations between the tundra and the boreal forest. Although it has declined in recent decades, it has no particular protection status. In Québec, migratory caribou are divided into two herds, the Leaf River herd and the George River herd, both of which may be present in the study area for part of the year.

Remote sensing data obtained from the MFFP indicate that migratory caribou occur in all three study areas but are less abundant in the southern parts of SA1 and SA3.

As for woodland caribou, which live year-round in the boreal forest, five herds are likely to be present in the study area: the Assinica, Nottaway and Reconnaissance herds in area SA1 and the Caniapiscau, Témiscamie and Reconnaissance herds in area SA3. Remote sensing data obtained from the MFFP indicate that the southern end of area SA1 and the area near the Eastmain River are used by woodland caribou, although they are absent from the northern half of this zone. Caribou are also present in SA3, mainly in the southernmost part of this zone, as well as in the entire eastern half. MFFP data also indicate that woodland caribou are absent from area SA2. Unlike migratory caribou, woodland caribou is considered at risk, both provincially and federally. It should also be noted that it is generally present in very low density, in the order of 1 to 2 individuals per 100 km^2, and its home range is vast (> 1000 km^2). Spatial distribution and habitat heterogeneity play an important role in meeting the needs of woodland caribou over an annual cycle. Large forest areas are sought after by the species, particularly in winter. Conversely, woodland caribou avoid recently disturbed environments such as burnt areas or forest cuttings, as well as linear anthropogenic infrastructures such as power transmission lines or roads. In the latter case, caribou avoidance of roads is proportional to traffic intensity.

8.8 TERRESTRIAL PROTECTED AREAS

Several projected protected areas are included in the study areas, but these do not yet have a definitive status. These include three projected biodiversity reserves and eight territorial reserves for protected area purposes (RTFAP). The objective of the biodiversity reserves is to promote the maintenance of biodiversity in the terrestrial environment and, more specifically, the representativeness of the various natural regions of Quebec. The status of territorial reserves for protected area purposes (RTFAP) allows for the recognition of the protected status for a territory before it is granted legal protection status. The largest number of proposed protected areas is found in the study area SA1. SA1 is also where the proposed infrastructuresare most likely to conflict with those areas, as several border are crossed by the Billy-Diamond Highway (it should be noted that a buffer area 500 m on either side of the highway corridor is excluded from protection in most projected protected areas to allow for various works related to the transportation corridor).

8.9 WILDLIFE MANAGEMENT

The study areas are located entirely in Hunting Zone 22, while they are divided between fishing Zone 22 South and Zone 22 North. These areas can be used by sport hunters and fishers on Category III lands, as defined by the James Bay and Northern Québec Agreement (JBNQA). Hunting, fishing and trapping on Category I and II lands, located closer to Cree communities, is only permitted for Crees, although non-Crees can harvest some species with the explicit written approval of the community where the activities are taking place. These lands cover nearly 30% of SA1 (Waskaganish, Eastmain and Wemindji), two thirds of the land portion of SA2 (Chisasibi and Whapmagoostui), while they are absent from SA3. In addition to the species that are usually targeted by hunting or sport fishing, Cree land users harvest several other traditionally important wildlife species, and some species designated under the JBNQA are reserved exclusively for their use, such as beaver (*Castor canadensis*) and lake sturgeon.

8.10 ISSUES AND CONSTRAINTS TO DEVELOPMENT

Generally speaking, the most sensitive components of the natural environment are wetlands, aquatic habitats, protected areas and woodland caribou habitat. There are also particularly sensitive habitats such as spawning grounds and other habitats of special interest, such as those important for specific species at risk. Although topography and geomorphology are not sensitive components, they are also identified as issues since they influence the infrastructures design. The following is a summary of how these different elements impact on the infrastructures' design or how this will need to be adapted accordingly:

- Topography: For technical reasons, the selected routes should, as far as possible, be established in relativelyflat areas. Areas with steep slopes should therefore be avoided.
- Geomorphology: The proposed routes should avoid areas of low bearing capacity, including peat-dominated areas and sensitive clay deposits. In addition, the choice of route should also take into account the presence of sources ofgranular material suitable for the construction of the railway or road foundation. Such sources should ideally bedistributed at different locations in the vicinity of the alignments, in order to minimize the transport of granularmaterial during construction as well as the ecological footprint of the potential infrastructures.
- Wetlands: Wetlands are habitats of significant ecological interest that should be avoided as much as possible by the new infrastructures. A vegetated protection strip should also be maintained around any wetland area to avoid encroachment effects. Any encroachment on wetlands will likely require adequate compensation by government authorities. The Regulation respecting compensation for adverse effects on wetlands and bodies of water (chapter Q-2, r. 9.1) does not apply to the study's areas. However, compensation could be required by COMEX or KEQC during the environmental assessment.
- Aquatic habitats and waterbodies: Lakes and watercourses are both important physical barriers to the proposed infrastructures and valued aquatic habitats. Lakes, including a riparian strip surrounding them (60 m for permanent watercourses and 30 m for intermittent ones), should be avoided by the selected alignments. As for rivers and streams, these will inevitably need to be crossed by the infrastructures. The number of crossings should ideally be minimized and the choice of crossing sites attempt to minimize the width of the crossings. Conversely, the design of crossings should also aim to minimize encroachment into important aquatic habitat, in particular spawning grounds, and the presence of sensitive habitats should always be considered. Finally, the numerous culverts planned will generally have to be designed to ensure that free upstream fish passage is maintained. It should be noted that encroachments into fish habitat will have to be compensated.
- Woodland caribou habitat: The proposed infrastructures will inevitably encroach on some woodland caribou habitat. Where possible, the selected routes should be located along existing infrastructure corridors where present since Woodland caribou tend to avoid existing infrastructure corridors, such that these areas are considered low quality habitat. In SA3, for which there is currently no existing infrastructure, the road corridor should avoid the eastern half, which is much more frequented by woodland caribou. Woodland caribou are unlikely to be found in SA2, although it would nevertheless be advantageous for the new railway to be located as close as possible to the future road.
- Protected areas: The selected routes should be located outside projected protected areas as much as possible, regardless of the latter's legal status. In the case of SA3, it would be advantageous for the route to pass to the west of the territorial reserve for protected area purposes (RTFAP) Aawiitakuch, to avoid the future road passing between two separate blocks of this reserve, which could hinder the connectivity between these two areas.
- Habitats of particular interest: Some particularly sensitive habitats could potentially be affected by the infrastructures under study. Where appropriate, routes should ideally be adjusted to avoid or minimize impacts on these habitats. Regarding aquatic habitats, spawning grounds are particularly sensitive habitats, while aquatic grass beds are also of interest. Habitats important for rare or endangered species of fauna and flora should also be avoided, especially if their geographic extent is limited.

These elements will require to be further detailed in the next phases of the study, more specifically during the Environmental and Social Impact Assessment (ESIA) process, where these will be explicitly required by authorities.

8.11 GAPS IN AVAILABLE INFORMATION & RECOMMENDATIONS

For each of the issues identified above, work will have to be carried out during the next stages of the study to further understand the effects of the proposed infrastructures on the surrounding natural environment. The following lines identify the main gaps based on available information and propose actions to be taken in the subsequent stages of the study. It is important to note that knowledge on northern Quebec's natural environment is evolving rapidly and several studies currently underway (e.g., on wetlands, caribou and fishes) will have to be taken into account in the next steps of La Grande Alliance:

- Topography: In the next stages of the study, a complete LIDAR survey will have to be generated for each ofthe proposed routes in order to have an accurate picture of the topography.
- Geomorphology: a photo-interpretation will have to be carried out in order to specify the delimitation of wetlands and deposits made up of unstable materials. This exercise will also identify sources of borrow material that could potentially be used during the works. In a second phase, it is recommended that an airbornesurvey of these potential sources of borrow materials be carried out to determine the quality and volume of these materials. Finally, the nature of the soils crossed by the selected routes should also be confirmed and specified by geotechnical surveys. It should be noted that in the case of area SA2, gaps in the available information were partially filled during a geotechnical drilling campaign carried out in the summer of 2022 (see Technical Note 10).
- Wetlands: The delimitation of wetlands likely to be affected by the proposed infrastructures will have to be clarified by acomplete photo-interpretation along the routes, since the information available from CanVec (Canada vectorial) is relatively imprecise. Subsequent field campaigns will make it possible to specify the characteristics of the wetlands potentially affected. In the case of SA2, work conducted in summer 2022 as part of the Feasibility Study refined the delineation of wetlands along the proposed alignment and their characteristics, so that the proposed alignment could be optimized.
- Aquatic habitats: It is recommended that a photo-interpretation of the watercourses crossed by the proposed infrastructuresbe carried out in order to identify the smaller watercourses and to specify their exact location.This exercise will also help determine the optimal crossing sites and will identify certain sensitive habitats. Subsequent field campaigns should aim to characterize in detail the aquatic habitats crossed, which will make it possible, in particular, to specify the impacts and to confirm watercourses for which structures to allow the free passage of fish will be required. For SA2, work carried out in summer 2022 confirmed the precise location and characteristics of the watercourses along the proposed alignment. Further work to characterize in detail the proposed crossing sites will nevertheless be required in future stages.
- Woodland caribou habitat: Information available on woodland caribou is based on precise data from telemetric monitoring carried out by the MFFP. Nevertheless, it will likely be beneficial to conduct additional aerial surveys in future phases, to validate the presence of wintering areas within a 10 km buffer zone on either side of the alignment. Such data would make it possible to better understand the impact on woodland caribou during the winter and to identify appropriate mitigation measures to minimize the risk of collision (e.g. signage or specific monitoring procedures using radio collars).
- Protected areas: In the event that the proposed routes cross or pass close to a projected protected area, the responsible authorities will need to be consulted at an early stage in order to fully understand the possible ways to make theproposed infrastructures compatible with the potentially affected areas. As these areas do not yet have a definitive status, there may be some flexibility in the final delineation of these areas, provided that conservation objectives are not compromised.

- Habitats of particular interest: Close attention should be paid to habitats of particular interest identified during engagement sessions with Cree land users (see Technical Note 3). This should include a detailed inventory with land users as well as photo-interpretation of watercourses crossed by the proposed infrastructuresto identify potential spawning grounds and other aquatic habitats of interest such as grass beds, in particular for smaller waterbodies. With regard to species at risk, future field campaigns should pay particular attention to potential habitats for these species, by photo-interpretation as well as with land users for the areas in question. The field campaigns will have to pay particular attention to the habitats which are of particular interest for rare plant species, especially in the area near Hudson Bay which is considered more suitable for these species.

Refer to Technical Note 6 for more detailed information.

9 MARINE ENVIRONMENT

Within the framework of La Grande Alliance studies, the development of a small seasonal harbour is considered in the southeastern Hudson Bay near Whapmagoostui/Kuujjuarapik. The study area extends from the northeastern boundary of the *Lac-Burton-Rivière-Rogan-et-la-Pointe-Louis-XIV Land Reserved for Protected Area* to the mouth of Tasiujaq Lake (formerly Guillaume-Delisle Lake and Richmond Gulf before that) while the area under consideration for the infrastructure extends from Black Whale Harbour that is about 30 km southwest of Whapmagoostui/Kuujjuarapik to Boat Opening that is about 60 km northeast of Whapmagoostui/Kuujjuarapik. A review of previous projects, databases and scientific literature was conducted to document water and sediment quality, the species using the area and the sensitive habitats. Special care was given to species at risk and invasive species. To complete these data sources, requests for inputs from local organizations were made. The existence of marine protected areas and land claims in the study area was investigated. A review of the legislation and regulations specifically applicable to harbour development, ship traffic, invasive species and sensitive marine features was also conducted. Data available for the study area is mainly from the hydroelectric project of Complexe Grande-Baleine and is more than 20 years old. Therefore, some of the information could be outdated since changes are happening fast in the Arctic. The Hudson system is still understudied and there is a lack of information regarding many subjects.

Hudson Bay is an oligotrophic inland sea with low nutritive salts. Few data on surface water quality in the Hudson Bay is available. In the study area, water salinity is mainly influenced by The Great Whale River and by James Bay and is generally somewhere between 21 PSU to 24 PSU for surface water and go as low as 0 PSU directly at the mouth of the river and up to 33 PSU in deep waters. In summer, sea surface temperature can reach 12°C in the Hudson Bay while the bottom layer stays around 0-2°C. According to available data, the pH is a little under the recommendation for the protection of aquatic life (chronic effect) of the M*inistère de l'Environnement et de la Lutte contre les changements climatiques* (MELCC 2022) and Canadian Council of ministers of the environment (CCME 1999) and water mercury levels were higher than the MELCC recommendation for the prevention of contamination in aquatic organisms which is based on a daily consumption of 15 g of fish, mollusk and crustacean. In the sediments, arsenic and copper concentrations were higher than recommendations from CCME and Environment Canada and M*inistère du Développement durable, de l'Environnement et des Parcs du Québec* (EC and MDDEP) although all these levels come from local geology and air pollution emanating from further south and depositing in arctic waters.

The east coast of the Hudson Bay is generally exposed to waves, wind and ice, and the substrate is mainly coarse sand. Intertidal habitats for meadows and macroalgae are limited within the study area and mainly present within the Manitounuk Sound. Coastal vegetation is dominated by minerotrophic bogs (50%) while bare sediments (fine or coarse) occupy an important place with about 37% on average in the study area. Salt marshes and eelgrass beds are more frequent and larger in the Manitounuk Sound than anywhere else in the study area. Macroalgae are most probably also more frequent and with higher density in the Manitounuk Sound since it is less exposed than the rest of the study area, although brown algae remain dominant. There is active primary production in summer at the surface particularly along the coast and epontic algae also play an important role in primary production during winter. Zooplankton is dominated by copepods and chaetognaths are dominant in terms of biomass. The assemblages of benthic invertebrates are typical of subarctic environments. Mussel beds are present in the Manitounuk Sound; information regarding their distribution for the rest of the study area is not available.

At least 47 fish species are documented in the study area, of which most are marine, but also diadromous or typically freshwater species are present. Crees and Inuit mainly fish Greenland cod (*Gadus ogac*), arctic cod (*Boreogadus saida*), sculpins, cisco (*Coregonus artedi*), lake whitefish (*Coregonus clupeaformis*), brook trout (*Salvelinus fontinalis*), lake trout (*Salvelinus namaycush*), capelin (*Mallotus villosus*) and arctic char (*Salvelinus alpinus*). Marine mammals are present in the study area. Pinnipeds are the most common as well as an important food resource. The ringed seal (*Pusa hispida*) is the most numerous and bearded seal (*Erignathus barbatus*) is second in importance. Beluga whales (*Delphinapterus leucas*) of the eastern Hudson Bay population are present mostly in the northern part of the study area but can be encountered anywhere in the study area. It is uncommon to sight other whales in the study area. Sightings of polar bears (*Ursus maritimus*) are frequent and denning sites are

likely present in the north of the study area. According to the available data, 97 bird species in 25 families are likely to inhabit the marine area and its coastline on an annual basis that represent an important migration route for many bird species. Bird concentrations are highest during the spring migration and particularly during the fall migration when waterfowl are about five times more numerous. Within the study area waterfowl is more frequent in the region of Manitounuk Sound where salt marshes and eelgrass beds are more present. However, their concentration is higher north of the study area near Nastapoka River. Waterfowl is an important food resource for Cree and Inuit communities.

The study area is in Belchers Islands Ecologically and Biologically Significant Area (EBSA) that is also a Priority Area for Conservation by World Wildlife Fund Canada (WWF Canada). Canadian Important Bird Areas (IBA) are at the limit, or near, the study area: Great Whale River, Little Whale River, Tasiujaq Lake and Nastapoka River for Harlequin Duck (*Histrionicus histrionicus*), and Belcher Islands, Salikuit Islands and Sleeper Islands for Common Eider (*Somateria mollissima*). Three small polynyas, which are areas of open water surrounded by sea ice, that can be covered by ice from time to time, are present in the study area: Paint Islands, Schooner Opening and Boat Opening. River estuaries are important for diadromous fish and belugas. In the study area, beluga whales are mainly present from Schooner Opening to Little Whale River estuary but use the entire zone. Manitounuk Sound is used by birds from spring to fall and is believed to be an important habitat in the capelin life cycle. Manitounuk Sound also has the greatest concentration of salt marshes and eelgrass meadows of the study area. The coastal zone around Little Whale River and Tasiujaq Estuary is identified as an important zone for beluga, and for the reproduction of Peregrine Falcon (*Falco peregrinus*) and Golden Eagle (*Aquila chrysaetos*) as well as an important zone for Inuit and Cree subsistence. Beluga hunting is prohibited in Little Whale River Estuary that is identified as a sanctuary for the species. According to Inuit and Cree traditional knowledge, polar bears are sighted from Whapmagoostui/Kuujjuarapik to farther north than Tasiujaq Lake and polar bear denning sites are present from the end of Manitounuk Sound up to Tasiujaq Lake. Kativik Regional Government identified Manitounuk Sound as an area of esthetic interest for its unique landforms and spectacular landscapes and Nunavik communities are requesting that a 10 km-wide coastal zone is recognized and obtains an official protection from governments for its diversity and important productivity notably through Kativik Regional Master Plan. Through community consultation by Eeyou and Nunavik Marine Region Wildlife Boards, Eeyou Istchee Crees and Inuit from Whapmagoostui/Kuujjuarapik voiced some concerns regarding waterfowl, its habitat and how to preserve it, a decrease in the abundance of seals, whales and walruses (*Odobenus rosmarus*), an increase in the eagle and polar bear numbers, changes in the beluga whale distribution, the presence of the rainbow smelt (*Osmerus mordax*), changes to the taste of animals, water levels and quality, caribou populations on the islands of the Eeyou Marine Region, fish (decrease in the populations of capelin, Arctic char, sardines and other fish) and its habitat, and seafood resources including shellfish and shrimp.

Among the different species likely to frequent the eastern Hudson Bay and its coast, 16 species have a protection status. Belugas of the eastern Hudson Bay population are likely to be met in the study area in summer while polar bears are likely to be met on the ice of the Hudson Bay in winter and inland and over the coast during summer. Seven bird species with a status are likely to frequent the coast of the study area from spring to fall. Among them, Harlequin Duck, Golden Eagle, Bank Swallow (*Riparia riparia*) and Rusty Blackbird (*Euphagus carolinus*) are likely to nest near or within the study area.

At this time, there are no marine invasive species documented in the study area. Eeyou Istchee Crees voiced some concerns regarding increase and introduction of cormorants, green crab (*Carcinus maenas*), algae, jellyfish, Greenland shark (*Somniosus microcephalus*), bald eagles (*Haliaeetus leucocephalus*), and vultures in the Eeyou Marine Region. Rainbow smelt (*Osmerus mordax*) has been confirmed further south in the Eeyou Marine Region, and anecdotal evidence suggests that it may be present near Whapmagoostui. An assessment on the risk of invasions of the Hudson Bay Complex identified 14 species with a risk for invasion. Of those, three are listed on the *100 of the World's Worst Invasive Alien Species*: warty comb jelly (*Mnemiopsis leidyi*), green crab and wakame (*Undaria pinnatifida*).

The study area covers three recognized claims: Eeyou Marine Region (Joint Zone), Nunavik Marine Region (Joint Zone) and Nunavut Settlement Area (Area B). These agreements acknowledge ownership and other rights to certain areas in the offshore, allows co-management for wildlife, land management, and development impact issues. As so, wildlife boards and impacts review boards exist for each of those regions.

There are no federal Marine Protected Areas in the study area according to Fisheries and Oceans Canada (DFO). Other marine protected and conserved areas are listed by DFO in the Canadian Protected and Conserved Areas Database (CPCAD), one within the study area, Tursujuq National Park (Québec), and a Land Reserved for Protected Area located outside the zone to the south (*Lac-Burton-Rivière-Roggan-et-la-Pointe-Louis-XIV*). Those two parks are land park that both have small, protected bays in the Hudson Bay and are outside of the terrestrial reach of the study area. There are no proposed marine protected areas in the study area. However, there is one project to protect Belcher Islands: Qikiqtait Protected Area. The study area is located within a Priority Area for Conservation by WWF Canada.

The development of a harbour in the Eeyou Marine Region implies various issues regarding laws and regulations, and environmental components, namely fish habitat, introduction of pollutants and contamination, and introduction of aquatic invasive species. It could also interact with the traditional uses of the area by Cree and Inuit communities. The main laws applicable to the marine environment in the context of La Grande Alliance are the *Fisheries Act*, the *Oceans Act*, the *Canada Wildlife Act*, the *Species at Risk Act*, the *Marine Mammal Regulations*, the *Migratory Birds Convention Act*, the *Aquatic Invasive Species Act*, the *Canada Shipping Act* and the *Ballast Water Regulations*.

The *Oceans Act* requires the Department of Fisheries and Oceans to designate Ecologically and Biologically Significant Areas (EBSA) across Canadian marine waters. There is a large overlap between EBSA and marine transport corridors. To minimize potential effects of shipping on wildlife, respect culturally and ecologically sensitive areas, enhance marine navigation safety, and guide economic development of the North, northern low-impact shipping corridors are under development by the Canadian Coast Guard (CCG), Transport Canada, and Canadian Hydrographic Service, together with Inuit, First Nations and Metis organizations and governments, provincial and territorial governments, and other key stakeholders through the Canadian Arctic region. Ultimately, this initiative should limit the areas available for shipping activity and provide a strong starting point for the integration of the protection of the marine environment and its traditional uses.

Main issues and constraints to the development of a harbour are related to higher maritime traffic that would increase collision risk with marine mammals, increase the risk of water and sediment contamination as well as increase the risk of invasion by non-indigenous species. Such a development also means higher disturbance both under- and above-water, habitat loss, changes in local water dynamics, and possibly a better access to harvested resources. Depending on the location of the harbour, it might also have a localized impact on the landscape appreciation (Manitounuk Sound).

It is recommended to proceed to some photointerpretation of the littoral to identify salt marshes and possibly eelgrass meadows, to perform specific inventories on species at risk, bird colonies and shellfish beds, summering haulout, and fish spawning areas. These studies would allow a better understanding of the use of the study area and would allow to better mitigate impacts on those species. Low Impact Shipping Corridors Initiative and Cree and Inuit community consultations must form an integral part of all future stages of work.

Refer to Technical Note 7 for more detailed information.

10 CLIMATE CHANGE

The objective of this section is to document the shifts in climate change over the lifetime of the infrastructure planned under The Grand Alliance. This assessment takes into account short-term (2021-2050) and long-term (2051-2080) climate projections and considers two Intergovernmental Panel on Climate Change (IPCC) emissions scenarios - RCP 4.5 and RCP 8.5.

La Grande Alliance proposed infrastructures includes port, roadways, and railways in northern Quebec, along the southern coast of Hudson Bay and farther inland. La Grande Alliance Study Area lies within a subarctic environment, which is rugged, forested, and glaciated (WWF, 2022; Agriculture and Agri-food Canada, 1995). The study area has:

- Cold winters and cool summers, which are projected to increase in temperatures;
- Sporadic permafrost, which is projected to experience ongoing degradation due to increasing temperatures and liquid precipitation regimes;
- Moderately dry conditions, which are projected to become wetter with increases in extreme precipitation events;
- Substantial snow accumulation, which is projected to remain relatively unchanged in the near future;
- Days with freezing rain, which are projected to nearly double;
- High wind gusts and sustained wind velocities, which are projected to nearly triple in some cases;
- A moderate number of fire spread days (i.e., days when weather conditions are favorable to the spread of wildfires), which are projected to increase up to three days per year in the more northern Eastern Subarctic zone of the study area;
- Riverine flooding, which requires further characterization but may potentially increase in the future;
- Coastal flooding, which is a short-term consideration but projected to ultimately decrease in the future due to land uplift.

The purpose is to assess if and how the climate hazards can impact and influence the infrastructure components included in the proposed Grande Alliance Studies. Overall, eight climate hazards are selected for the region and should be considered in further assessments:

1. Extreme Cold
2. Extreme Precipitation
3. Freezing Rain
4. Land Instability
5. High Winds
6. Wildfires
7. Riverine Flooding
8. Coastal Flooding

These climate hazards have the potential to interact with the infrastructure components included in La Grande Alliance proposed infrastructures and should be further studied. Three data gaps are identified (linked to riverine flooding, geotechnical knowledge, permafrost distribution and melt, and wind). In addition to remedying the data gaps, proposed next steps include a climate resilience assessment following the applicable provincial laws, while being aligned with ISO 31000 and ISO 14091 standards for risk management and climate change adaptation to better quantify the level of risk for each climate-infrastructure interaction.

Refer to Technical Note 9 for more detailed information.