LA GRANDE ALLIANCE

LA GRANDE ALLIANCE

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

TECHNICAL NOTE 19
BENEFIT-COST ANALYSIS

FINAL VERSION

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EXECUTIVE SUMMARY

This technical note monetizes the social and community-level benefits and disbenefits of the built infrastructure proposed by Phase II and Phase III of La Grande Alliance. Social and community-level benefits and disbenefits are the positive and negative externalities to economic agents who will not be directly involved in the construction and the operation of La Grande Alliance infrastructure. The externalities generated by transportation infrastructure come in the form of travel time savings, reduced transportation costs, better environment and improved safety for the entire population, firms, and governments in the Northern region of Quebec.

As the study area is situated in a remote area with abundant natural resources, lack of transportation infrastructure makes all forms of economic development, namely mining but also community economic development, extremely difficult. The study area is well known for its Hydro-Québec landmarks and infrastructure which will reach their end of life soon, and therefore will require replacement and, quite possibly, upgrading. Demand for transportation of goods and people is expected to grow over the next decades. Based on our forecasted demand for transportation, social and community-level benefits were assessed and monetized using the MTQ's 2016 Benefit-Cost Analysis Guidance.

Several traditional benefits were quantified, and a number of non-quantifiable benefits were discussed qualitatively. For quantifiable benefits, seven categories were quantified, namely:

1. Freight shipping costs;
2. Passenger transportation costs;
3. Travel time for passengers and drivers;
4. Users' vehicle operating expenses;
5. GHG emissions;
6. Air contaminants emissions;
7. Road accidents.

Table ES-1 summarizes the Benefit-Cost Analysis results monetized over the entire 2027-2074 period. This 48-year period of analysis includes 13 years of construction in Phase II from 2027 to 2039, 13 years of construction in Phase III from 2032 to 2044, and 30 years of operations starting from 2040 and 2045 for Phase II and Phase III respectively.

The present CBA uses the net present value (NPV) and the Benefit-to-Cost Ratio (BCR) as two common benefit-cost evaluation measures. Both the NPV and the BCR express the relation of discounted benefits to discounted costs as a measure of the extent to which a Project's benefits either exceed or fall short of the costs. The NPV is the difference between the Project total benefits and the Project costs, while the BCR is the ratio between the former over the latter.

In sum, Phase II is expected to generate a NPV of $2.3 billion and a BCR of 1.36 when no discount rate was used. Phase III is expected to create a loss for the society with a NPV of - $3.1 billion and a BCR of 0.37. On a discounted standpoint, Phase II returns a negative NPV of - $1.6 billion, with a BCR of 0.20. For Phase III, the discounted NPV and discounted BCR are both negative, with - $1.0 billion and -0.01. The interpretation of a negative BCR is that for every dollar investing in La Grande Alliance's Phase III, the associated discounted economic loss for the society would be equivalent to an amount of $0.01. If both phases II & III were combined, the BCR becomes 0.93 when using no discount rate, and 0.13 when using a discount rate of 2.37%.

The most important benefit brought by the proposed La Grande Alliance infrastructure is users' vehicle operating cost savings ($4.0 billion), followed by travel time savings ($1.5 billion), both generated mostly by Phase II. To a lesser extent, the benefits of reduced GHG emission, air contaminant emissions, and road accidents are all significant. However, the operating and maintenance of La Grande Alliance infrastructure is expected to be costly, with $2.3 billion to be spent over the 2040-2074 period.

Table Cost Benefit Analysis Results, 2027-2074 (Million of 2023 Dollars)

#	Benefit & Cost Item	Undiscounted Value (M$)			Discounted Value (M$) at 2.37%		
		Phase II	Phase III	Total	Phase II	Phase III	Total
1	Freight shipping cost savings (Whapmagoostui only)	14	4.1	18	1	0.2	1
2	Passenger transportation cost savings (Whapmagoostui only)	57	0.9	57	4	0.0	4
3	Travel time savings (road &rail transportation)	1,469	5.6	1,475	100	0.2	101
4	Users' vehicle operating expenses (road transportation)	3,996	5.3	4,002	273	0.2	273
5	GHG emissions (road &rail transportation)	669	0.7	670	40	0.0	40
6	Air contaminant emissions (road &rail transportation)	310	0.2	310	21	0.0	21
7	Accident Cost Savings (including Fatalities, Injuries and PDO) - (road transportation)	379	2.0	381	26	0.1	26
8	Infrastructure Operating and Maintenance Costs (road & rail transportation)	(1,484)	(766)	(2,250)	(98)	(31)	(129)
9	Residual Value	3,327	2,560	5,888	41	20	61
10	**Total Benefits**	**8,737**	**1,813**	**10,550**	**409**	**(11)**	**399**
11	**Total Costs (CAPEX)**	**6,439**	**4,956**	**11,395**	**2,031**	**1,014**	**3,045**
12	**NPV**	**2,297**	**(3,143)**	**(845)**	**(1,621)**	**(1,025)**	**(2,646)**
13	**BCR**	**1.36**	**0.37**	**0.93**	**0.20**	**(0.01)**	**0.13**

TABLE OF CONTENTS

1 INTRODUCTION 1

2 METHODOLOGY AND BASIS OF ASSUMPTIONS 3

2.1 Overview 3

2.2 Definition of No-Build and Build Scenarios 4

2.3 Timelines 9

2.4 General Model Assumptions 10

3 INFRASTRUCTURE COSTS 11

3.1 Capital Expenditures (CAPEX) 11

3.2 Operating and Maintenance (O&M) Costs 14

4 BENEFITS 16

4.1 Benefit Categories 17

4.2 Phase II 18

4.3 Rupert River – La Grande Study Area 29

4.4 Phase III 33

5 SUMMARY OF RESULTS 37

5.1 Summary of CBA Results 37

5.2 Breakdown of Benefits by Component 39

5.3 Combined Phases I-II-III CBA Results 41

6 ADDITIONAL QUALITATIVE BENEFITS 42

7 CONCLUSION 43

TABLE OF CONTENTS

TABLES

Table 2-1 No-Build and Build Scenarios for Phase I, II and III 4

Table 3-1 No-Build CAPEX & Residual Value per Option (Million of 2023 Dollars) 11

Table 3-2 Build CAPEX per Segment (Million of 2023 Dollars) 12

Table 3-3 Capital Costs per Phase (Million of 2023 Dollars) 13

Table 3-4 Residual Value per Phase (M$2023) 13

Table 3-5 No-Build OPEX per Option (Million of 2023 Dollars) 14

Table 3-6 Operating and Maintenance Costs per Phase (M$2023) 14

Table 4-1 Description of Infrastructure Assets and Users 16

Table 4-2 CBA benefit categories and definitions 17

Table 4-3 Cargo Shipping Rates for Phase II Whapmagoostui/Kuujjuarapik Road Extension 19

Table 4-4 Freight Volumes Destined to Whapmagoostui/Kuujjuarapik - Phase II No-Build and Build Cases (Tons per Annum) 19

Table 4-5 Travel Distance by Road (Passenger and Freight) for Phase II (Km) (One-Way Distances) 20

Table 4-6 Total Freight Travel Costs Savings for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023) 20

Table 4-7 Passenger Rates for Phase II Whapmagoostui/Kuujjuarapik Road Extension (One-Way) 20

Table 4-8 Total Passenger Travel Costs Savings for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023) 21

Table 4-9 Vehicle Operating Expenses 22

Table 4-10 Vehicle Fuel Consumption Costs 22

TABLE OF CONTENTS

Table 4-11 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023) 22

Table 4-12 Total GHG and Air Contaminant Emissions Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area (Undiscounted $2023) 23

Table 4-13 Incident Frequency in Quebec per Billion Vehicle-Kilometres 24

Table 4-14 Cost per Vehicular Incident (MTQ Guidelines) 25

Table 4-15 Total Vehicle-Kilometres for Passenger and Freight Vehicles (2040) 25

Table 4-16 Total Safety Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023) 25

Table 4-17 Regional Freight Volumes Applied to Route 167-Trans-Taiga Study Area 26

Table 4-18 Distance and Travel Time between Val d'Or and Brisay for Route 167-Trans-Taiga Build and No-Build cases 26

Table 4-19 Value of Time for Passengers and Drivers per Hour ($2023) 27

Table 4-20 Total Freight Travel Time Savings for Phase II Route 167-Trans-Taiga Study Area ($2023) 27

Table 4-21 Total Freight Truck Vehicle Operating Costs and Fuel Consumption Costs for Phase II Route 167 – Trans-Taiga Study Area ($2023) 27

Table 4-22 Total GHG and Air Contaminant Emissions Costs for Phase II Route 167-Trans-Taiga Study Area ($2023) 28

Table 4-23 Total Safety Costs for Phase II Route 167-Trans-Taiga Study Area ($2023) 28

Table 4-24 Freight Volumes for Rupert River to La Grande Railway - Phase II No-Build and Build Cases (Tons per Annum) 29

TABLE OF CONTENTS

Table 4-25 Distance and Travel Time between Rupert River and La Grande for Build and No-Build cases 30
Table 4-26 Total Freight Travel Time Savings for Phase II Rupert River – La Grande Study Area ($2023) 30
Table 4-27 Passenger Traffic Demand for Phase II and Phase III Passenger Rail Service (Number of Round Trips per Annum) 30
Table 4-28 Total Passenger Travel Time Savings for Phase II Rupert River - La Grande Study Area ($2023) 30
Table 4-29 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase II Rupert River - La Grande Study Area ($2023) 31
Table 4-30 Total GHG and Air Contaminant Emissions Costs for Phase II Rupert River - La Grande Study Area ($2023) 32
Table 4-31 Total Safety Costs for Phase II Rupert River - La Grande Railway Study Area ($2023) 32
Table 4-32 Freight Volumes Destined to Whapmagoostui/Kuujjuarapik - Phase III No-Build and Build Cases (Tons per Annum) 33
Table 4-33 Distance and Travel Time Between La Grande and Whapmagoostui/Kuujjuarapik for Build and No-Build Cases 34
Table 4-34 Total Freight Travel Time Savings for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023) 34
Table 4-35 Total Passenger Travel Time Savings for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023) 34
Table 4-36 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023) 35

TABLE OF CONTENTS

Table 4-37 Total GHG and Air Contaminant Emissions Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023) 35

Table 4-38 Total Safety Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023) 36

Table 5-1 Cost Benefit Analysis Results, Phases II and III 37

Table 5-2 Cost Benefit Analysis Results, Phases II and III 38

Table 5-3 Phase II CBA Results by Component, Undiscounted 2023 million Dollars 39

Table 5-4 Phase III CBA Results by Component, Undiscounted Million 2023 Dollars 40

Table 5-5 Combined CBA Results, Phases I, II, III 41

FIGURES

Figure 2-1 Benefit-Cost Analysis Study Areas 5

Figure 2-2 Proposed Project and Phases Timeline 9

1 INTRODUCTION

This Technical Note 19 (TN19) presents the Cost Benefit Analysis (CBA) developed by WSP for the proposed La Grande Alliance Phases II and III infrastructure. A CBA is one of the standardized tools to improve decision-making on a particular project. It quantifies the benefits and disbenefits of a project in monetary terms, and then compares the value to the project costs to provide an assessment on whether the quantified benefits meet or exceed the project costs. This TN19 relies on information presented in the Market Study[1] and Technical Note 21 – Financial Analysis, as well as secondary sources, which are noted in-line in the contents of this note.

The primary objectives for the CBA are to:

1. Identify potential benefits that can be quantified and monetized according to industry standards for Phase II and III projects;
2. Develop the CBA model in line with standard industry practice;
3. Compute the benefit-cost ratio (BCR) of the Project by phase;
4. Briefly summarize potential qualitative benefits of the proposed infrastructure that cannot be quantified or monetized.

The proposed La Grande Alliance transportation infrastructure consists of:

PHASE I (1-5 YEARS)[2] (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, that of the Billy-Diamond Highway (BDH) starting at the town of Matagami towards km 257 of the BDH (Rupert River Bridge).
- **Railway: Grevet to Chapais**

  A return to service for the 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: Upgrade & extension to Trans-Taiga**

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

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

  A proposed road corridor connecting Chisasibi community's access road and Whapmagoostui/Kuujjuarapik, over 207 km.

[1] Feasibility Study, Phase I, Prefeasibility Study, Phases II-III, Market Study, 2022/07/18.

[2] 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.

PHASE III (16-30 YEARS)

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

  A proposed railway alignment extending from the Phase II railway alignment, and which follows, as much as possible, the feasibility roadway alignment leading to Whapmagoostui/Kuujjuarapik developed during this study by WSP. The Phase III railway alignment extends over an approximate distance of 219 km.

- **Harbour at Whapmagoostui/Kuujjuarapik**

  A proposed seasonal Harbour for shallow draft vessels/boats (~6 m water depth) along the Whapmagoostui/Kuujjuarapik coastline between the mouth of Great Whale River and the entrance of the Manitounuk Strait.

Phases II and III are the subjects of this Technical Note. The CBA for Phase I was conducted by the VEI team. It should be noted that both the VEI team and the WSP team have produced independent analysis using different economic models and assumptions. The WSP team has not verified the Phase I analysis and has presented the output results “as is” within the body of this Technical Note for informational purposes only.

2 METHODOLOGY AND BASIS OF ASSUMPTIONS

2.1 OVERVIEW

The overall goal of a CBA is to take a broader perspective where public welfare associated with a project is evaluated to justify the costs of a project. A CBA is an evaluation framework that quantifies the economic advantages or benefits (e.g., increased trade flow, reduced travel times, etc.) and disadvantages or disbenefits (e.g., increased GHG emissions, adverse environmental impacts, etc.) and costs (e.g., capital investment, of an investment alternative as compared to a base case, typically a "No-Build" scenario where the infrastructure is not constructed). Benefits and costs are categorized and defined using industry standard methodologies for CBAs and are quantified in monetary terms to the extent possible. The CBA produces a net present value (NPV) and benefit-cost ratio (BCR). Both can be used to interpret the dollar value of the monetized benefits generated by the project for each dollar spent on the project.

2.1.1 BASIS OF CBA MODEL

CBAs are a common methodology used in industry to assess whether a project is considered a good investment from a socio-economic perspective. Under the model, a project is considered a "good investment" if for each dollar spent, one or more dollars are generated in benefits (i.e., a BCR> 1.0). Different jurisdictions or industries have publicly available standards for CBAs, such as MTQ's 2016 Cost-Benefit Analysis Guidance for Public Roads, British Columbia's Cost-Benefit Analysis Guidebook, or the US Department of Transportation's Benefit-Cost Analysis Guidance for Discretionary Grant Programs. Governments and reputed organizations also publish standard dollar-value conversion metrics that, for example, can be applied to quantify the monetary value of air pollution, vehicle degradation, travel time savings, or accident reduction. Because La Grande Alliance proposed infrastructures are in the province of Quebec, the use of the MTQ's 2016 Cost-Benefit Analysis Guidance for Public Road[3] is suitable in this context.

The CBA framework involves defining a base scenario, typically a "No-Build" scenario, which is compared to the "Build" scenario, where the project is built as proposed. The CBA assesses the incremental difference between the "No Build" scenario and the "Build" scenario, which represents the net change in welfare. CBAs are forward-looking exercises which seek to assess the incremental change in welfare over a project life cycle. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

A CBA is a useful tool to understand and quantify socio-economic benefits of a project. It can be used to support decision makers in determining whether a project is considered a good investment. It is noted that CBA guidelines also acknowledge that projects may have qualitative benefits that cannot be reasonably monetized but deserve consideration in evaluating whether a project should proceed.

[3] Ministère des Transports et de la Mobilité durable, Guide de l'analyse avantages-coûts des projets publics en transport routier. Partie 1: Méthodologie (2016).

2.1.2 CBA MODEL BOUNDARIES

As noted in the Market Study, for socio-demographic and regional matters, the study area covers the Eeyou Istchee Baie-James territory which includes Cree and Jamesian communities and Kuujjuarapik Inuit communities. For inter-regional economic activities, the region is extended to include both Abitibi-Témiscamingue and Saguenay-Lac-Saint areas. For the purpose of the CBA, the analysis is conducted from the perspective of the communities, which represent the socio-economic boundary for evaluating the benefits derived from the project.

2.2 DEFINITION OF NO-BUILD AND BUILD SCENARIOS

A CBA always requires that a No-Build and a Build case be defined to evaluate the incremental impact of the proposed project. Under a **No-Build scenario**, also referred to as a 'base case' or 'business as usual' scenario, the proposed project is not built or implemented. Under a **Build scenario**, the project under consideration is built or implemented. To assess the incremental impact of the proposed project, one needs to assess separately how the economy and society would operate and fare under each scenario. The purpose of this section and the following sub-sections is therefore to define the No-Build and Build scenarios for Phases II and III of the infrastructure program.

The CBA for Phases I, II and III were conducted separately, in line with how the proposed La Grande Alliance infrastructure has been studied, and accounts for the different timelines and construction sequencing. Table 2-1 summarizes how "No-Build" and "Build" scenarios were defined for all phases of the LGA. As stated in the CBA conducted by the VEI team for Phase I, the status quo consists of rebuilding the existing BDH to meet new travel demand that was recently updated.[4] As a result the No-Build case for Phase I involves the rehabilitation of the first 257 kilometers from Matagami to Rupert River. If Phase I is built, then only regular maintenance of that portion is required over the project lifecycle.

Because the focus of this investigation is a CBA for Phases II and III, **under both No-Build scenarios, La Grande Alliance Phase I and the last 365 kilometers of the BDH were built because it represents how the system will exist in the future, even if Phases II and III were not built.**

For the Phase II CBA, the rehabilitation of the 620-km BDH and the construction of Phase I are assumed to be complete, and that both projects would be operational. For the Phase III CBA, Phase II construction is assumed to be complete, and that the entire LGA infrastructure would be open for public.

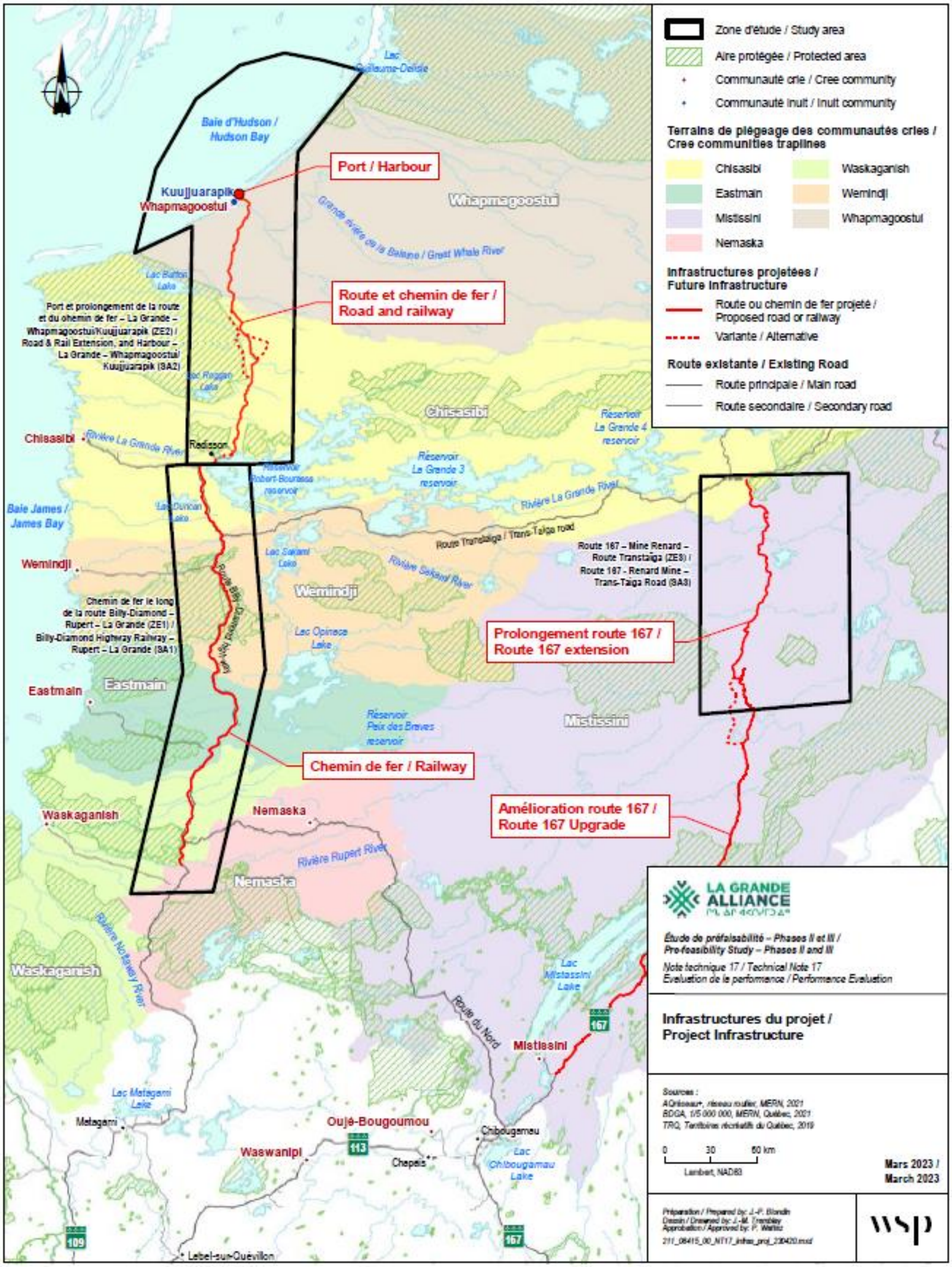
Table 2-1 No-Build and Build Scenarios for Phase I, II and III

	NO-BUILD SCENARIO	BUILD SCENARIO
Phase I	First portion of the BDH Rebuilt (4 Options 0, 1, 2, and 3)	Phase I + regular maintenance of the BDH
Phase II	Last portion of the BDH Rebuilt (4 Options 0, 1, 2, and 3) + Phase I constructed	Phase II constructed
Phase III	PhaseII constructed	Phase III constructed

Both Phase II and Phase III consist of both road and rail segments, and Phase III contains a port that, in addition to being three separate infrastructure classes, have significant geographic separation. As a result, the "study area" of each infrastructure segment is also different as are the associated benefits. For these reasons, the CBA discusses the benefits associated with each segment separately before amalgamating the benefits into an overall BCR for each phase.

A reference map is provided in Figure 2-1 below that sets out nomenclature of the study areas discussed under the No-Build and Build cases in the following section.

[4] The initial version of this technical note considered that the BDH would not be rehabilitated.


Zone d'étude / Study area
Aire protégée / Protected area
Communauté crie / Cree community
Communauté inuit / Inuit community
Terrains de piégeage des communautés cries / Cree communities traplines
Chisasibi
Waskaganish
Eastmain
Wemindji
Mistissini
Whapmagoostui
Nemaska
Infrastructures projetées / Future Infrastructure
Route ou chemin de fer projeté / Proposed road or railway
Variante / Alternative
Route existante / Existing Road
Route principale / Main road
Route secondaire / Secondary road
Port / Harbour
Route et chemin de fer / Road and railway
Prolongement route 167 / Route 167 extension
Chemin de fer / Railway
Amélioration route 167 / Route 167 Upgrade
Baie d'Hudson / Hudson Bay
Baie James / James Bay
Kuujjuarapik
Whapmagoostui
Chisasibi
Radisson
Wemindji
Eastmain
Waskaganish
Nemaska
Mistissini
Oujé-Bougoumou
Waswanipi
Chibougamau
Chapais
Matagami
Lebel-sur-Quévillon
Route Transtaiga / Trans-Taiga road
Route 167 – Mine Renard – Route Transtaiga (ZE3) / Route 167 - Renard Mine – Trans-Taiga Road (SA3)
Port et prolongement de la route et du chemin de fer – La Grande – Whapmagoostui/Kuujjuarapik (ZE2) / Road & Rail Extension, and Harbour – La Grande – Whapmagoostui/ Kuujjuarapik (SA2)
Chemin de fer le long de la route Billy-Diamond – Rupert – La Grande (ZE1) / Billy-Diamond Highway Railway – Rupert – La Grande (SA1)
Rivière La Grande River
Rivière Rupert River
Réservoir La Grande 3 reservoir
LA GRANDE ALLIANCE
Étude de préfaisabilité – Phases II et III / Pre-feasibility Study – Phases II and III
Note technique 17 / Technical Note 17
Évaluation de la performance / Performance Evaluation
Infrastructures du projet / Project Infrastructure
0 30 60 km
Lambert, NAD83
Mars 2023 / March 2023
wsp

2.2.1 PHASE II – NO-BUILD CASE

At the time of writing this technical note, some updates on Phase I's CAPEX were made to reflect new demand for goods movement mainly from the mining and then the forestry sector. According to the request from SDC to perform a comparison between the LGA and the actual "doing-nothing" scenario, and between the LGA and a "doing something" scenario, it is understood that different scenarios for the No-Build case should be considered. In fact, three scenarios to renovate the existing BHD, plus a "non-rehabilitation" scenario for the existing BDH were proposed.

Rupert River – La Grande Study Area (SA1)

Under Phase I, the status quo was defined as doing nothing or rehabilitating the first 257 km of the existing BDH the rehabilitation of the last 363 kilometers of the BDH and Phase I infrastructure are assumed to be completed in the No-Build cases for Phase II and III. Since goods destined beyond Rupert River are the subject of the Phase II CBA, in the No-Build case, traffic destined to Matagami is transshipped to the road at Rupert River for the journey. Similarly, passengers use personal vehicles to move by road along the Rupert River – La Grande section of the rebuilt BDH.

In the Phase II No-Build case, shipments destined northbound within the Rupert River to La Grande study area are transshipped from rail to the BDH at Rupert River. Likewise, passengers to destinations north of Rupert River continue using personal vehicles.

Whapmagoostui-Kuujjuarapik Study Area (SA2)

Whapmagoostui is the northernmost Cree community in Quebec, located at the mouth of the Great Whale River on the coast of Hudson Bay in Nunavik. It is the last remaining Cree community without road access. Air service is provided to Kuujjuarapik Airport, which serves Kuujjuarapik and nearby Whapmagoostui, by Air Inuit and Air Creebec. Collectively, air service provides multiple connecting flights per week to local nearby towns, as well as direct flights to Chisasibi and Montreal.

The Whapmagoostui-Kuujjuarapik area is served by the Fédération des Coopératives du Nouveau-Québec (FCNQ) for retail sales, construction materials, distribution of petroleum products, hotel service industry, real estate, cable television/Internet, as well as other community services (WSP, 2021). As elaborated in the Market Study, the estimated consumer good needs for Whapmagoostui-Kuujjuarapik are based on the average supply per capita for the James Bay communities, which equates to a total of 3,783 tons per annum.

Desgagnés Transarctick operates vessels to Whapmagoostui and Kuujjuarapik communities, which delivers consumer goods (food, clothes, packages, etc.) and equipment (transportation equipment, machinery, etc.). Desgagnés Transarctick similarly makes two annual round trips from Sainte-Catherine Port to Kuujjuarapik.

In addition to the per capita consumption estimates, approximately four to six premanufactured houses are shipped by sea to Whapmagoostui-Kuujjuarapik annually. As per the Market Study, this equated to 117 tons per year. Two scheduled trips are made each year (once each in the fall and summer) by NEAS to provide houses and construction material.

In the Phase II No-Build case, no road connection between La Grande and Whapmagoostui-Kuujjuarapik is constructed. Without the proposed road connection, Whapmagoostui-Kuujjuarapik remains accessible by air or water transportation only for cargo movements, and air only for passenger movements.

Route 167 – Trans-Taiga Study Area (SA3)

Route 167 currently extends from Saint-Félicien near Lac Saint-Jean, winds north to connect Chibougamau and Mistissini, then terminates at the Renard mine site. Route 167 connects to Route du Nord just north of Chibougamau, and onward to BDH via Route du Nord. South of Chibougamau connects to Route 113. The northernmost 100 km of Route 167 connecting to the Renard mine is categorized as a resource road, and is currently used only as an access road to/from the mine site. Renard staff fly in and out from a purpose-built airport located at the mine. North of Route 167, the Trans-Taiga Road extends east-west from Brisay and connects to the BDH approximately 50 km south of Radisson.

In the Phase II No-Build case, the existing road network has only the one north-south connection from Chisasibi to Mistissini, using the existing Route 167 to connect to Route du Nord to the BDH south of Rupert River.

2.2.2 PHASE II – BUILD CASE

Rupert River – La Grande Study Area (SA1)

Under the Phase II Build Case, a rail connection will be constructed that extends the new Phase I rail infrastructure network, extending the main line a further 340 km northbound from Rupert River to La Grande, including new loading/intermodal facilities near La Grande River that will allow for transloading from rail to the proposed road connection as part of the Phase II Build case.

The rail is assumed to capture freight traffic that will have previously relied on the BDH for northbound cargo. The Market Study notes that Hydro-Québec expressed interest in the use of the rail up to La Grande, and it is anticipated that the construction sector will make use of the railway, forgoing the existing maritime routes. Mining projects are also assumed to use the north-south rail, including the Rupert River to La Grande segment of Phase II. Additionally, consumer goods, estimated in the market study at approximately 8,800 tons, are expected to transfer from road to rail to provide supplies to the James Bay communities.

Passenger service also commences along the new railway and is assumed to capture traffic from the personal vehicle trips that otherwise use the BDH.

Whapmagoostui/Kuujjuarapik Study Area (SA2)

As elaborated in the Market Study, upon completion of the road from La Grande to Whapmagoostui/Kuujjuarapik, a proposed road corridor will be available and it is anticipated that the 3,783 tons per annum of consumer goods would be shipped from Matagami to La Grande by rail (**see Rupert River to La Grande Study Area**), and from La Grande to Whapmagoostui/Kuujjuarapik by road.

As per the Market Study, the construction sector is the main generator of general maritime cargo traffic, and this is expected to remain the case in Phase II. Until the southern railway reaches Whapmagoostui/Kuujjuarapik in Phase III, the prefabricated houses and other construction materials continue by sea, as due to their size, they were not considered well suited for long-haul road transportation.

Under the Phase II Build Case, residents of Whapmagoostui/Kuujjuarapik will also benefit from the new connection to the main road corridor in the region, the BDH, which is expected to replace air travel for local/regional trips. At this time, there was no information on whether a regional or long-distance bus service was anticipated, and as such, it is assumed that personal vehicles will be the primary mode of transit for passengers to nearby towns.

Under the Phase II Build case, Whapmagoostui/Kuujjuarapik consumer goods are shipped by rail to La Grande, then transloaded in La Grande from rail to road, and shipped north along the highway. Passengers making local or regional trips can now do so by road using personal vehicles.

Route 167 – Trans-Taiga Study Area (SA3)

Under Phase II, Route 167 will be extended from the Renard mine site to form an eastern corridor in the form of a north-south connection to the Trans-Taiga Road. The extension will provide a second north-south transportation corridor and reduce travel time between Chibougamau and Chisasibi. In the Build case, existing gravel segments of Route 167 are also paved.

Because the connection is intended to provide a secondary corridor and is expected to attract only resource movements, the volumes along the road are limited to the Hydro-Québec power plants in the region, with some potential for future mining projects.

Two main shipping companies move cargo within the region, Kepa Transport, which supplies goods to the James Bay Cree communities and also serves Hydro-Québec, and Transport Jacques Auger which also delivers petroleum products to Cree communities and companies on the James Bay Territory.

While the connection to the Trans-Taiga Road will provide a second eastern corridor that connects the two most populous Jamesian communities of Chibougamau and Chisasibi, the information available does not suggest that the new road will generate a significant number of new passenger trips nor will it result in any significantly shorter passenger journeys when compared to existing routes, and as such, no passenger benefits are quantified in Phase II Build case associated with the Route 167 extension.

In the Phase II Build Case for Route 167 – Trans-Taiga study area, a second north-south corridor attracts some freight movement bound for easterly destinations because of the reduced travel distance.

2.2.3 PHASE III – NO-BUILD CASE

Whapmagoostui/Kuujjuarapik Study Area (SA2)

In the Phase III No-Build case, the BDH road extension is operational, and remains the only land connection from La Grande to Whapmagoostui/Kuujjuarapik.

In the Phase III No-Build case, the Phase II Build case becomes the status quo.

2.2.4 PHASE III – BUILD CASE

Whapmagoostui/Kuujjuarapik Study Area (SA2)

As per the Market Study, once Whapmagoostui/Kuujjuarapik is accessible by train, it is expected that all the goods and equipment will reach Whapmagoostui/Kuujjuarapik by rail, forgoing the need to transfer from rail to truck near La Grande river. The 3,783 tonnes per annum (TPA) would therefore all be shipped by rail once the construction of La Grande-Whapmagoostui/Kuujjuarapik rail corridor is completed.

According to Market Study, in light of the collected stakeholder survey data, shipping manufactured houses by rail is preferred over vessel and trucks. Once the railway reaches Whapmagoostui/Kuujjuarapik from the south, 117 tons of manufactured houses and other construction materials, which were previously transported by sea vessel, would likely be transported by rail to Whapmagoostui and Kuujjuarapik.

In the Market Study, passenger traffic was separated into three categories of potential movement, the local population, visitors and tourists, and workers. Passenger train service is assumed to capture demand from the local population, and attract visitors and tourists, while workers are assumed to continue to use a “fly in fly out” system for the major industries.

In the Phase III Build case, an intermodal port connection in Whapmagoostui/Kuujjuarapik on James Bay is also constructed and operationalized. The new harbour is intended to create a sea link between the Eeyou Istchee-Baie-James communities to the global economy.

As stated in the Market Study, rail transportation is considered preferred over water transportation, and as such no demand is expected for the Whapmagoostui harbour after 2045. The Market Study separately noted that, when the port infrastructure is combined with the rail connection at Whapmagoostui/Kuujjuarapik, the corridor could be of interest for the Duncan Lake iron ore mine project and/or to the Great Whale iron ore project, 65 km east of Whapmagoostui/Kuujjuarapik. As described in the Financial Analysis, new infrastructure could lead economic actors to evaluate projects which were previously not considered or to re-evaluate rejected projects, which could impact the freight transportation demand for Phase III. It is noted, however, that investment decisions depend on many additional factors such as, for example, iron ore prices on the global market, competing regional projects, and additional infrastructure investment needs.

At this time, there is no indication that these mining projects are expected to come online during the analysis period, and as such, the port has not been studied under the CBA as there are no quantifiable benefits associated with the investment.

In the Phase III Build case, rail becomes the mode of choice for moving cargo into Whapmagoostui/Kuujjuarapik. Passenger rail commences, replacing all of the personal vehicle movements generated in Phase II between La Grande and Whapmagoostui/Kuujjuarapik.

2.3 TIMELINES

Figure 2-2 shows the preliminary schedule for the proposed infrastructures according to the phases described in the previous sections. The timeline was previously developed in tandem with La Grande Alliance and established as being the base case dates for the Financial Analysis. For each phase, the preliminalry studies, design and construction period are assumed to last 13 years and the operation period to last 30 years. More specifically:

— Phase I's design and construction (not covered in this CBA) is scheduled from 2022 to 2034, and the operations from 2035 to 2064;

— For Phase II, the design and construction of the infrastructure starts in 2027 and ends in 2039, with the operations starting in 2040 and ending in 2069;

— In Phase III, the design and construction period is planned for 2032 to 2044, and the operation period from 2045 to 2074.

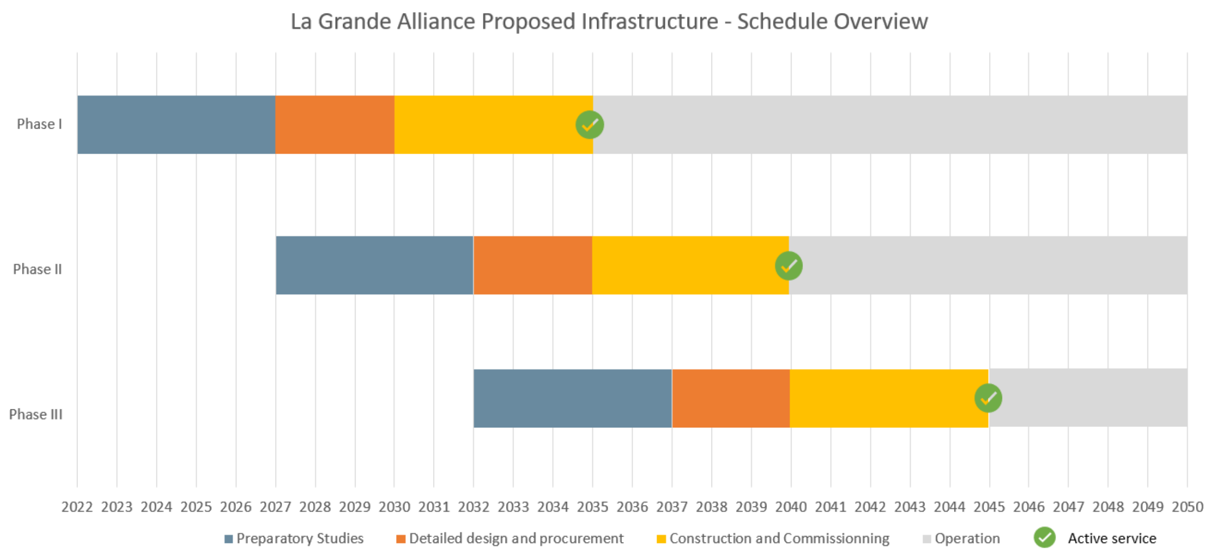


Figure 2-2 Proposed Project and Phases Timeline

2.4 GENERAL MODEL ASSUMPTIONS

The CBA model includes the following analytical assumptions:

— The construction of Phase II ends in 2039, then Phase II'S benefits/disbenefits are assumed to be fully realized in 2040 when Phase II's infrastructure is in full operation and open for the public;
— The construction of Phase III ends in 2044, then Phase III's benefits/disbenefits are assumed to be fully realized in 2040 when Phase II's infrastructure is in full operation and open for the public
— The useful life of all new infrastructure is assumed to be 60 years, counted from the first year of the operating period for each phase;
— The net change in benefits/disbenefits and costs will be calculated for 13 years of construction (2027-2039) and 30 years of operation (2040-2069) for Phase II; and for 13 years of construction (2032-2044) and 30 years of operation (2045-2074) for Phase III;
— Whenever possible, the model uses MTQ[5] recommended monetized values for travel time costs, reduced fatalities, injuries, property damage, reduced vehicle operating costs, and emissions, while relying on best practices for monetization of other benefits;
— Dollar values are in real 2023 dollars. In instances where cost estimates and benefits valuations are expressed in historical or future dollar years, escalation factors are used to adjust the values;
— Future benefits and costs are discounted with a real discount rate of 2.37%, which is in line with what MTQ recommends for transportation infrastructure;
— For travel distances, all goods and passengers are assumed to travel the full length of the infrastructure segment (from origin to destination and back) based on information extracted from the Market Study, i.e., intermediary stops are not modelled;
— As per the Market Study, freight traffic is assumed to be constant throughout the study period. As per the Market Study, passenger traffic has periodic increases in estimated traffic.

[5] Ministère des Transports du Québec, 2016. Guide de l'analyse avantages coûts des projets publics en transport routier. Lien : https://www.transports.gouv.qc.ca/fr/entreprises-partenaires/entreprises-reseaux-routier/guides-formulaires/documents-gestionprojetsroutiers/guide-avantages-couts-projets-publics.pdf

3 INFRASTRUCTURE COSTS

3.1 CAPITAL EXPENDITURES (CAPEX)

3.1.1 NO-BUILD CASE CAPEX AND RESIDUAL VALUES

As agreed in the initial version of this technical note, the actual scenario (called Option 0) would not need any capital investment. The three options proposed in the new version would require, however, substantial amount of capital to meet the new estimated demand. To estimate the CAPEX for each option for the last 363 kilometers of the BDH, the same unit cost per km estimated for the first 257 kilometers of the BDH was applied. In sum, to the total CAPEX required to complete the construction work were estimated to range from $1.2B if option 1B is adopted to $5.1B if option 3B is adopted. These costs exclude sustaining capital costs which will be included in the operation and maintenance costs (OPEX)

Assuming that the maintenance work of the BDH will allow the infrastructure to last approximately 60 years. A lifespan of 60 years is consider to be appropriate due to the infrastructure type, the hard meteorological conditions, the low demand, and the level of sustaining capital spendings. If it is the case, then after the year of construction completion in 2034, the year the value of the assets falls to zero would be 2094. Assuming the asset depreciates at a constant rate per year, the remaining capital asset value at the end year of analysis, commonly called the residual value, is consequently estimated to be $520M in undiscounted 2023 dollars for Option 1B, $1.3B for Option 2B, and $2.3B for Option 3B (Table 3-1).

Table 3-1 No-Build CAPEX & Residual Value per Option (Million of 2023 Dollars)

Variable	Unit	Value			
		Option 0	Option 1	Option 2	Option 3
Construction Costs	M$	0	1,156	2,907	5,104
Lifespan	years	60	60	60	60
Depreciation Rate	M$/year	0	19	48	85
Residual Value	M$	0	520	1,308	2,297

Source: WSP calculation based on VEI inputs

3.1.2 BUILD CASE CAPEX & RESIDUAL VALUES

The breakdown of direct construction costs is taken from Technical Note 16 – Construction Cost Estimate (TN16). TN16 separates the costs by phase, segment, and cost item. Details of the assumptions made, and methodology used to obtain the estimated construction costs can be found in TN16. The schedule of the construction costs is presented in Technical Note 15 – Construction Overview (TN15). Breakdown of cost schedule per segment and per item, assumptions, and methodology used are detailed in TN15. The alignment of the construction costs and the projected schedule was made with the help of WSP’s technical team. In summary, the cost items are grouped into the following five categories:

- Preparatory studies;
- Detailed design and procurement;
- Construction and commissioning - Rail;

- Construction and commissioning - Roads;
- Construction and commissioning - Harbour.

Table 3-2 presents the initial capital expenditures by expense category and by segment, excluding taxes, with and without contingencies and risks. The total preparatory studies, design and construction costs for Phase II were estimated to be $6.44 billion, and $4.96 billion for Phase III. As previously stated, capital expenditures were assumed to be distributed over the schedules presented in Section 2.3. For each phase, the preparatory studies are expected to last 5 years, the detailed design and procurement to last 3 years, and the construction and commissioning to last 5 years, for a total of 13 years. Therefore, CAPEX do not include sustaining capital costs. This latter is however included the Operating and Maintenance Costs presented in section 3.2.

Table 3-2 Build CAPEX per Segment (Million of 2023 Dollars)

EXPENSE CATEGORY	PHASE II			PHASE III	
	Roadway: La Grande to Whapmagoostui/ Kuujjuarapik	Route 167: Upgrade & extension to Trans-Taiga	Railway: Rupert to La Grande	Railway: La Grande to Whapmagoostui/ Kuujjuarapik	Port at Whapmagoostui/ Kuujjuarapik
Preparatory Studies	159	117	440	544	8
Detailed Design and Procurement	79	59	220	272	4
Construction and Commissioning - Rail	0	0	2,199	2,722	0
Construction and Commissioning - Roads	793	585	0	0	0
Construction and Commissioning - Harbour	0	0	0	0	29
Sub-total	***1,031***	***761***	***2,859***	***3,538***	***41***
Contingencies (30%)	238	176	660	817	9
Risks (20%)	159	117	440	544	6
Total cost (excluding taxes)	**1,428**	**1,053**	**3,958**	**4,899**	**57**

Source: WSP

Table 3-3 summarizes the cost by phase for the Build and No-Build cases. For both phases, there is no capital expenditure in the No-Build scenarios.

Table 3-3 Capital Costs per Phase (Million of 2023 Dollars)

Expense Catagory	PHASE II	PHASE III	Total
Preparatory Studies	715	552	1,268
Detailed Design and Procurement	358	276	634
Construction and Commissionning - Rail	2,199	2,722	4,921
Construction and Commissionning - Roads	1,378	0	1,378
Construction and Commissionning - Harbour	0	29	29
Sub-Total	***4,651***	***3,579***	**8,230**
Contingencies (30%)	1,073	826	1,899
Risks (20%)	715	551	1,266
Total cost (excluding taxes)	**6,439**	**4,956**	**11,395**

Source: WSP

Assuming that the maintenance work will allow La Grande Alliance infrastructure to last approximately 60 years, meaning that the year the value of the assets falls to zero would be 2100 for Phase II infrastructure and 2104 for Phase III infrastructure. Assuming the asset depreciates at a constant rate per year, which is $107.3 million for Phase II and $82.6 million for Phase III, the remaining capital asset value at the end years of analysis, commonly called the residual value, is consequently estimated to be $3.3 billion in undiscounted 2023 dollars for Phase II and $2.6 billion for Phase III (Table 3-4).

Table 3-4 Residual Value per Phase (M$2023)

VARIABLE	UNIT	VALUE		
		Phase II	Phase III	Total
CAPEX	M$	6,439	4,956	11,395
Lifespan	years	60	60	
Depreciation Rate	M$/year	107.3	82.6	189.9
Residual Value	**M$**	**3,327**	**2,560**	**5,888**

3.2 OPERATING AND MAINTENANCE (O&M) COSTS

3.2.1 NO-BUILD CASE OPEX

As in the No-Build Case CAPEX, the do-nothing and the do-something would require different levels of effort for operate and maintain the infrastructure. In fact, no capital investment in the BDH would cost $20.1M per year for operation and maintenance of the 363 km of the BDH. Rehabilitating it would cost however much less than that. To estimate the OPEX for each option for the last 363 kilometers of the BDH, the same unit cost per km per year estimated for the first 257 kilometers of the BDH was applied. On a yearly basis, the annual costs required for operation and maintenance of the infrastructure would range from $4.5M if option 1B is adopted to $6.6B if option 3B is adopted.

For the do-nothing option, no sustaining capital costs would be required over a 30-year period of operation. For doing-something option, sustaining capital costs are expected to occur sometime over the lifespan of the operation period. On a yearly basis, sustaining capital costs result in an average amount of $19.6M, $27M, and $34.5M for each option respectively.

In total, summing the OPEX and the sustaining CAPEX amounts to between $20.1M to $41.1M per year depending on which option is chosen in the end.

Table 3-5 No-Build OPEX per Option (Million of 2023 Dollars)

Variable	Unit	Value			
		Option 0	Option 1B	Option 2B	Option 3B
OPEX	M$/year	20.1	4.5	6.4	6.6
Sustaining CAPEX	M$/year	0	19.6	27.0	34.5
Total OPEX	M$/year	**20.1**	**24.1**	**33.4**	**41.1**

Source: WSP calculation based on VEI inputs

3.2.2 BUILD CASE OPEX

O&M costs are presented separately for Phase II and III, divided between road and railway segments (Table 3-6). The methodology for road and rail O&M costs are first summarized, followed by sections that present the assumptions and methodology used to obtain the operating costs for each Build scenario (Phase II and Phase III) and their respective No-Build scenario.

Table 3-6 Operating and Maintenance Costs per Phase (M$2023)

		TOTAL KM	ANNUAL OPEX (M$)
Phase II			
Road	La Grande to Whapmagoostui/Kuujjuarapik	207	$3.5
	Route 167: Upgrade & extension to Trans-Taiga	376	$6.3
	Sub-Total	**583**	**$9.8**

		TOTAL KM	ANNUAL OPEX (M$)
Rail	Rupert to La Grande		
	Freight O&M Costs	340	$33.3
	Passenger O&M Costs	340	$2.4
	Sub-Total (excl. sustaining Capex)	**340**	**$35.7**
	Sustaining Capital Costs	340	$23.7
	Sub-Total (incl. sustaining Capex)	**340**	**$59.4**
Phase III			
Rail	La Grande to Whapmagoostui/Kuujjuarapik		
	Freight O&M Costs	219	$21.4
	Passenger O&M Costs	219	$1.6
	Sub-Total (excl. sustaining Capex)	**219**	**$23.0**
	Sustaining Capital Costs	219	$15.3
	Sub-Total (incl. sustaining Capex)	**219**	**$38.3**

Source: WSP

3.2.2.1 *ROAD O&M COSTS*

Road maintenance costs were calculated from SDBJ's "*Détermination du seuil minimal d'entretien pour la route de la Baie-James (Route Matagami-Radisson et chemin de Chisasibi)*". The total road operating expenses were divided by the length of the BDH to obtain the unit operating cost per km. The initial unit cost per km was first estimated in constant dollar of 2013, then inflated to today's constant dollar by using Consumer Price Index (CPI) obtained from Statistics Canada. As per Technical Note 21 – Financial Analysis, the unit O&M cost was estimated to be $16,808/km in 2023 dollars.

It is worth noting that the build-case OPEX were initially calculated for all LGA road components, except for the BDH starting from the 257km to the 620km. In this version, operating and maintaining that portion would require the same level of effort as it would be if the LGA is approved to go ahead. Therefore, $20.1M per year would be allocated to the task. In other words, the incremental change in OPEX for Option 0 would be zero.

3.2.2.2 *RAIL O&M COSTS*

For rail components, O&M costs were broken-down by Freight category and Passenger category. For these expenses, a parametric approach has been applied, using Phase I's rail operating costs as inputs. In fact, cost parameters associated with the Matagami-Rupert River rail segment were used for Phase II and III's rail segments. As per Technical Note 21 – Financial Analysis, the all-in annual operating costs carried in the CBA were estimated to be $105,000/km in 2023 dollars.

Over the entire project horizon, depreciation and damages to the assets will occur at some point in time. To keep the assets last longer, maintenance and rehabilitation works need to be done periodically, thus requiring some sustaining capital costs. This latter is expected to occur on the 10th year of the operation period, and then every 5 years afterwards. From a parametric analysis, it was estimated that the annual average sustaining capital costs amount to $23.67 million and $15.25 million for Phase II and for Phase III respectively.

4 BENEFITS

As described in Chapter 2, a CBA accounts for the *incremental benefits and disbenefits of a project*, compared to a No-Build case. Each major project or infrastructure segment proposed within Phase II and Phase III are reviewed separately in terms of the socio-economic benefits induced by each Build case, described in section 2.2 of this report.

Benefits associated with each mode of transportation are quantified according to the users or societal groups impacted by each asset type and segment. The following table summarizes each phase by asset type and the users modelled in the CBA.

Table 4-1 Description of Infrastructure Assets and Users

PHASE	ASSET TYPE	DESCRIPTION OF ASSETS	USER CATEGORIES MODELLED IN CBA
Phase II	Road	**La Grande to Whapmagoostui/Kuujjuarapik** A proposed road corridor connecting Chisasibi community's access road and Whapmagoostui/Kuujjuarapik, over 207 km. **Route 167:** **Upgrade & extension to Trans-Taiga** Upgrade and paving the section from the Mistissini community access road to the access Stornoway Renard Mine access road over an approximate distance of (±204 km); North extension to connect with the Trans-Taiga Road near km 408, over 172 km.	**Road users:** - Personal passenger vehicles - Freight shippers **Society at large:** - Natural environment (i.e., GHG and air contaminants) - Road safety
	Rail	**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.	**Rail users:** - Passenger rail customers - Freight shippers **Society at large:** - Natural environment (i.e., GHG and air contaminants) - Road safety
Phase III	Rail	**La Grande to Whapmagoostui/Kuujjuarapik** A proposed railway alignment extending from the Phase II railway alignment, and which follows, as much as possible, the feasibility roadway alignment leading to Whapmagoostui/Kuujjuarapik developed during this study by WSP. The Phase III railway alignment extends over an approximate distance of 219 km.	**Rail users:** - Passenger rail customers - Freight shippers **Society at large:** - Natural environment (i.e., GHG and air contaminants) - Road safety
	Port	**Whapmagoostui/Kuujjuarapik** A port at Whapmagoostui/Kuujjuarapik.	- N/A (see section 2.2.4 Phase III – Build Case)

4.1 BENEFIT CATEGORIES

The benefits seen in Table 4-2 were quantified and then classified under three main long-term outcomes: economic competitiveness, environment, and safety. General definitions for each benefit category are provided in the table. Each benefit was considered in the context of the Build and No-Build cases described earlier in section 2.2. The methodology for quantifying the incremental benefit for each infrastructure segment is elaborated in the following sections, organized by phase and study area.

Table 4-2 CBA benefit categories and definitions

LONG-TERM OUTCOME	BENEFIT (DISBENEFIT) CATEGORY	DESCRIPTION
Economic Competitiveness	Shipping Cost – Freight	For beneficiaries within the economic boundaries of the project, a reduction in transportation costs for freight provides economic benefit to the community in the form of reduced operating costs, a more level competitive playing field within broader economic markets, and/or potentially reduced costs to end-consumers.
	Travel Cost – Passenger	For beneficiaries within the economic boundaries of the project, a reduction in cost for passengers provides economic benefit to the community in the form of better access to transportation and services and more purchasing power.
	Travel Time Savings - Freight	For freight shippers, travel time is considered a cost to businesses, as long travel times, delays, and disruptions have negative impacts to business operations. For freight shippers, more direct/shorter routes result in better efficiency, contribute to levelling competitive advantages, and provide more certainty in how they operate their businesses.
	Travel Time Savings - Passenger	For commuters, travel time is considered a cost to users, and its value is a function of the disutility that travellers attribute to time spent travelling. For passengers, a reduction in travel time translates into more time available for work, leisure, or other activities.
	Users' vehicle operating expenses	Projects that reduce the length of travelled road routes during result in a decrease in vehicle kilometres travelled (VKT), and as a result, produce reduced vehicle O&M costs (including the cost of fuel, as well as maintenance and repair, replacement of tires, and the depreciation of the vehicle over time) which are a net benefit to road users.
Environment	GHG and air contaminant emissions	Projects that decrease automobile and commercial truck travel, either through more direct routes, modal shifts to lower-emission technology, and/or reduced idling time or bottlenecks, provide environmental and sustainability benefits to society related to reduction in GHG emissions and air pollution in the form of nitrous oxide (NOx), particulate matter (PM2.5 and PM10), sulfur dioxide (SO2), benzene (HC) and carbon dioxide (CO2). Projects that result in a net increase of GHG or air contaminant emissions result in an environmental disbenefit, which can often the case with greenfield infrastructure projects that are not replacing a higher-polluting alternative.
Safety	Fatalities, Injuries, Property Damage Only (PDO)	Safety benefits are generated in the form of reduced collisions and incidents as a result of road improvement projects, shorter travel distances, or modal shifts that reduce the number of vehicles on the road (e.g., reduction in freight vehicles on the road, or a modal shift of vehicles to passenger rail).

4.2 PHASE II

4.2.1 *WHAPMAGOOSTUI/KUUJJUARAPIK STUDY AREA*

4.2.1.1 *TRANSPORTATION COSTS*

Whapmagoostui/Kuujjuarapik remains without road access, meaning that air travel is the only existing option for passengers and all cargo is shipped in by sea vessel. Under the Phase II Build case, a proposed road extension is built to reach Whapmagoostui/Kuujjuarapik, which will provide a new access mode and route for the community.

For new transportation infrastructure, standard CBA practice compares existing travel conditions for passengers and freight (e.g., travel time savings) to future conditions where a new or improved asset reduces travel times for users. However, in the case of Whapmagoostui/Kuujjuarapik, transportation options for the existing Base Case are severely constrained, for example:

1. **Cargo shipments are limited to twice yearly** due to both limited market size and weather conditions, meaning that travel time for a vessel to reach Whapmagoostui/Kuujjuarapik cannot reasonably be used as a benchmark to quantify the project benefits, as the wait time for imports can be up to 6 months;
2. **Passenger flights are faster than road or rail travel,** which also means that travel time savings is not a quantifiable benefit when comparing flight time to road or rail travel time in the Build case; however, flight is considered expensive, and the remote nature and lack of road access is considered an inhibitor to local and regional passenger travel, meaning that affordable access should be considered a benefit to the local population.

In consideration of the above, a separate benefit category for "affordability" was included in the CBA to quantify the local economic benefit of reduced cost and increased access to for passenger and freight travel.

It should be noted that, in a more broadly defined CBA that defines benefits from the perspective of the national economy, affordability would traditionally be considered a "cash transfer" and would not be considered an economic benefit, as the transfer of benefit would be offset by the disbenefit experienced by another segment of the economy (e.g., airlines). However, within the context of this CBA, transportation cost savings is considered as a benefit within the defined CBA boundaries, which is investigating the benefit to a specified geographic region and beneficiary population, as the economic benefits are being evaluated from the perspective of the regional communities.

SHIPPING COST – FREIGHT

In the No-Build Case, shipping costs per twenty-foot equivalent unit container ($/TEU) for freight by vessel were sourced from NEAS sealift rates for 2022.

In the Build case for Phase II, freight is assumed to move by rail up to the La Grande terminal, where it is transshipped to road for the remainder of the journey. Therefore, for the Build Case, shipping costs are a combination of road travel shipping costs, which used an average MTQ $/ton km for the 0-to 1,000 km distance to obtain the calculated 0.1061 $/ton-km, and rail shipping costs, which used the 0.04 $/ton km from the Canadian Rail Association figure.

Table 4-3 Cargo Shipping Rates for Phase II Whapmagoostui/Kuujjuarapik Road Extension

VARIABLE	UNIT	VALUE	SOURCE
No-Build Case			
Shipping cost (sea vessel)	$/TEU	7,625	NEAS (2022)[6]
Build Case			
Shipping cost (road freight)	$/ton km	0.1061	MTQ (2022)[7]
Shipping cost (rail freight)	$/ton km	0.0428	Canadian Rail Association (2022)[8]

Total freight volumes, which consist of consumer goods and prefabricated houses, for the Whapmagoostui/Kuujjuarapik region were extracted from information provided in the Market Study, summarized below in Table 4-4. The first year of operation for Phase II is presented.

Table 4-4 Freight Volumes Destined to Whapmagoostui/Kuujjuarapik - Phase II No-Build and Build Cases (Tons per Annum)

	NO-BUILD CASE (2039)	BUILD CASE (2039)
Sea vessel volumes		
Consumer good supplies – Whapmagoostui	2,132	0
Consumer good supplies – Kuujjuarapik	1,651	0
Prefabricated houses	117	117
Sub-total	3,900	117
Road volumes		
Consumer good supplies – Whapmagoostui	0	2,132
Consumer good supplies – Kuujjuarapik	0	1,651
Prefabricated houses	0	0
Sub-total	0	3,783
Total tonnage	3,900	3,900

Source: Market Study

Sea vessel costs are calculated based on the total tonnage, converted to twenty-foot equivalent units (TEUs) with an estimated 30 tons per TEU, then multiplied by the quoted rate in Table 4-3. Because unit cost is quoted by NEAS in TEUs to Whapmagoostui/Kuujjuarapik, total travel distance is not relevant in the No-Build case.

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[6] https://neas.ca/wp-content/uploads/Sealift-Rates_2022_Nunavik.pdf
[7] http://www.bv.transports.gouv.qc.ca/per/1258039/04-2022.pdf
[8] https://www.railcan.ca/wp-content/uploads/2023/02/2022_Q4_RAC_Quarterly_Report_Draft_EN_Draft_Rev.1.pdf

For the Build case, road and rail costs are calculated based on the total tonnage multiplied by the travel distances in Table 4-5, and then multiplied by the average freight unit rate in Table 4-3.

Table 4-5 Travel Distance by Road (Passenger and Freight) for Phase II (Km) (One-Way Distances)

	BUILD CASE	NO-BUILD CASE
Road (La Grande to Whapmagoostui)	236	0
Rail (Val-d'Or to La Grande)	913	0

The following table summarizes the net freight cost savings associated with the construction of the proposed road in Phase II for the full life of the project, presenting discounted and undiscounted net savings.

Table 4-6 Total Freight Travel Costs Savings for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
No-Build case travel cost	991,247	29,737,422
Build case travel cost	514,292	15,428,762
Travel cost savings benefit	**476,955**	**14,308,660**

Source: Model output

TRAVEL COST – PASSENGER

For the No-Build case, there was no data available on the number of passenger-trips per year in or out of the Kuujjuarapik Airport[9], and likewise no information was available on the proportion of trips to various destinations. Therefore, a typical flight from Kuujjuarapik Airport to Val-d'Or was assumed for a benchmark. Table 4-7 presents the assumed cost for a one-way trip.

For the Build case, passengers are assumed to travel between La Grande terminal and Whapmagoostui/Kuujjuarapik with personal vehicles, then transfer to train for the remainder of the journey. The rail cost was based on a calculated average for train passenger services in remote locations.

Table 4-7 Passenger Rates for Phase II Whapmagoostui/Kuujjuarapik Road Extension (One-Way)

VARIABLE	UNIT	VALUE	SOURCE
No-Build Case Travel Cost			
Flight cost (one way)	$/passenger	707.44	Air Creebec[10]
Build Case Travel Cost			
Whapmagoostui Road personal vehicle travel costs	$/passenger-km	0.470	CAA[11]
La Grande Passenger Rail travel costs	$/passenger-km	0.215	Market Study

[9] https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=2310025301
[10] https://reservations.aircreebec.ca/search-result
[11] https://carcosts.caa.ca/fr

As noted above, no information was available on the number of passenger flights per year to/from Kuujjuarapik Airport. The Market Study provided an estimate based on surveys of the anticipated ridership for Phase II and III of the passenger rail service (see Table 4-27 in section 4.3). Owing to the lack of data on current passenger demand for air travel, as a baseline, it was assumed that the project rail passenger traffic volumes were a representation of the future road traffic as well as the baseline of annual demand for flights to/from Kuujjuarapik Airport. In other words, the demands for rail service, road service, and air service are equal and there is no accounting for induced demand. This has no effect on the CBA model results, because the standard calculation considers only the differential modal shift (e.g., the number of air passengers that opt to drive instead).

Flight costs are given by trip between origin and destination, and as such total travel distance is not required in the calculations for the No-Build case. For the Build case, road and rail costs are calculated based on the passenger unit rate above, multiplied by an assumed average trip distance for passengers, presented above in Table 4-5. The following table summarizes the net passenger cost savings associated with the construction of the proposed road in Phase II for the full life of the project, presenting discounted and undiscounted net savings.

Table 4-8 Total Passenger Travel Costs Savings for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
No-Build case travel cost	2,807,112	90,795,679
Build case travel cost	998,697	32,302,623
Travel cost savings benefit	**1,808,425**	**58,493,056**

Source: Model output

4.2.1.2 *COMMENTS ON TRAVEL TIME SAVINGS*

Typically, travel time savings is considered a benefit (or disbenefit) that is quantified and monetized in a transportation infrastructure CBA. For example, a new highway is likely to reduce the amount of time passengers spend on their commute both along the highway (which is faster) and on the existing roads (because traffic congestion will improve). Likewise, a project that increases travel time would be said to have a disbenefit, for example a project that reduces the speed along a road (perhaps as part of a safety improvement project) would increase the travel time of passengers using that road.

In the case of the Whapmagoostui/Kuujjuarapik road connection, while travel times by road are longer than a flight to the same destination, the disbenefit that could be associated with a longer travel time by road has been dismissed in this analysis because residents are not obligated to drive and can continue to fly if they prefer.

4.2.1.3 *USERS' VEHICLE OPERATING EXPENSES*

Vehicle operating cost savings include the cost of fuel, as well as maintenance and repair, replacement of tires, and the depreciation of the vehicle over time. Fuel consumption rates per vehicle kilometre travelled (VKT) are used to calculate the vehicle operating cost savings. Estimates of VKT (see Table 4-5) and unit costs for vehicle operating costs (Table 4-9) and fuel consumption costs (Table 4-10) are applied to the consumption rates to calculate the total vehicle operating cost. Both fuel consumption rates and vehicle operating expenses are measured in dollars per vehicle kilometres travelled (VKT) and are used to calculate the vehicle operating cost savings. Separate rates are used for freight vehicles and private passenger vehicles. It is worth to note that rail operating costs were already included in the overall O&M costs of the infrastructure, and therefore not included in the calculation of users' vehicle operating expenses. Only freight trucks and passenger vehicles are considered to avoid double counting benefits or disbenefits.

As stated above, the base case has no road option, and because of trips made by personally owned vehicles will experience additional wear and tear, the project produces a disbenefit in this category.

Table 4-9 Vehicle Operating Expenses

	UNIT	FREIGHT TRUCKS	PASSENGER VEHICLE	SOURCE
Cost per kilometre ($2015)	$/km	0.266	0.105	MTQ[12]
Cost indexation ($2015 to $2023)	index	1.314	1. 314	CPI for Quebec, Transportation Item
Road operating expenses ($2023)	$/km	0.349	0.138	-

Table 4-10 Vehicle Fuel Consumption Costs

	UNIT	FREIGHT TRUCKS	PASSENGER VEHICLE	SOURCE
Cost per kilometre ($2015)	$/km	0.57	0.167	MTQ[13]
Cost indexation ($2015 to $2023)	index	1.60	1.60	CPI for Quebec, Gasoline Item
Road fuel consumption costs ($2023)	$/km	0.91	0.27	-

For freight, because the operating expenses measure the cost per kilometre for one vehicle, volumes must be converted to the number of trucks required to complete the shipments. Truck-kms were calculated by converting the tonnages presented in Table 4-4 using an estimated 30 tons per truck, then multiplying by the round-trip travel distances (equal to twice the distances presented in Table 4-5). Once the total truck-km for each case is known, it is multiplied by the quoted freight truck rates in Table 4-9 and Table 4-10.

Similarly for passengers, vehicle-kms are calculated by converting the number of passengers to vehicles using an assumed personal vehicle occupancy of 2.0 passengers per vehicle, then multiply by the round-trip travel distances equal to twice the distances presented in Table 4-5. Once the total vehicle-kms for each case is known, it is multiplied by the quoted passenger vehicle rates in Table 4-9 and Table 4-10.. As noted in Table 4-27, passenger demand is assumed to grow overtime, which is reflected in the project lifecycle costs.

Table 4-11 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Freight		
No-Build case vehicle operating cost	0	0
Build case vehicle operating cost	74,936	2,248,093
Users' vehicle operating benefit	**-74,936**	**-2,248,093**
Passenger		
No-Build case vehicle operating cost	0	0
Build case vehicle operating cost	94,676	3,062,280
Users' vehicle operating benefit	**-94,676**	**-3,062,280**
Total users' vehicle operating benefit	-169,613	-5,310,373

Source: Model output

[12] https://www.transports.gouv.qc.ca/fr/entreprises-partenaires/entreprises-reseaux-routier/guides-formulaires/documents-gestionprojetsroutiers/guide-avantages-couts-projets-publics.pdf

[13] https://www.transports.gouv.qc.ca/fr/entreprises-partenaires/entreprises-reseaux-routier/guides-formulaires/documents-gestionprojetsroutiers/guide-avantages-couts-projets-publics.pdf

4.2.1.4 *GHG AND AIR CONTAMINANT EMISSIONS*

Some projects can create environmental and sustainability benefits relating to reduction in air pollution associated with decreased personal vehicle and freight vehicle travel. Projects that generate new emissions (e.g., that either induce new vehicle trips or create a modal shift from a less GHG-intense mode to a more GHG-intense mode) may produce a disbenefit.

For the case of Whapmagoostui/Kuujjuarapik, the base case pollutants from sea and air are assumed not to change between the Build and No-Build case, because it is assumed that the number of weekly flights will remain constant and that the sea vessel continues to make a semi-annual stop at Kuujjuarapik. While a reduction in sea or air service in the Build case may result in an improvement to the GHG and air contaminant disbenefits, it is not known if the commercial airlines or vessel operators plan to reduce service, and as such, the CBA considers the more conservative scenario where both airlines and vessel operators operate the same service levels in the Build case as in the No-Build case.

In this CBA, GHG is measured and monetized, as are five forms of air contaminants: nitrous oxide (NOx), particulate matter (PM2.5 and PM10), sulfur dioxide (SO2), benzene (HC) and carbon dioxide (CO2). For roads, the MTQ CBA guideline provides conversion factors for the cost of each pollutant per metric tonne of emissions, as well as the conversion factor for calculating total weight of emissions per pollutant per kilometre travelled for various vehicle types based on the travelling speed of the vehicle. The conversions can be found in section 4 of the "Guide de l'analyse avantages-coûts des projets publics en transport routier. Partie 2: paramètres valeurs de 2015"[14]. Consumer Price Index (CPI) was used to convert $2015 to $2023. An assumed speed of 70 km/h was used for the proposed road to Whapmagoostui/Kuujjuarapik in all vehicle categories. Extracts from the guideline and the associated calculation tables to quantify the cost per pollutant are omitted from this report owing to the size and length of the calculation tables. Total kilometres for the journey are as previously presented in Table 4-5.

It is worth noting that, according to MTQ and industry standard, GHG costs escalate over time in today's dollars, which is one reason they are modelled and reported separately from air contaminants.

Table 4-12 Total GHG and Air Contaminant Emissions Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area (Undiscounted $2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Freight		
No-Build case GHG cost	0	0
Build case GHG cost	12,753	518,990
GHG benefit	**-12,753**	**-518,990**
No-Build case air emissions cost	0	0
Build case air emissions cost	5,909	177,263
Air contaminant benefit	**-5,909**	**-177,263**
Passenger		
No-Build case GHG cost	0	0
Build case GHG cost	20,315	893,804

14 Ministère des Transports et de la Mobilité durable, Guide de l'analyse avantages-coûts des projets publics en transport routier. Partie 2: paramètres valeurs de 2015 (2016).

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
GHG benefit	**-20,315**	**-893,804**
No-Build case air emissions cost	0	0
Build case air emissions cost	2,192	70,910
Air contaminant benefit	**-2,192**	**-70,910**
Total GHG and air contaminant benefit	41,169	1,660,967

Source: Model output

4.2.1.5 *FATALITIES, INJURIES, PROPERTY DAMAGE ONLY (PDO)*

Safety benefits are generated in the form of reduced collisions and incidents as a result of three potential parameters:

— A reduction in the number of vehicles on the road, which is attributed to a modal shift from road to rail;
— An investment in road safety improvements, such as projects that improve visibility or calm traffic;
— A reduction in the necessary travel distance for personal vehicles to reach their destinations.

For the Phase II proposed road to Whapmagoostui/Kuujjuarapik, because the No-Build case has no road traffic, the newly generated vehicular traffic in the Build case will generate a disbenefit in the form of traffic incidents.

Since the Whapmagoostui/Kuujjuarapik proposed road will be a new construction for which no existing data exists, the number of fatalities, injuries, and property damage only (PDO) incidents for the Whapmagoostui/Kuujjuarapik road are assumed to follow average Quebec rates, which are reported by Transport Canada, summarized below.

Table 4-13 Incident Frequency in Quebec per Billion Vehicle-Kilometres

ROAD (VEHICLES AND TRUCKS)	QUEBEC	SOURCE
Fatalities (per billion vehicle-km)	4.8	Transport Canada[15]
Injuries (per billion vehicle-km)	338.8	Transport Canada
PDO (per billion vehicle-km)	774.2	Partenariat Données Québec[16] and assumptions regarding total vehicle-kms in the province

Costs associated with road incidents are provided by MTQ's CBA guidelines in section 2 of the "Guide de l'analyse avantages-coûts des projets publics en transport routier. Partie 2: paramètres valeurs de 2015"[17]. Costs have been adjusted from $2015 to $2023 using the CPI for the Quebec transportation products group.

Based on the estimated transfer vehicle-kilometres, the road segment from La Grande to Whapmagoostui/Kuujjuarapik is estimated to suffer 0.45 PDOs, 0.20 injuries, and 0.003 deaths per year due to road-related incidents.

15 https://tc.canada.ca/fr/transport-routier/statistiques-donnees/statistiques-collisions-route-canada-2020
16 https://www.donneesquebec.ca/recherche/fr/dataset/rapports-d-accident
17 Ministère des Transports et de la Mobilité durable, Guide de l'analyse avantages-coûts des projets publics en transport routier. Partie 2: paramètres valeurs de 2015 (2016).

Table 4-14 Cost per Vehicular Incident (MTQ Guidelines)

	COST/ACCIDENT	SOURCE
Indexation	1. 314	CPI for Quebec, Transportation Item
Fatal accident ($2023)	$5,521,165	MTQ[18]
Injuries ($2023)	$229,958	MTQ
Property Damage Only ($2023)	$18,471	MTQ

Total costs are calculated by multiplying the number of vehicle-kilometres by the frequency in Table 4-13 and the cost per incident in Table 4-14. Total vehicle-kilometres for passengers assumes a vehicle occupancy rate of 2.0, and tonnage is converted to truck using a conversion rate of 30 tonnes per truck. Passenger vehicle-kilometres (see Table 4-27) increase slightly over time according to the projections in the Market Study. Each vehicle makes a round trip.

The total vehicle-kilometres in 2040 is presented in Table 4-15 below. The total safety cost is presented in Table 4-16.

Table 4-15 Total Vehicle-Kilometres for Passenger and Freight Vehicles (2040)

	TOTAL DISTANCE (2040)
Passenger vehicle-kilometres	467,827
Truck vehicle-kilometres	59,469
Total	**527,296**

Table 4-16 Total Safety Costs for Phase II Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
No-Build case safety cost	0	0
Build Case safety cost	62,596	2,008,104
Total safety benefit	**-62,596**	**-2, 008,104**

[18] https://www.transports.gouv.qc.ca/fr/entreprises-partenaires/entreprises-reseaux-routier/guides-formulaires/documents-gestionprojetsroutiers/guide-avantages-couts-projets-publics.pdf

4.2.2 ROUTE 167 – TRANS-TAIGA STUDY AREA

4.2.2.1 TRAVEL TIME SAVINGS

FREIGHT

The travel time can be monetized as it is considered a cost to users. Projects that reduce travel times offer benefit to users in the form of more time available for work, leisure, or other activities. For the Route 167 to Trans-Taiga Road extension, Hydro-Québec freight volumes that currently travel from the south toward the generating stations in the eastern part of the region will benefit from reduced travel distance and associated travel time savings.

Currently, the Billy-Diamond Highway is the only north-south land route to supply Hydro-Québec's generating stations along the Trans-Taiga Road. Kepa Transport and Transport Jacques Auger provided survey response data as part of the Market Study outreach. Their reported regional volumes are presented below in Table 4-17.

The Market Study did not specifically provide freight volume data for the eastern corridor region, and data was not separated by origin-destination pairs. As such, a methodology was required to allocate a portion of the freight volumes to the future Route 167-Trans-Taiga connection. Hydro-Québec is expected to be the largest single user of the corridor to supply three of its stations: Brisay, Laforge-1, and Laforge-2. The three stations make up 9.6% of the MW capacity for Hydro-Québec in the overall region, which was used as a proxy to estimate the proportion of Kepa Transport and Transport Jacques Auger traffic destined to pass through the new northbound Route 167.

It is assumed that in both the No-Build and Build cases for Route 167-Trans-Taiga study area, all freight moves by road only, as the freight is currently moved by long-haul trucking companies and will continue to operate its deliveries for Hydro-Québec by road.

Table 4-17 Regional Freight Volumes Applied to Route 167-Trans-Taiga Study Area

	KEPA TRANSPORT	TRANSPORT JACQUES AUGER
Trips per year	300	432
Tons per truck	30	30
Regional total[1]	**9,000**	**12,960**
Assumed proportion passing through Road 167[2]	10%	10%
Total tons per year – Route 167	**2,097**	

Sources: 1. Market Study Survey, 2. WSP assumptions

To calculate travel time savings, 9.6% of the total trips per year is used to estimate the number of one-way trips. For the purpose of the CBA, travel distance was calculated for journeys originating in Val-d'Or and destined to Brisay, located all trucks are assumed to make round trips. Total travel distances are summarized in Table 4-18 below. To calculate the travel time for the new section, using information from Technical Note 11, a 50 km/hr travel speed was assumed for the existing mine road and a 70 km/hr travel speed for paved roads and the MTQ road.

Table 4-18 Distance and Travel Time between Val d'Or and Brisay for Route 167-Trans-Taiga Build and No-Build cases

VARIABLE	UNIT	VALUE	SOURCE
No-Build case			
Distance	km	1,372	Google Maps
Time	hours/trip	20.35	Google Maps
Build case			
Distance	km	1,279	Google Maps + Technical Note 11
Time	hours/trip	16.82	Google Maps + Technical Note 11

The MTQ CBA guidelines provide standard inputs for the value of time for passengers and drivers for road travel, which have been updated to 2023 dollars.

Table 4-19 Value of Time for Passengers and Drivers per Hour ($2023)

VALUE OF TIME	UNIT	VALUE
Drivers	$/hour	41.07
Passengers	$/hour	20.96

Source: MTQ

Total travel time savings are presented below in Table 4-20.

Table 4-20 Total Freight Travel Time Savings for Phase II Route 167-Trans-Taiga Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Travel time - No-Build case	116,857	3,505,706
Travel time - Build case	96,562	2,896,853
Travel time savings benefit	**20,295**	**608,853**

Source: Model output

PASSENGER

The northern Route 167 segment is currently considered a resource road. While the connection to the Trans-Taiga Road will provide a second eastern corridor, the information available does not suggest that it will generate any significant number of shorter passenger journeys when compared to existing routes, and as such, no passenger benefits are quantified in Phase II Build case associated with the Route 167 extension.

4.2.2.2 *USERS' VEHICLE OPERATING EXPENSES*

As defined in Table 4-2 and described further in section 4.2.1.3, vehicle operating cost savings are associated with reduced travel distances and idle time. For Phase II Route 167 extension to the Trans-Taiga Road, a reduction in travel distance between Val d'Or and Brisay for freight vehicles (presented above in Table 4-18) generates a positive benefit for the project. The estimated total vehicle operating savings are calculated by multiplying VKT and unit costs from MTQ, previously presented under section 4.2.1.3 in Table 4-9 and Table 4-10. As noted above, no passenger volumes are generated by the Route 167 extension, and as such, there are no passenger users.

Table 4-21 Total Freight Truck Vehicle Operating Costs and Fuel Consumption Costs for Phase II Route 167 – Trans-Taiga Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Vehicle operating cost - No-Build case	241,715	7,251,445
Vehicle operating cost - Build case	225,383	6,761,497
Total users' vehicle operating benefit	**16,332**	**489,948**

Source: Model output

4.2.2.3 *GHG AND AIR CONTAMINANT EMISSIONS*

Projects can create environmental and sustainability benefits relating to reduction in air pollution associated with decreased personal vehicle and freight vehicle travel. Four forms of emissions are measured and monetized, including: nitrous oxide (NOx), particulate matter (PM2.5 and PM10), sulfur dioxide (SO2), benzene (HC) and carbon dioxide.

Emissions benefits are realized through the net positive difference in vehicle-kilometres between the Build and No-Build case in the project area. As described in section 4.2.1.4, the MTQ CBA guideline provides conversion factors for the cost of each pollutant and the weight of emissions based on travelling speed. An assumed average speed of 70 km/h was used for the existing and new paved road to in all vehicle categories, and 50 km/hr for existing mine road, environmental benefits were quantified. It's commonly known that environmental benefits are relatively low as compared to other traditional benefits such as travel time savings and vehicle operating cost savings.

Table 4-22 Total GHG and Air Contaminant Emissions Costs for Phase II Route 167-Trans-Taiga Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Freight		
GHG cost - No-Build case	41,136	1,674,052
GHG cost - Build case	38,357	1,560,944
GHG benefit	**2,779**	**113,108**
Air emissions cost - No-Build case	19,059	571,778
Air emissions cost- Build case	17,772	533,146
Air contaminant benefit	**1,288**	**38,633**
Total GHG and air contaminant benefit	**4,067**	**151,741**

Source: Model output

4.2.2.4 *FATALITIES, INJURIES, PROPERTY DAMAGE ONLY (PDO)*

For the Route 167-Trans-Taiga extension, the reduction in the necessary travel distance for freight to reach Brisay generates a marginal reduction in traffic incidents. The same methodology presented in section 4.2.1.5 was used to calculate the number of fatalities, injuries, and PDO for the No-Build and Build cases. The only relative change in the calculation is the reduction in travel distance for the 9.6% of traffic that is routed to Brisay, presented above in Table 4-18.

Table 4-23 Total Safety Costs for Phase II Route 167-Trans-Taiga Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Accident cost - No-Build case	22,772	683,146
Accident cost - Build Case	21,233	636,989
Total safety benefit	**1,539**	**46,157**

4.3 RUPERT RIVER – LA GRANDE STUDY AREA

4.3.1.1 *TRAVEL TIME SAVINGS*

FREIGHT

As noted in the benefit category definitions, travel time savings are a net benefit for users. Travel time savings apply to both freight drivers (e.g., truck drivers or train conductors) and passengers in personal or mass transit vehicles. The table below, extracted from the Market Study, presents the annual freight demand forecast for the Rupert River-La Grande rail extension, which is predominantly attributed to future mining projects. Also noted in the Market Study, smaller volumes are projected to be generated from wood logging, as well as freight movements of consumer good supplies and general freight to serve the region. These freight volumes were noted to be mostly constant over the analysis period. In the Phase II Build Case, the road between La Grande to Whapmagoostui/Kuujjuarapik is operational, and therefore volumes that previously took sea vessels will begin using rail up to La Grande. This increase in freight volumes is therefore reflected in the Build Case.

Table 4-24 Freight Volumes for Rupert River to La Grande Railway - Phase II No-Build and Build Cases (Tons per Annum)

	NO-BUILD CASE (2040)	BUILD CASE (2040)
Rail volumes		
Forest Prod.	0	319,000
Mining	0	4,461,000
Others	0	22,000
Consumer good supplies – Whapmagoostui/Kuujjuarapik	0	3,783
Sub-total	**0**	**4,984,783**[19]
Road volumes		
Forest Prod.	319,000	0
Mining	4,461,000	0
Others	22,000	0
Sub-total	**4,981,000**	**0**
Total tonnage	**4,981,000**	**0**

Source: Market Study

For the No-Build case, tonnage is converted to truck-kilometres using an assumed 30 tons per truck, which is then multiplied by the travel time in the table below. The number of trucks per day equates to approximately 455, which are almost entirely attributable to the mining operations estimated in the Market Study. For the Build case, tonnage is converted to train-kilometres using an assumed 30 tons per wagon and 170 wagons per train, resulting in 2.7 trains per day. The total number of trains is then multiplied by the travel time below.

All trips are round trips. The time savings is calculated by comparing the cumulative No-Build case travel time to the Build case travel time, then monetizing the savings using the MTQ standard inputs for the value of time for passengers and freight for road travel (Table 4-19). The same rates were applied for the value of time for train travel.

[19] In the previous version of the study, the freight demand for the Rupert River to La Grand railway was 4.6 million tons. The new freight demand estimate increased to 5.0 million tons mainly due to the mining sector and forest products.

Table 4-25 Distance and Travel Time between Rupert River and La Grande for Build and No-Build cases

VARIABLE	UNIT	VALUE	SOURCE
No-Build case (road)			
Distance	km	343	Google Maps
Time	hours/trip	3.88	Google Maps
Build case (rail)			
Distance	km	340	Technical Note 16
Time	hours/trip		
Freight train	hours/trip	3.52	Technical Note 12
Passenger train	hours/trip	2.64	Technical Note 12

Source: WSP

Total travel time savings for freight are presented in the table below.

Table 4-26 Total Freight Travel Time Savings for Phase II Rupert River – La Grande Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Travel time cost – No-Build case	52,963,255	1,588,897,659
Travel time cost – Build case	282,687	8,480,620
Travel time savings benefit	**52,680,568**	**1,580,417,039**

Source: Model output

PASSENGER

Passenger rail is also assumed to capture vehicular volumes from the BDH. The number of passenger trips for the rail segments in Phase II and Phase III were provided by the Market Study and are presented in Table 4-27 below.

Table 4-27 Passenger Traffic Demand for Phase II and Phase III Passenger Rail Service (Number of Round Trips per Annum)

CORRIDOR	OPERATING YEAR	2031	2041	2051	2061	2071
Rupert River – La Grande	Phase II	4,835	5,358	5,755	5,986	6,044
La Grande – Whapmagoostui	Phase III	1,984	2,099	2,165	2,172	2,119

Source: Market Study

For the CBA, passenger and freight are assumed to have the same travel times in the No-Build case (road), but different travel time for rail passengers and rail freights (Table 4-25). Applying the value of time rates from MTQ for passengers (Table 4-19) produces the following time travel savings benefits for passenger travel.

Table 4-28 Total Passenger Travel Time Savings for Phase II Rupert River - La Grande Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
No-Build case travel time	830,636	28,009,668
Build case travel time	564,837	19,046,717
Travel time savings benefit	**265,799**	**8,962,951**

Source: Model output

4.3.1.2 *USERS' VEHICLE OPERATING EXPENSES*

The reduction of road traffic along the BDH due to a conversion of both freight personal vehicles to rail service results in a net reduction of vehicle operating expenses. Vehicle operating and fuel costs become zero in the Build case, as all freight and passenger traffic is moved to rail service.

The rail passenger numbers in Table 4-27 were converted to passenger vehicles using an occupancy rate of 2.0 per vehicle. The number of trucks is calculated using a 30 ton per truck conversion of the freight traffic in Table 4-24. As previously stated in Section 3.2.2.2, the railway operating costs were included in the "all-in" operating expenses. To avoid double counting benefits/disbenefits, rail O&M costs are not included here.

Table 4-29 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase II Rupert River - La Grande Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Freight		
Vehicle operating cost - No-Build case	143,523,665	4,305,709,951
Vehicle operating cost - Build case	0	0
Users' vehicle operating benefit	**143,523,665**	**4,305,709,951**
Passenger		
Vehicle operating cost – No-Build case	708,444	23,889,249
Vehicle operating cost - Build case	0	0
Users' vehicle operating benefit	**708,444**	**23,889,249**
Total users' vehicle operating benefit	**144,232,109**	**4,329,599,200**

Source: Model output

4.3.1.3 *GHG AND AIR CONTAMINANT EMISSIONS*

Following the same methodology presented in section 4.2.1.4, emissions benefits related to the new Rupert River - La Grande rail achieve in a net positive difference through a modal shift from freight trucks and personal vehicles in the No-Build case to the less-GHG intensive freight and passenger rail service in the Build case.

Cost for GHG emissions for a metric ton remains the same regardless of the mode of transport. The volume of emissions, however, depends on the number of trucks or cars compared to train, and the rate of fuel consumption each.

For freight, the same methodology describe above was used to calculate the number of trucks as compared to trains required to move the estimated volumes. For passenger trains, with reference to the Market Study, it was assumed based on similar remote passenger train services that a twice-weekly round-trip service would be operated.

The CBA applies a train fuel efficiency rate of 3.33 litres/1,000 gross-ton-km, published quarterly by Railway Association of Canada[20]. The weight of a freight train was estimated to be 366 tons based on information from

[20] https://www.railcan.ca/wp-content/uploads/2022/09/2022_Q2_RAC_Quarterly_Report_Rev.2_EN.pdf

Quorum Corporation plus the hauled tonnage, and the weight of a passenger train was estimated to be 367 tons based on information obtained from VIA Rail.

Table 4-30 Total GHG and Air Contaminant Emissions Costs for Phase II Rupert River - La Grande Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Freight		
GHG cost - No-Build case	24,425,617	994,006,230
GHG cost - Build case	6,620,223	269,411,520
GHG benefit	**17,805,394**	**724,594,710**
Air emissions cost - No-Build case	11,316,875	339,506,244
Air emissions cost - Build case	144,665	4,339,940
Air contaminant benefit	**11,172,210**	**335,166,304**
Passenger		
GHG cost - No-Build case	76,008	3,502,196
GHG cost - Build case	47,289	1,924,419
GHG benefit	**28,719**	**1,577,777**
Air emissions cost - No-Build case	8,202	276,588
Air emissions cost - Build case	1,033	31,000
Air contaminant benefit	**7,169**	**245,588**
Total GHG and air contaminant benefit	29,013,492	1,061,584,379

Source: Model output

4.3.1.4 *FATALITIES, INJURIES, PROPERTY DAMAGE ONLY (PDO)*

For the Rupert River - La Grande Railway, the conversion of road traffic to rail service in the Build case results in a net decrease in accidents by reducing the number of vehicles on the road, which results in a safety benefit by reducing the vehicle-kilometres travelled along the BDH. The same methodology presented in section 4.2.1.5 was used to calculate and monetize the number of fatalities, injuries, and PDO for the No-Build and Build cases.

Based on the estimated transfer of vehicles from road to rail, the rail segment along the BDH from Rupert River to La Grande is estimated to prevent 89 PDOs, 39 injuries, and 1 death per year due to road-related incidents.

Table 4-31 Total Safety Costs for Phase II Rupert River - La Grande Railway Study Area ($2023)

	2040 (FIRST YEAR OF OPERATION)	2040-2069 (PROJECT LIFECYCLE)
Accident cost - No-Build case	13,717,989	411,539,664
Accident cost - Build Case	0	0
Total safety benefit	**13,717,989**	**411,539,664**

Source: Model output

4.4 PHASE III

4.4.1 *WHAPMAGOOSTUI/KUUJJUARAPIK STUDY AREA*

4.4.1.1 *TRAVEL TIME SAVINGS*

FREIGHT

As presented in the Market Study, the Phase III extension of the rail from La Grande -Whapmagoostui/Kuujjuarapik is expected to carry approximately 4,000 tons of freight per annum to Whapmagoostui/Kuujjuarapik to supply the community with consumer goods, construction materials, and housing. Before the opening of the operational period for Phase III in 2045, volumes destined to Whapmagoostui/Kuujjuarapik will have already experienced a modal shift away from sea vessels, instead moving via the new Phase II proposed road extension, with the exception of 117 tons per annum for prefabricated homes.

Table 4-32 Freight Volumes Destined to Whapmagoostui/Kuujjuarapik - Phase III No-Build and Build Cases (Tons per Annum)

	NO-BUILD CASE (2045)	BUILD CASE (2045)
Sea vessel volumes		
Consumer good supplies – Whapmagoostui	0	0
Consumer good supplies – Kuujjuarapik	0	0
Prefabricated houses	117	0
Sub-total	117	0
Road volumes		
Consumer good supplies – Whapmagoostui	2,132	0
Consumer good supplies – Kuujjuarapik	1,651	0
Prefabricated houses	0	0
Sub-total	3,783	0
Rail volumes		
Consumer good supplies – Whapmagoostui	0	2,132
Consumer good supplies – Kuujjuarapik	0	1,651
Prefabricated houses	0	117
Sub-total	0	3,900
Total tonnage	3,900	3,900

Source: Market Study

The methodology for calculating the time travel savings is the same as described in section 4.3.1.1. It is noted that, similar to described in section 4.2.1.2, travel time for sea vessels could not be quantified because of the limited frequency of service. As such, the travel time associated with the 117 tons for the prefabricated houses are not quantified in the No-Build case. The following table summarizes the distance and travel time used in the calculations.

Table 4-33 Distance and Travel Time Between La Grande and Whapmagoostui/Kuujjuarapik for Build and No-Build Cases

VARIABLE	UNIT	VALUE	SOURCE
No-Build case (road)			
Distance	km	236	Technical Note 16 + Google Maps
Time	hours/trip	3.37	Technical Note 11
Build case (rail)			
Distance	km	219	Technical Note 16
Time			
Freight train	hours/trip	2.27	Technical Note 12
Passenger train	hours/trip	1.70	Technical Note 12

Source: WSP

Total travel time savings for freight are presented in the table below.

Table 4-34 Total Freight Travel Time Savings for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2045 (FIRST YEAR OF OPERATION)	2045-2074 (PROJECT LIFECYCLE)
Travel time cost - No-Build case	34,893	1,046,783
Travel time cost - Build case	142	4,274
Travel time savings benefit	**34,751**	**1,042,509**

Source: Model output

PASSENGERS

For passenger service, Phase III will create a modal shift from the road traffic generated by Phase II to passenger rail service. The Market Study provided passenger rail estimates for the La Grande to Whapmagoostui/Kuujjuarapik segment, which was presented previously in Table 4-27.

Passenger and freight are assumed to have the same travel times (Table 4-33). Applying the value of time rates from MTQ for passengers, (Table 4-19), produces the following time travel savings benefits for passenger travel.

Table 4-35 Total Passenger Travel Time Savings for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2045 (FIRST YEAR OF OPERATION)	2045-2074 (PROJECT LIFECYCLE)
Travel time cost - No-Build case	296,373	9,098,750
Travel time cost - Build case	149,649	4,594,286
Travel time savings benefit	**146,724**	**4,504,464**

Source: Model output

4.4.1.2 *USERS' VEHICLE OPERATING EXPENSES*

Similar to the Rupert River to La Grande rail segment, the operationalization of freight and passenger services in Phase III leads to a reduction of the road traffic generated in Phase II along the new Whapmagoostui/Kuujjuarapik road, resulting in a net reduction of vehicle operating expenses in Phase III. Recall that the No-Build Case for Phase III assumes completion of Phase II infrastructure.

The same assumptions were made for occupancy rate (2.0 passengers per vehicle) and for the net weight of a truck (30 tonnes per truck). Likewise, the methodology presented in section 4.2.3.2 was applied to quantify the vehicle operating expenses for the No-Build and Build case. Again, it is worth to repeat here that rail O&M costs were already included in the infrastructure's O&M costs (see Section 3.2.2.2). Therefore, they are not included in the calculation of benefits/disbenefits.

Table 4-36 Total Freight Truck and Passenger Vehicle Operating Costs and Fuel Consumption Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2045 (FIRST YEAR OF OPERATION)	2045-2074 (PROJECT LIFECYCLE)
Freight		
No-Build case vehicle operating cost	74,936	2,248,093
Build case vehicle operating cost	0	0
Users' vehicle operating benefit	**74,936**	**2,248,093**
Passenger		
No-Build case vehicle operating cost	100,164	3,075,069
Build case vehicle operating cost	0	0
Users' vehicle operating benefit	**100,164**	**3,075,069**
Total users' vehicle operating benefit	175,100	5,323,162

Source: Model output

4.4.1.3 *GHG AND AIR CONTAMINANT EMISSIONS*

GHG emissions and air contaminant emissions follow the same case as Rupert River- La Grande study area, where the net positive difference in achieved through a modal shift from freight trucks and personal vehicles in the No-Build case to the less-GHG intensive freight and passenger rail service in the Build case. The same assumptions are applied as previously described.

Table 4-37 Total GHG and Air Contaminant Emissions Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2045 (FIRST YEAR OF OPERATION)	2045-2074 (PROJECT LIFECYCLE)
GHG cost - No-Build case	37,927	1,537,824
GHG cost - Build case	20,562	821,203
GHG benefit	**17,365**	**716,621**
Air emissions cost - No-Build case	8,228	248,468
Air emissions cost- Build case	406	12,171
Air contaminant benefit	**7,822**	**236,297**
Total GHG and air contaminant benefit	**25,187**	**952,918**

Source: Model output

4.4.1.4 *FATALITIES, INJURIES, PROPERTY DAMAGE ONLY (PDO)*

Similarly, the safety benefits for Phase III Whapmagoostui/Kuujjuarapik are achieved through a net decrease in accidents by reducing the number of vehicles on the road through the modal shift from road to rail. The same methodology presented previously is applied.

Table 4-38 Total Safety Costs for Phase III Whapmagoostui/Kuujjuarapik Study Area ($2023)

	2045 (FIRST YEAR OF OPERATION)	2045-2074 (PROJECT LIFECYCLE)
Accident cost - No-Build case	65,815	2,015,606
Accident cost - Build Case	0	0
Total safety benefit	**65,815**	**2,015,606**

5 SUMMARY OF RESULTS

5.1 SUMMARY OF CBA RESULTS

The present BCA uses the Net Present Value (NPV) and the Benefit Cost Ratio (BCR) as two common evaluation measures. Both measures express the relation of discounted benefits to discounted costs to what extent the Project benefits either exceed or fall short of the costs. The NPV is the difference between the Project total benefits and the Project costs, while the BCR is the ratio between the former over the latter.

Table 5-2 presents the evaluation results for the entire phases II and III. All benefits and costs are presented in incremental changes, i.e., the difference between the Build Scenario and the No-Build Scenario. Recall that the No-Build Scenario consists of four options. Option 0 considers no investment for the current BDH. Options 1, 2, and 3 consider upgrading the current BDH to meet the new estimated travel demand. All numbers presented in the table were calculated inconstant 2023 dollars, discounted at 2.37 over an evaluation period of, for each phase, five years of construction plus 30 years of operation, %in conformity with the MTQ CBA guidance (2016).

Overall, the Project will generate negative NPVs in all four options of B$3.9, with Option 0 is the most disadvantageous amongst the four options. The BCR for this option would be equal to 0.52. This is mainly due to no-investment made for the BDH which makes a huge incremental change in project CAPEX estimated to be B$8.1, while the total benefits would be merely half of the total costs. With an incremental change of B$3.9 in total costs, and a total benefit of B$3.7, Option 3 would become the most promising option as the NPV for the society is estimated to be M$291. The implied BCR is 0.93. mainly because of the significant investment made for the BDH which makes Phase II' benefits of M$3.2 outweigh the infrastructure costs of M$628.

Table 5-1 Cost Benefit Analysis Results, Phases II and III

Outcome per Option	Discounted Value (M$) at 2.37%		
	Phase II	Phase III	Total
Total Benefits (Incremental Changes)			
Option 0 (without investment to the BDH)	3,775	474	4,249
Option 1 (B$1.2 investment to the BDH)	3,849	474	4,323
Option 2 (B$2.9 investment to the BDH)	3,543	474	4,018
Option 3 (B$5.1 investment to the BDH)	3,196	474	3,670
Total Costs (Incremental Changes)			
Option 0 (without investment to the BDH)	4,812	3,333	8,145
Option 1 (B$1.2 investment to the BDH)	3,864	3,333	7,197
Option 2 (B$2.9 investment to the BDH)	2,429	3,333	5,762
Option 3 (B$5.1 investment to the BDH)	628	3,333	3,961
NPV			
Option 0 (without investment to the BDH)	-1,037	-2,858	-3,896
Option 1 (B$1.2 investment to the BDH)	-15	-2,858	-2,874
Option 2 (B$2.9 investment to the BDH)	1,114	-2,858	-1,744
Option 3 (B$5.1 investment to the BDH)	2,567	-2,858	-291

Outcome per Option	Discounted Value (M$) at 2.37%		
	Phase II	Phase III	Total
BCR			
Option 0 (without investment to the BDH)	0.78	0.14	0.52
Option 1 (B$1.2 investment to the BDH)	1.00	0.14	0.60
Option 2 (B$2.9 investment to the BDH)	1.46	0.14	0.70
Option 3 (B$5.1 investment to the BDH)	5.09	0.14	0.93

All societal benefits were calculate for seven categories:

1 Freight shipping cost savings;
2 Passenger transportation cost savings;
3 Travel time savings;
4 Users' vehicle operating expense savings;
5 GHG emissions cost savings;
6 Air contaminants cost savings;
7 Accident cost savings;

In addition, LGA infrastructure operating and maintenance costs as well as the residual value of the infrastructure were also assessed. The sum of these two categories combined with the seven above-mentioned outcomes equates the total Project benefits.

The following section present the breakdown of seven benefit categories. Among them, the most important benefit brought by the proposed LGA infrastructure is users' vehicle operating cost savings ($4.3 billion), followed by travel time savings ($1.6 billion), both generated mostly by Phase II. To a lesser extent, the benefits of reduced GHG emission, air contaminant emissions, and road accidents are all significant. However, the operating and maintenance of La Grande Alliance infrastructure is expected to be costly, with expenditures estimated at$2.3 billion over the 2040-2074 period.

Table 5-2 Cost Benefit Analysis Results, Phases II and III

#	BENEFIT & COST ITEM	UNDISCOUNTED VALUE (M$)			DISCOUNTED VALUE (M$) AT 2.37%		
		Phase I I	Phase III	Total	Phase II	Phase III	Total
1	Freight shipping cost savings (Whapmagoostui only)	14	4	18	7	1.8	9
2	Passenger transportation cost savings (Whapmagoostui only)	57	1	57	28	0.4	28
3	Travel time savings	1,590	6	1,596	776	2.4	778
4	Users' vehicle operating expenses	4,325	5	4,330	2,111	2.3	2,113
5	GHG emissions	725	1	726	342	0.3	342
6	Air contaminant emissions	335	0	335	164	0.1	164
7	Accident Cost Savings (including Fatalities, Injuries and PDO)	410	2	412	200	0.9	201

#	BENEFIT & COST ITEM	UNDISCOUNTED VALUE (M$)			DISCOUNTED VALUE (M$) AT 2.37%		
		Phase I I	Phase III	Total	Phase II	Phase III	Total
8	Infrastructure Operating and Maintenance Costs (Including train O&M costs)	(1,484)	(766)	(2,250)	(718)	(329)	(1,047)
9	Residual Value	3,327	2,560	5,888	1,160	775	1,935
10	**Total Benefits**	**9,298**	**1,813**	**11,111**	4,068	454	4,522

Source: Model Output

5.2 BREAKDOWN OF BENEFITS BY COMPONENT

Table 5-3 presents the breakdown of benefits by component for Phase II. As discussed previously, savings on freight and passenger transportation costs have been calculated for the Whapmagoostui area only, in order to compare the cost of transportation via the proposed new Whapmagoostui road with the cost of transportation via the existing seaway. This is why only the Cree Whapmagoostui community, and the Inuit Kuujjuarapik community will benefit from this infrastructure However, these communities would not benefit from the new Route 167, nor from the new rail line from the Rupert River to La Grande.

It should be noted that the new road to Whapmagoostui would not save travel time, as flight is generally faster than road transport. With the new road, residents of the Cree community of Whapmagoostui and the Inuit community of Kuujjuarapik will be able to drive south, increasing the number of vehicle-kilometres travelled. As a result, the use of roads entails disadvantages such as vehicle operating costs, GHG and air contaminant emissions, and the risk of accidents.

As far as the extension of Route 167 is concerned, only a small proportion of the population would benefit, according to information obtained from Kepa Transport and Transport Jacques Auger. Indeed, total benefits from this infrastructure are estimated at a relatively low $1.3 million.

On the other hand, the extension of the railroad to La Grande should considerably reduce travel time and vehicle operating costs, for both freight and passenger transport. Moreover, rail transport generally generates fewer GHGs and considerably reduces the risk of road accidents.

In summary, Phase II would generate total profits of $6.9 billion, of which $6.8 billion (or 99.1%) would be generated by rail infrastructure. This is mainly due to potential demand from the mining industry and, to a lesser extent, the forestry industry.

Table 5-3 Phase II CBA Results by Component, Undiscounted 2023 million Dollars

#	BENEFIT & COST ITEM	PHASE II (2040-2069)			
		Whapmagoostui Road	Route 167	BDH Raiway Rupert River to La Grande Railway	Total
1	Freight shipping cost savings (Whapmagoostui only)	14.3			14,3
2	Passengers' transportation cost savings (Whapmagoostui only)	56.5			56,5
3	Travel time savings		0.61	1 589	1,590

#	BENEFIT & COST ITEM	PHASE II (2040-2069)			
		Whapmagoostui Road	Route 167	BDH Raiway Rupert River to La Grande Railway	Total
4	Users' vehicle operating expenses	(5.3)	0.49	4 330	4,325
5	GHG emissions	(1.4)	0.11	726	725
6	Air contaminant emissions	(0.2)	0.04	335	335
7	Accidents (including Fatalities, Injuries and PDO)	(2.0)	0.05	412	410
Total		**61.8**	**1.30**	**7,394**	**7,457**

Table 5-4 presents the breakdown of estimated benefits by infrastructure for Phase III. Extending the rail line to Whapmagoostui would further reduce freight and passenger transportation costs, travel times and the number of road vehicles. The latter would reduce vehicle operating costs, as well as the risk of road accidents.

Due to the lack of demand for the port, no benefits in any of the seven categories were assessed for the Whapmagoostui/Kuujjuarapik port infrastructure. In summary, the extension of the Phase III rail line would bring additional benefits to Cree and Inuit communities in the region, estimated at $18.8 million over the period 2045-2074.

Table 5-4 Phase III CBA Results by Component, Undiscounted Million 2023 Dollars

#	BENEFIT & COST ITEM	PHASE III (2045-2074)		
		Whapmagoostui Railway	Whapmagoostui Harbour	Total
1	Freight shipping cost savings (Whapmagoostui only)	4.10	0	4.10
2	Passengers' transportation cost (Whapmagoostui only)	0.86	0	0.86
3	Travel time savings	5.56	0	5.56
4	Users' vehicle operating expenses	5.32	0	5.32
5	GHG emissions	0.71	0	0.71
6	Air contaminant emissions	0.24	0	0.24
7	Accidents (including Fatalities. Injuries and PDO)	2.02	0	2.02
Total		**18.81**	**0**	**18.81**

5.3 COMBINED PHASES I-II-III CBA RESULTS

This section summarizes the results of the CBA for the three phases of La Grande Alliance using a discount rate of 2.37%. Phase I's CBA results calculated by the VEI consultant team are now presented in Table 5-5 for informational purposes only. Combining the three phases together, Option 3 is the only option in which the total the entire LGA. All other options would generate a negative NPV, meaning not socially beneficial for the entire society.

Table 5-5 Combined CBA Results, Phases I, II, III

Outcome per Option	Discounted Value (M$) at 2.37%			
	Phase I	Phase II	Phase III	Total
Total Benefits (Incremental Changes)				
Option 0	540	3,775	474	4,789
Option 1	2,839	3,849	474	7,162
Option 2	3,889	3,543	474	7,907
Option 3	5,178	3,196	474	8,848
Total Costs (Incremental Changes)				
Option 0	2,986	4,812	3,333	11,131
Option 1	3,889	3,864	3,333	11,086
Option 2	3,889	2,429	3,333	9,651
Option 3	3,889	628	3,333	7,850
NPV				
Option 0	-2,447	-1,037	-2,858	-6,342
Option 1	-1,050	-15	-2,858	-3,924
Option 2	0	1,114	-2,858	-1,744
Option 3	1,288	2,567	-2,858	997
BCR				
Option 0	0.18	0.78	0.14	0.43
Option 1	0.73	1.00	0.14	0.65
Option 2	1.00	1.46	0.14	0.82
Option 3	1.33	5.09	0.14	1.13

Sources: VEI, WSP

6 ADDITIONAL QUALITATIVE BENEFITS

In addition to the quantified benefits for La Grande Alliance's infrastructure, there are several other qualitative benefits worth mentioning. First of all, the ultimate goal of transportation is accessibility. Better accessibility generally improves the mobility of people, goods and services, and their activities. Better accessibility also improves the ability of businesses to access desired resources, services and markets, including natural resources, labor, work sites, professional services, customers, etc. Whapmagoostui is the last Cree community without overland access, meaning that stakeholder consultations have revealed that all development projects must overcome the obstacles caused by high transportation costs and logistical difficulties associated e with transportation offered only by sea (twice-yearly delivery frequency) or by air when the weight and size of materials are not prohibitive.

Second, the study area is located in a remote region with abundant natural resources. La Grande Alliance's projects would increase the value of Quebec's natural resources by reducing transportation costs, and position Quebec as a global mining hub, particularly for lithium.

Third, La Grande Alliance projects would improve connectivity between Cree and Jamesian communities, businesses and workers. This would increase their capacity and worker productivity over the long term.

Fourth, the market study revealed that the housing needs of the communities' inhabitants continue to grow, while living conditions have deteriorated due to the high cost of transporting building materials and extreme weather conditions. The development of La Grande Alliance's transportation infrastructure would not only reduce housing costs, but also the price of perishable goods and healthcare costs for the population of the Nord-du-Québec region.

7 CONCLUSION

This technical note highlighted the monetizable benefits and societal costs of the La Grande Alliance major transportation infrastructure project for Phases II and III. Although the project's costs significantly exceed its societal benefits, several important benefits for the entire population of Northern Quebec have not been quantified. Among the quantifiable benefits, the reduction in users' vehicle operating costs would be the most significant ($4.0 billion), followed by travel time savings ($1.5 billion). These two categories are mainly the result of Phase II infrastructure. To a lesser extent, benefits related to the reduction of greenhouse gas emissions, air contaminant emissions, road accidents and transportation costs are all significant. Beyond these economic, social and environmental benefits, the transportation infrastructures proposed by La Grande Alliance are likely to stimulate economic development, increase worker productivity and improve community quality of life.