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Transportation Infrastructure Program
Feasibility Study, Phase I
VOLUME 5 - ECONOMIC, RISK AND FINANCIAL

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Transportation infrastructure program feasibility study, phase I

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ABREVIATIONS

Acronyms	Definition
$	Canadian dollar
B	Billion
B/C	Benefit/cost ratio
BDH	Billy Diamond Highway
BDHR	Billy Diamond Highway Alignment Railway
BOOT	Bild-Own-Operate-Transfer
CAPEX	Capital Expenditures
CCDC	Cree Construction and Development Company
CCQ	Commission de la construction du Québec
CO	Carbon Monoxide
DBB	Design-Bid-Build
DD	Detailed Design
EBCA	Economic Benefit Cost Analysis
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
GCR	Grevet-Chapais Railway
GHG	Greenhouse gases
GST	Goods and Services Tax
InfraCo	Infrastructure Owner
IRR	Internal Rate of Return
JV	Joint Venture
k	Thousand
LC	Life cycle
M	Million
MTPA	Million tonnes per Annum
NOx	Nitrogen oxides
NPV	Net Present Value
OMOT	Operation Mobilization Orientation and Training
O/H	Overhaul
OPEX	Operating Expenditures
RFQ	Request for Quotes
RFP	Request for Proposals
PM	Particulate matter
PMO	Project Management Office
QIM	Québec Intersectoral Model

Acronyms	Definition
QST	Québec Sales Tax
RDN	Route du Nord
RRQ	Régie des rentes du Québec
SO2	Sulfur Dioxide
TPC	Total Project Cost
VOC	Volatile organic compounds
UQAC	Université du Québec à Chicoutimi
UQAT	Université du Québec en Abitibi-Témiscamingue
Yr	Year

11. ECONOMIC ANALYSIS

11.1 BENEFIT COST ANALYSIS

11.1.1 Objective and Methodology

The Economic Benefit- Cost Analysis (EBCA) approach is a well-known and recognized procedure used to structure and analyze available information in evaluating public infrastructure projects to address the efficiency issue and the economic growth such projects may generate. Facilitating choice among projects and allocating public resources are the two main objectives of the EBCA.

The economic analysis measures the Project's impacts on the well-being of society. It compares the situation with and without the Project and calculates the incremental benefits and costs to society resulting from implementing it. Meanwhile, the financial analysis focuses on the financial impact of the Project on the Cree Communities, the Provincial Government and the private sector, i.e., the concessionaire for the railway operation. Figure 11-1 shows the overall VEI approach to carrying out the economic and financial analysis and how it integrates the relevant study tasks, data, and information.

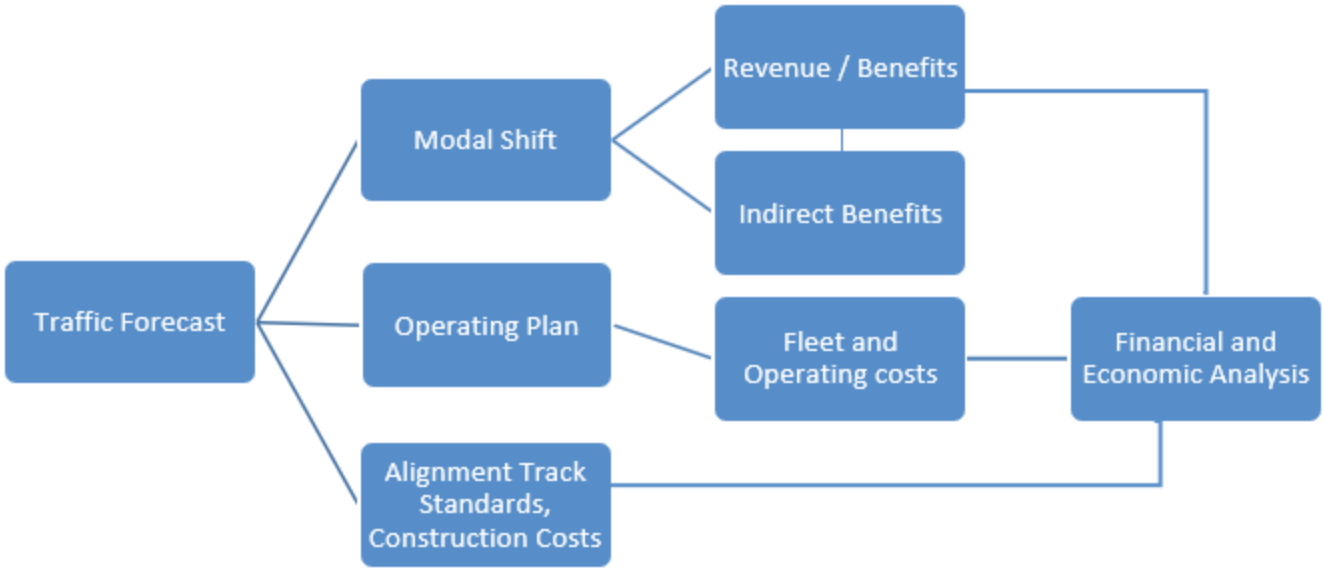

Figure 11-1: Inputs to Economic and Financial Analysis

The economic analysis determines the appropriate scope and phasing of the investments. The financial analysis is used to determine the financial rate of return for the same alternatives as the economic analysis and the effect of different institutional structures. The analysis for the institutional structures has assumed all railway lines and roadways have been built, but each section is owned and operated by separate entities. Therefore, the studied options include varying amount of infrastructure.

Table 11-1: Economic and financial model inputs

Input	Model(s)
CAPEX (Capital Expenditures)	Economic & Financial
OPEX (Operating Expenditures)	Economic & Financial
Traffic	Economic & Financial
Revenues	Financial
WACC (Weighted Average Cost of Capital) of the Concessionaire	Financial
Assets Partitioning between Government and Concessionaire	Financial
Passenger Consumer Surplus	Economic
Environmental Externalities	Economic
Avoided Resource costs	Economic
Cost adjustment	Economic
Avoided Road Maintenance cost	Economic

The inputs that are common to both economic and financial analyses include capital expenditures, operating expenditures, expected traffic, and the life of physical assets. The capital expenditures (CAPEX) can be found in the Final Technical Study Report (LGA-1-GN-F-FRN-RT-0002_01 VEI Volume 2 - LGA Technical).

The values in the economic model are identical to those in the financial model, excluding any form of tax. It is the inflation and discounting assumptions that differ. In the economic model, costs are presented in constant dollars of December 31, 2022, and include a 20% contingency, whereas for the financial model, the cash flows are in current dollars. This means that the latter includes the expected inflation over the study horizon.

The economic analysis aims to measure and evaluate the positive and negative impacts of a project, program, policy, or regulation to estimate, in monetary terms, the net benefit to society. The economic analysis considers only the incremental costs and benefits relative to a baseline scenario, i.e., those directly attributable to the Project under study. In this sense, the benefit-cost analysis considers only questions of efficiency and must answer the question : are the economic benefits greater than the economic costs to all members of society without discrimination? This type of analysis allows for comparing projects with varying characteristics and consequences.

The first objective of this mandate is to evaluate the socio-economic profitability of the Grande Alliance Study in this corridor based on the benefits to users and non-users and its economic costs.

More specifically, the objectives are to :

- To provide public decision makers with recognized indicators of the social cost effectiveness of this specific train infrastructure project compared to the baseline scenario, which would be the projected status quo over time. These indicators are the benefit/cost ratio, the net present value, and the internal rate of return.
- Provide an answer as to the social profitability of the Project compared to the status quo.

The economic analysis follows two premises:

- The costs considered are free of any form of tax, such as sales tax, an excise tax on fuel or municipal taxes, as they constitute a transfer between agents.
- The analysis is performed in 2023 constant dollars and uses an economic discount rate of 2.37% . The basis of comparison of the proposed scenario to the baseline is in present value terms as of January 1, 2023.

The monetary value for the benefits and economic costs of the Project are compared to the base case. All elements of cost and benefit are detailed, and the appropriate monetary value attributed to them. Figure 11-2 lists the quantifiable factors that are considered:

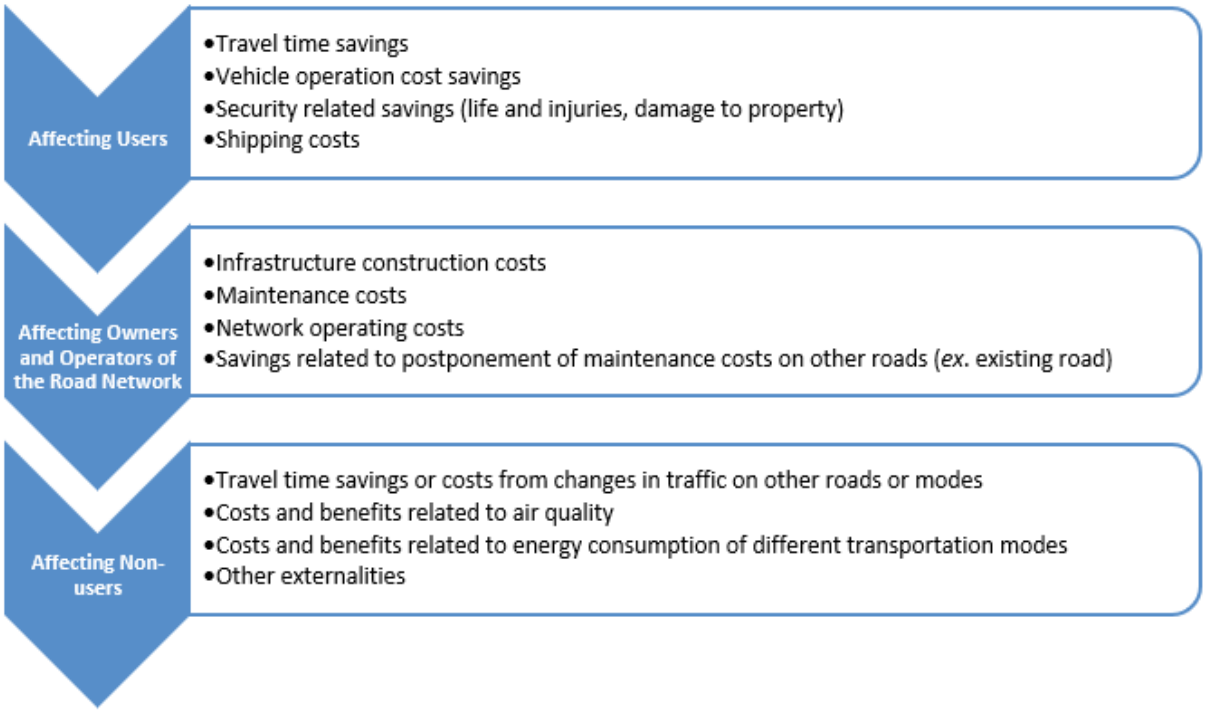

Figure 11-2: Benefits and Cost Items

11.1.2 Do Nothing Scenario and With Project Scenario

Do Nothing Scenario:

The Billy-Diamond Highway, the Route du Nord and the community roads are the backbone of the current freight transport and private transportation. The road network ensures access to the community's land transportation for equipment, material, and workers to and from various sites of the major James Bay Hydro-Québec projects. Today, it provides access to Hydro-Québec's facilities and supplies maintenance and renovation equipment, including those requiring specialized wide-load movements.

Often, this equipment is transported by rail to Abitibi, then transshipped onto trucks and transported by road to James Bay. The current state of the road causes delays and uncertainty in supply. Given the road conditions' current state, a review must be performed before heavy loads are transported to ensure and identify areas that require special attention for the transportation of non-standard equipment.

The Do-nothing scenario refers to a situation that does not have a train link between Matagami and kilometric point (KP) 257 along the Billy Diamond Highway corridor, nor the return to the service of the railway between Lebel-sur-Quévillon and Chapais (referred to as the Grevet-Chapais line). This scenario includes all costs to be incurred for the operation and maintenance of the existing network over the 30-year period. The associated cost refers to resources that would have been consumed. As such, they are considered a cost reduction to the project and are referred to as differential costs.

Therefore, all further savings and costs will be compared to this base-case situation. From an economic standpoint, the resources consumed or liberated during this 30-year period are compared against this base case. In other words, building the railways may reduce or differ the required road maintenance and periodic rehabilitation. If the Project does not go forward, it may require additional road maintenance on roads paralleling the railway. For road transport, the without-project case is assumed to see a continuing expansion of the mining industry, generating additional heavy truck movements on the road network as economic development occurs. The induced traffic would largely affect the Billy Diamond Highway from Mistissini to Radisson, and the Route du Nord from the junction of the Billy Diamond Highway and Mistissini to routes 113 east and 167 south.

Phase 1

Phase I of LGA includes (CDC, 2021a) :

- The rehabilitation of local road connections to the Cree communities of Waskaganish, Eastmain, Wemindji and Nemaska;
- The construction of a North-South Railway hereinafter the Billy Diamond Highway Railway (BDHR) line parallel to the Billy Diamond Highway (BDH) between Matagami and the Rupert River;
- The rehabilitation of the Grevet-Chapais railway (GCR) line;
- The implementation of transshipment centres along these railway lines (namely one near KP 257 of the BDH).

During project execution, the CDC added the renewal of the Route du Nord and the construction of a new access road to Mistissini to VEI's mandate (CDC, 2021b). For analysis purposes, all these components are assumed to begin construction in 2030.

11.1.3 Parameters

11.1.3.1 Dates and assumptions

The assumptions for the study are as follows. The analysis period is set at 30 years. The construction for the phase I is assumed to begin in 2030, the streams of net benefits will span to the end of 2064. All initial infrastructure investments have been assumed to be completed by 2035. A sequence of sustaining capital investments is planned over the 30-year operating period.

The key dates are shown below:

Table 11-2: Key reference dates

Dates and periods	Value
Discount date	2030-01-01
Study start date	2022-01-01
Phase 1	2030-01-01
Duration of the implementation period (months)	60 months
Construction completion date	2034-12-31
Start of operations	2035-01-01
End Phase 1 Analysis	2084-12-31
Period of analysis (months)	360 months
Price reference date	2022-01-01

The following studies and activities are expected to take place during the study period:

- Feasibility study (28 months)
- Project review period / EIA procurement / Geotech / LIDAR (9 months)
- EIA Study / Agreements / Land acquisition (32 months)
- Project review period / DD procurement / PMO (9 months)
- Detailed design (DD) (12 months)
- Construction procurement “RFQ+RFP” (12 months)
- Communications (5 months)

11.1.3.2 Discount rate

An economic discount rate is a tool used in financial and economic analysis to determine the present value of future cash flows. It represents the opportunity cost of investing money in one project instead of another, or in a risk-free investment such as a government bond.

In simple terms, an economic discount rate can be thought of as the interest rate used to calculate the value of money today compared to its value in the future. The idea is that money in the present is worth more than the same amount of money in the future, due to the potential to earn interest or make other investments with it.

For example, let's say you have the choice between receiving $100 today or $110 one year from now. If you have an economic discount rate of 10%, you will choose to receive the $100 today because you could invest it and earn a 10% return, making it worth $110 in one year.

The economic discount rate is used to calculate the net present value (NPV) of a project by discounting future cash flows back to their present value. This helps decision makers evaluate the feasibility of a project by comparing the present value of its expected benefits to the cost of investing in the project.

Overall, an economic discount rate is a tool used to account for the time value of money and the opportunity cost of investing capital in one project instead of another.

The current analysis sets the economic discount rate at 2.37%, which is the recommended value for "Guide de l'analyse avantages coûts des projets publics en transport routier" by MTQ (2017). This rate represents a shift from

the 10% recommended in the "Canadian infrastructure projects according to Transport Canada" (TC2022). The latter has been held constant for many years now and is used in the sensitivity analysis.

11.1.4 Costs

The following section presents the socio-economic costs that have been considered in the ECBA project analysis. They include:

- Capital costs and their residual values
- Sustaining capital costs
- Incremental maintenance and operating costs.

Railway infrastructure is a capital expenditure (CAPEX) that involves building and maintaining fixed assets such as tracks, bridges, and tunnels. However, ongoing costs of operating and maintaining the infrastructure are considered OPEX expenses. These costs include routine maintenance, repairs, replacement of components, and upgrades to infrastructure. Examples of OPEX expenses include rent, salaries, utility bills, marketing expenses, supplies, travel, and insurance premiums. It's important for businesses to include railway infrastructure costs as part of their OPEX expenses to accurately reflect the ongoing costs of operating the railway. Note that the accounting treatment of these expenses may vary depending on accounting standards and specific circumstances. The values in the economic model are identical to those in the financial model, excluding any form of tax. It is the inflation and discounting assumptions that differ. In the economic model, costs are presented in constant dollars of December 31st, 2022, whereas for the financial model, the cash flows are in current dollars. This means that the latter includes the expected inflation over the study horizon.

11.1.4.1 Capital Costs

The initial construction amounts to ***3.419 billion dollars*** for the Billy Diamond Highway rail alignment (BDHR) and the Grevet Chapais Railway alignment (GCR). As stated above, the capital costs incur between 2030 and 2035, as described in the CAPEX section of the Technical Report (LGA-1-GN-F-FRN-RT-0002_01 VEI Volume 2 - LGA Technical). The total capital costs are detailed in Table 11-3.

Table 11-3: Initial Capital Expenditure in real undiscounted values.

Railway Alignment (2023 M$)	Billy Diamond Highway Railway	Grevet Chapais Railway
Civil & Earthworks	604.57	289.08
Structures	271.42	127.43
Drainage	88.87	25.42
Trackwork	1,061.13	687.94
Level Crossing Surface	2.84	1.46
Signalling & Telecommunications	14.62	15.23
Buildings & Passenger Stations	38.16	6.67
Depots & Storage Areas	60.98	26.39
Environmental Protection	5.92	0.02
Rolling Stock	61.68	28.72
Subtotal	**2,210.20**	**1,208.35**
	Total	**3,418.54**

In the same matter, Table 11-4 presents the road rehabilitation costs shown in the technical report (LGA-1-GN-F-FRN-RT-0002_01 VEI Volume 2 - LGA Technical) amounting to 1.06 billion dollars before contingency and permitting costs.

Table 11-4: Total Road Investment Costs in Current value.

Socio-economic costs(2023M$)	Access Roads	Route du Nord
Site organization:	142.90	162.08
Earthworks:	59.93	52.35
Roadway and pavement:	311.36	435.94
Drainage and engineering structures:	60.25	97.33
Signposting:	4.05	4.68
Miscellaneous works:	23.70	39.30
Subtotal	602.20	791.67
	Total	**1,393.87**

The following tables present total economic costs over the project horizon discounted at 2.37% The current values are in 2023 constant dollars and are discounted from the beginning of the assumed construction period of 2030. The values are expressed in millions unless otherwise specified.

The net present value of the BDHR and GCR are further detailed in Table 11-5, the Route du Nord and the Access roads are detailed in Table 11-6.

Table 11-5: Total railway investment costs in net present value

Present value (2023M$)	BDHR	% of total	Grevet Chapais Railway	% of total
Civil & Earthworks	570.32	27%	278.48	25%
Structures	260.25	13%	123.04	11%
Drainage	85.80	4%	24.83	2%
Track work	989.13	48%	633.83	56%
Level Crossing Surface	2.58	0%	1.33	0%
Signalling & Telecommunications	13.33	1%	13.90	1%
Buildings & Passenger Stations	36.84	2%	6.39	1%
Depots & Storage Areas	57.52	3%	23.98	2%
Environmental Protection	5.52	0%	0.02	0%
Rolling Stock	54.23	3%	27.13	2%
Subtotal	2,075.54	100%	1,132.92	100%
		Total	**3,209.46**	

Discounted at 2.37% as of 2030

Table 11-6: Total Road Investment Costs in Present Value

Socio-economic costs(2023M$)	Access Roads	Route du Nord
Site organization:	136.54	151.16
Earthworks:	57.27	48.82
Roadway and pavement:	297.51	406.58
Drainage and engineering structures:	57.57	90.77
Signposting:	3.87	4.36
Miscellaneous works:	23.27	36.66
Subtotal	576.04	738.36
	Total	**1,314.39**

Discounted at 2.37% as of 2030, in 2023M$

The economic analysis focuses on the railway infrastructure, which is expected to attract over 1.578 million tonnes of freight per year. The cost savings associated with existing road rehabilitation constitute a benefit for the railways.

The total discounted cost for the complete LGA infrastructure program amounts to 4,5 billion dollars, of which 94% is incurred in the initial construction phase. The BHDR is by far the most considerable component of the project, as it accounts for 46% of the total capital budget. The Grevet Chapais Railway follows with a 25% share of the cost. The cost to maintain the roads in good condition represents close to 73% of the total sustaining capital. However, the current cost of supporting capital for roads allows for a savings of $81 million.

Table 11-7: LGA Capital and Sustaining Costs - Present Value (2023M$)

Present value (2023 $M)	CAPEX	Sustaining Capital	Pollution during Construction	Total
BDHR	2,077	55	96	***2,228***
GCR	1,132	23	30	***1,185***
Route du Nord (improvement)	738	121	32	***891***
Access Roads (improvement)	576	86	18	***680***
Capital expenditure	**4,523**	**284**	**175**	***4,982***
Route du Nord (gravel)	(32)	(19)		***(51)***
Access Roads (gravel)	(103)	(62)		***(165)***
Differed Capital	**(135)**	**(81)**		***(216)***
Capital expenditure and Pollution during Construction	**4,388**	**203**	**175**	**4,550**

11.1.4.2 Pollution During Construction

Construction also contributes to greenhouse gas (GHG) emissions, whereas rail transportation reduces them due to efficiency in freight train transportation when compared to truck transportation. The construction of the LGA project will generate 332 million tons of CO^2 equivalent, valued at 145 million dollars. The deforestation required for the BDHR amounts to 113,615 CO^2 equivalent, close to half of the BDH-associated externalities. The figure below illustrates the proportion of pollution emanating from the heavy machinery and generators used during construction.

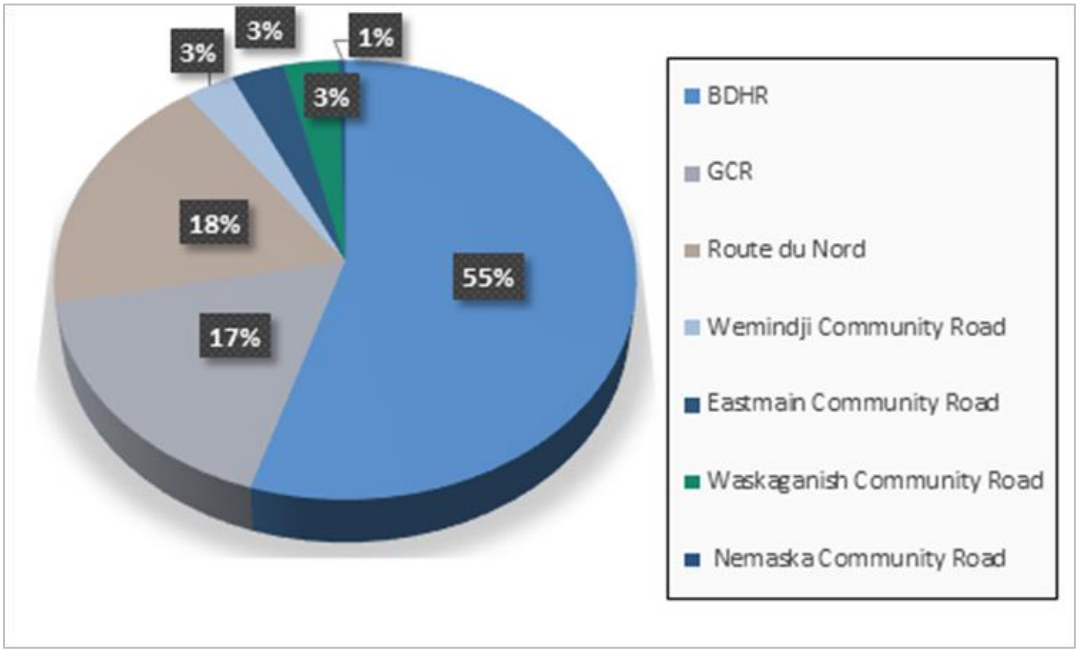

Figure 11-3: Machine and Generator GHG emissions during construction

The pollution created by the use of heavy machinery and generators during the construction will come at a social cost of 175 million dollars.

Table 11-8: Machinery and generators Greenhouse gas emissions during construction

Present value	CO_2 equivalent (t)	Present value
BDHR	182,389	96
GCR	56,973	30
Railway Subtotal	239,362	126
Route du Nord	60 200	32
Wemindji Access Road	9,978	5
Eastmain Access Road	10,569	6
Waskaganish Access Road	11,091	6
Nemaska Access Road	1,297	1
Access Road Subtotal	93,135	49
Total	**332,497**	**175**

Discounted at 2.37% as of 2030, in 2023M$

11.1.5 Residual Value

The residual value at the end of the Project reflects the value of assets that have a life longer than the life of the Project. For these assets, residual value is calculated by multiplying the initial asset value by the difference between the useful life of an asset and the project horizon, then dividing by the asset's life. This value is then discounted.

The total residual value of the Project is presented in the following table for Grevet Chapais Railway.

While some of the project infrastructure has a useful life that exceeds the analysis horizon (e.g., 50 years for structures and engineering works, etc.), other infrastructure will require renewal in whole, or in part before the end of the analysis horizon.

The life span and residual values of the capital assets for the railway infrastructure are presented in Table 11-9.

Table 11-9: Residual values at the end of Phase 1 operations

Value in 2084 (2023M$)	Life expectancy	BDHR	Grevet Chapais Railway
Civil & Earthworks	50	242	116
Structures	100	190	89
Drainage	25	18	5
Track work	100	743	482
Level Crossing Surface	25	1	0
Signalling & Telecommunications	15	0	0
Buildings & Passenger Stations	100	27	5
Depots & Storage Areas	100	43	18
Environmental Protection	50	2	0
Rolling Stock	50	25	11
Subtotal in 2064		1 289	726
Present value		568M$	320M$

11.1.6 Railway Operating and maintenance costs

The operating costs amount to 538 M$ for BDHR. and 186 for GCR. The differences are driven by the railway's length, annual tonnage, and passengers. As expected, freight operations are the most significant cost drivers for the operation's present value. The total passenger service operating cost is $31 million for BDH and $10 million for GCR for a total of $41 million over the 30-year operation period.

Table 11-10: Railway operation net present cost

Present value(2023M$)	BDH Railway	Grevet Chapais Railway	Total
MOW Workforce Requirement	144.09	50.93	195.02
Rolling stock Maintenance	37.63	18.54	56.17
Operating costs - Freight	325.85	106.64	432.49
Subtotal	507.57	176.12	683.68
Operating costs - Passenger	31.19	10.05	41.25
Total	**538.76**	**186.17**	**724.93**

Discounted at 2.37% as of 2030, in 2023M$

11.1.7 Railway Operating and maintenance costs

The operating and maintenance costs for railways are presented in this section.

11.1.7.1 Railway Personnel

The railway staffing, as detailed in the operating plan, total 214 employees. The annual payroll including social charges is estimated at 27.16 M$ per year. The posting is detailed in Table 11-11.

Table 11-11: Railway workforce payroll by posting

Groupe	NSR	GCR	Total	Yearly salary
Director	1		1	260,000
Administration	11	2	13	117,000
Operations	67	25	92	130,000
Passenger services	10	3	13	130,000
Rolling stock maintenance	45	4	49	123,500
Maintenance of Way	35	11	46	123,500
Total	169	45	214	27,163,500

11.1.7.2 Maintenance of way

The maintenance of way cost requirements includes staffing for internal maintenance activities as well as subcontracted activities. The internal activities include one field monitoring of on-foot inspections of the track, switches & turnouts, expansion joints, environmental inspections and minor repairs. The outsourced activities include bridge and culvert inspections, track geometric records, ultrasonic rail testing, track grinding is outsourced.

The railway maintenance strategy is started within the first years of operation and increase to the 5th year. Afterwards, the inspection and maintenance regime are performed on a yearly basis. It is assumed that the activities are pursued on a different portion of the track each year as to respect required federal maintenance standards. This strategy explains the linear cash flows throughout the operating period as shown in Figure 11-4 and Figure 11-5.

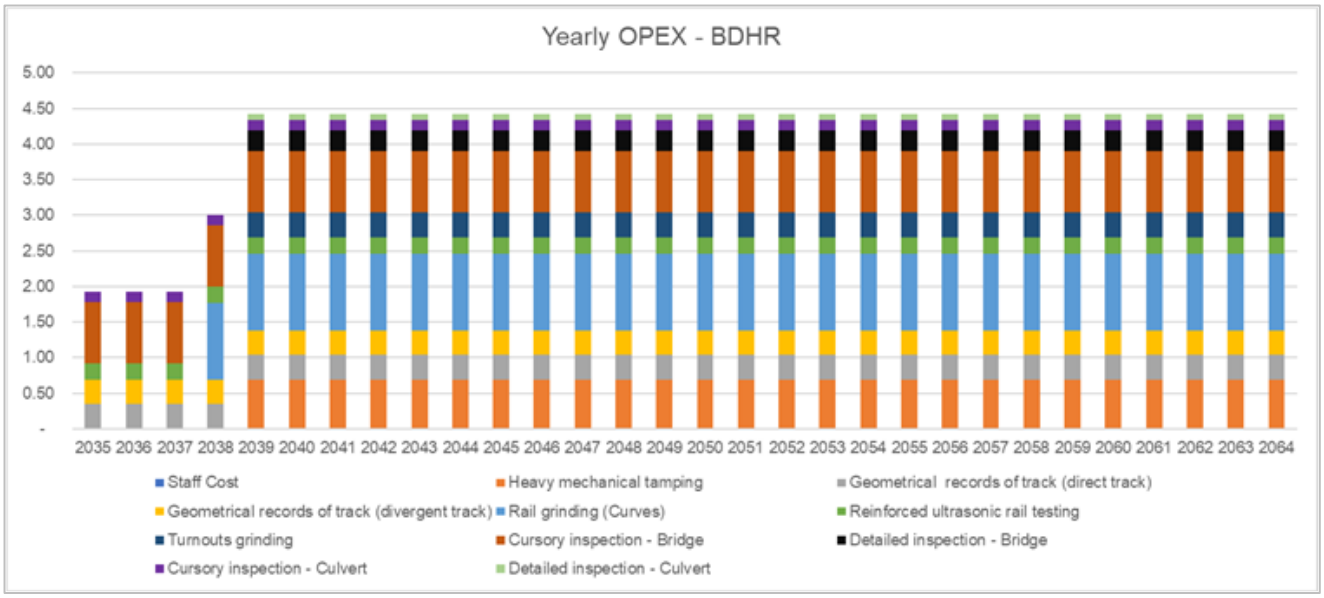

Figure 11-4: Yearly Opex – BDHR

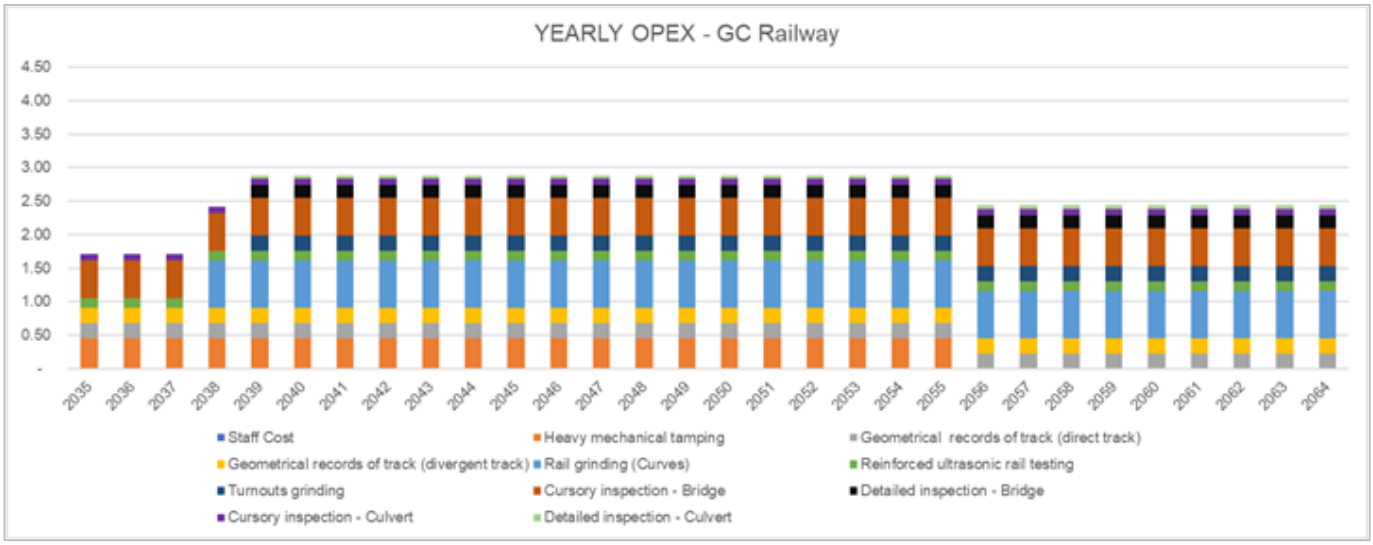

Figure 11-5: Yearly Opex - GCR

11.1.7.3 Rolling stock maintenance

The rolling stock maintenance costs are briefly detailed in the following table. The maintenance regime follows standard practices with yearly maintenance and inspections, minor overhauls every 6 years for the locomotives and major overhauls every 12 years for the freight cars and passenger cars.

Table 11-12: Freight train maintenance regime

Freight Services	Quantity	Yearly Cost	Minor O/H (yr 6)	Major O/H (yr 12)
Locomotives				
SD70ACe or equiv.	4	83,000	400000	750,000
Spare parts	1			1,000,000
Freight Cars				
Covered hopper	159	5,000		15,000
Bulkhead flat car	56	5,000		15,000
64' flat car	101	5,000		15,000
89' flat car	5	5,000		15,000
Ballast car	10	5,000		15,000
Side Dump car	3	5,000		15,000
Box car	2	5,000		15,000
Covered Mill Gondola	47	5,000		15,000
Subtotal		**2,584,050**	**1,600,000**	**9,745,000**

Table 11-13: Passenger train maintenance regime

Passenger Services	Quantity	Yearly Cost	Minor O/H (yr 6)	Major O/H (yr 12)
Locomotives				
SD70ACe or equivalent.	2	95,450	400,000	750,000
Passenger Cars				
Coachs	4	28,750		500,000
Gencar	2	11,500		250,000
Subtotal		**328,900**	**800,000**	**4,000,000**

11.1.7.4 Fuel consumption

The train fuel consumption is split between the two alignments and demand segments. Annually, the trains consume 765 million litres to carry the 1.57 MTPA of freight, and 49,6 million litres for passenger travel. The yearly fuel cost amounts to 1,86 million $ per year.

Table 11-14: Annual fuel consumption

Phase I	Diesel consumption	Liters/year	M$/yr
BDHR	Freight	546,156	1.25
	Passenger	29,273	0.07
	Subtotal	575,429	1.32
GCR	Freight	218,634	0.50
	Passenger	20,311	0.05
	Subtotal	238,945	0.5
	Total	**814,374.**	**1.86**

11.1.7.5 Other costs

The administrative and overhead costs consist of insurances, administration and management. They are respectively valued at 5% and 3% of the total OPEX costs. A OPEX contingency of 15 % is applied to all cost.

11.1.8 Road Maintenance costs

The following table presents the basis of calculation for the incremental costs. The current study covers 763 kilometres of roads of which 79 km are currently paved and 45 km do not exist (Mistissini Secondary Access Road). As a result, the total distance of paved and unpaved roads differ between the two scenarios. In the Do-Nothing scenario, the unpaved road maintenance costs are applied to the 233 km whereas in the studied scenario, the total number of paved kilometres amounts to 278 km. The maintenance cost of the existing 79 km does not change.

The Route du Nord will be paved on the 406 kilometres.

Table 11-15: Access roads surface type and length

Access roads	Total length	Paved km	Unpaved km
Waskaganish	102	22	80
Eastmain	104	30	74
Wemindji	96	23	73
Nemaska	10	4	6
Route du Nord	406	0	406
Mistissini (new road)	45	Non existing	Non existing
TOTAL	**763**	79	639

The road maintenance costs are based on per kilometer costs. The values are derived from VEI's maintenance work performed on northern roads. As many of the costs are identical for both types of roads, they balance each other leaving the differential unchanged. The two main cost drivers are the additional winter maintenance, de-icing, abrasive costs for the paved roads and the summer levelling, maintenance of crowns and slopes plus the dust control for the unpaved roads. The per kilometer costs are presented in **Table 11-16**.

Table 11-16: Yearly road maintenance cost per kilometer

Activité d'entretien routier (2023M$)	Unpaved $/KM	Paved $/KM
Maintenance of erosion protection of ditches, patching or resurfacing of shoulders	500,00	
Maintenance of small signage	116.05	116,05
Maintenance of semi-rigid crash barriers	1 502,10	1 502,10
Culvert repair & cleaning	641.46	641,46
Circuit patrol	248,20	248,20
Winter maintenance, snow removal , de-icing , abrasives; de-icing of culverts	5 055,88	8 097,25
Summer levelling, maintenance of crowns and slopes	2 739,36	184,00
Recovery, transportation and disposal of animals	20.00	20,00
Manual & mechanical dismantling of dams and control of harmful beavers	120.00	120,00
Dust suppressant spreading (dust control)	856.44	-
Flagger Service	942,92	942,92
Bridges inspection (annual)	136,91	136,91
Bridges inspection (periodic – 2 years)	1 026,85	1 356,57
Bridges Cleaning	30.00	30,00
General Fees and Administration (Owner) (1% Of Annual Cost)	2 944,00	4 233,0
Total	**16 880,17 $**	**17 628,46 $**

The maintenance cost net present value for the access roads amounts to 11 M$, and 16 M$ for the Route du Nord. Given the extra kilometres to be maintained the additional cost's present value rises to 0.62 M$ over the 30 years of operations as shown in the following table.

Table 11-17: Access roads surface type and length

Road maintenance costs ($2022M)	With Project	Without Project
Access roads	10.99	9.32
Route du Nord	16.05	17.09
Subtotal	27.04	26.42
Difference		0.62

Discounted at 2.37% as of 2030

Paving the community access roads and the Route du Nord generates a net cost savings of 0.76 M$ as shown in the following table.

Table 11-18: Annual maintenance cost of access roads to communities.

Access road	KM	Paved roads	Unpaved	Difference
Waskaganish	102	3,14 $	3,05 $	0,09 $
Eastmain	104	3,20 $	3,11 $	0,09 $
Wemindji	96	2,96 $	$2.87	0,09 $
Nemaska	10	0,31 $	0,30 $	0,01 $
Subtotal	312	$9.61	$9.32	0,28 $
Mistissini (new road)	45	1,39 $		
Access Roads	357	10,99 $	$9.32	1,67 $
Route du Nord	406	16,05 $	17,09 $	-$1.05
Total	**763**	25,65 $	$26.42	-$0.76

11.1.9 Summary of costs

The total LGA infrastructure program's present value is $5,678. As expected, 81% of the costs are incurred in the construction phase. The operating and maintenance cost represent 13% of the total. As expected, the BDHR is the most expensive investment project, as it represents 49% of the total present value.

The table below presents the total infrastructure costs in terms of present value, divided among the different railway components and construction, investment, and operation costs.

Table 11-19: Maintenance cost present value summary

Socio-economic costs(2023M$)	BDHR	GCR	Access roads	Route du Nord	TOTAL
Conception and construction	2,172	1,163	608	726	4,668
Sustaining capital	54	24	67	140	284
Operating costs	539	186	2	(1)	726
Total Costs	2,765	1,373	676	865	5,678

Discounted at 2.37% as of 2030

11.1.10 Benefits

The following section presents the methodological approach taken to calculate the monetary value of the socio-economic benefits expected from new train infrastructure and new community access roads.

From an economic standpoint, opportunity cost refers to the cost of choosing one option over another or the cost of foregoing the next best alternative. When deciding between two or more options, the opportunity cost of the chosen option is the value of the benefits that could have been obtained from the next best alternative, foregone.

Opportunity cost is an important concept in economics because it helps decision makers evaluate the trade-offs associated with different choices. By considering the opportunity cost of a decision, more informed choices that maximize benefits and minimize costs can be made. For the LGA infrastructure program, the opportunity cost of building the BDHR and GCR to move freight and people by train rather than by car or truck is evaluated.

This study will produce benefits for the freight and passenger demands and these two travel demand segments will be treated separately. Freight transport is the primary demand segment. Passenger demand is the second segment. Results will be resented for both demand segments.

These benefits result from improvements in the transportation system's performance and changes in the travel patterns of its users. Most benefits are common to both demand segments. The benefits include the following cost reductions:

- Travel time savings
- Road safety
- Fuel costs
- Vehicle operating costs
- Air pollutant and greenhouse gas emissions

Benefits are directly related to speed, distance, traffic volume, and vehicle occupancy. The new train line's impact on traffic has been assessed in the traffic study. It has been assumed that the shift in modes will have implications, notably, the implementation of the railway will help the CDC maintain its current economic development and support expected growth.

11.1.10.1 Value of time

Calculating the economic value of time involves estimating how much an individual or society are willing to pay for a reduction in time spent on a particular activity. The method for estimating the value of time is to use data on wages or salaries and the purpose of the trip, since it can be assumed that the individual values their time at least at that rate. Another method for estimating the value of time is to evaluate how much they would be willing to pay for a faster or more comfortable way of travel and use the responses to estimate the economic value of time saved.

The economic value of time saved has been calculated by multiplying the time saved by the estimated value of time. The recommended hourly time value of a truck driver in 2023 is $37.18, and for a person travelling by car is $16.08 for the driver and $11.30 for the passenger, as stated in the Guide to Cost Benefits Analysis and adjusted for inflation with the consumer price index.

11.1.10.2 Road Safety

The cost of an accident is evaluated using the willingness-to-pay approach. This approach is the one favoured by the MTQ in the '*Guide de l'analyse avantages-coûts des projets publics en transport'*. It assesses the value of accidents involving human lives by measuring the amount that citizens are willing to pay to preserve life, taking into account the costs related to the loss of quality of life and grief following an accident. Willingness to pay is based on surveys or studies of worker premiums.

Table 11-20: Economic cost of road accidents in Québec

Accident type	Nord-du-Québec administrative région	Willingness to pay	Total economic value
Deaths	4	4 997 464	20 822 766
Accident w/ Major Injuries	17	1 232 409	21 156 349
Accident w/ Minor Injuries	111	156 402	17 360 665
Property Damage Only	284	16 719	4 748 064
Total	**416**		**64,087,844**
Value of an accident avoided by kilometres travelled			$0.40

11.1.10.3 Fuel consumption

The amount of fuel a vehicle uses depends on its fuel efficiency, which is typically expressed in miles per gallon (mpg) or litres per 100 kilometres (L/100 km). To calculate fuel costs, multiply the distance travelled by the fuel consumption rate and the cost of fuel per unit. The fuel consumption estimates are based on the consumption rates by speed and travel distances. Fuel prices are shown in Table 11-21. All taxes and levies are removed in the economic cost. The initial prices are those provided by the Régie de l'énergie for the region for 2022.

Table 11-21: Tax-free fuel charges in Northern Québec

Fuel	Average price	GST	QST	Provincial tax	Federal Excise Tax	Prix hors taxe
Regular Gasoline	¢ /litre	9.98%	5%	19.20 ¢/l	10¢/l	¢/l
	207.90	189.04	180.04	160.84	150.84	150.84
Diesel	¢ /litre	9.98%	5%	0	20.20¢/l	¢/l
	225.00	204.59	194.85	174.65	170.65	170.65

11.1.10.4 Vehicle operating costs;

Vehicle operating costs refer only to the variable costs of vehicles that are associated with their use on the road. These costs include oil consumption, tire wear, and maintenance and service costs. No specific models or data are available to estimate vehicle operating costs for the Eeyou Istchee area fleet. Consequently, vehicle operating costs are calculated using MTQ values.

The results are discounted to 2023 dollars using the growth rate of the consumer price index. The average VOC vehicle operating cost for all automobile trips is estimated at $0.13 /vehicle kilometres. The equivalent cost for a truck is $0.32/km.

11.1.10.5 Air pollutant and greenhouse gas emissions;

The value of one ton of greenhouse gas emissions (GHG) varies depending on a number of factors, including the specific context and location in which the GHG emissions occur, the type of GHG emitted, and the market or policy mechanism used to value the emissions.

In some cases, GHG emissions are subject to carbon pricing mechanisms such as carbon taxes or emissions trading schemes, which assign a price to each ton of GHG emissions. The price of a ton of GHG emissions can fluctuate over time based on market conditions and government policy decisions. For example, as of December 2021, the price of carbon in the European Union Emissions Trading System was approximately $94 per tonne, which is very close to the MTQ proposed value below.

In addition to greenhouse gas emissions, several other classic air pollutants are emitted from transportation, including:

Nitrogen oxides (NOx) : These are a group of highly reactive gases that contribute to smog, acid rain, and ground-level ozone formation. NOx emissions from transportation are primarily produced by combustion engines and are associated with respiratory and cardiovascular health impacts.

Particulate matter (PM) : PM is a complex mixture of tiny particles and droplets that can be inhaled deep into the lungs, and can cause a range of health impacts, including respiratory and cardiovascular diseases. PM is emitted from a variety of sources, including combustion engines and brakes, and can also contribute to visibility impairment.

Volatile organic compounds (VOCs) : VOCs are a group of chemicals that can react with other pollutants to form ground-level ozone, which can cause respiratory and cardiovascular health impacts. VOCs are emitted from a variety of sources, including gasoline and diesel fuel, and can be produced by evaporation from fuel and other materials.

Carbon monoxide (CO) : CO is a colourless, odourless gas that can be toxic at high concentrations. CO is primarily emitted from combustion engines and can contribute to respiratory and cardiovascular health impacts.

Sulfur dioxide (SO_2) : SO_2 is a colourless gas that the combustion of sulfur-containing fuels can produce. SO^2 is associated with respiratory health impacts and can contribute to acid rain.

The air pollution and GHG emissions are estimated at a gram per kilometre of travel by vehicle type and speed.

The quantification of pollution and greenhouse gases (GHG) is a function of speeds by vehicle categories (light vehicles, regular trucks, heavy trucks).

The air pollution emissions are:

- Carbon monoxide (CO);
- Hydrocarbons (HC);
- Nitrogen oxides (NOx);
- Sulphur oxides (SOx);
- Fine particles (PM10 and PM2.5);
- Greenhouse gases (GHG) in CO2 equivalent.

The costs used for these same pollutants are presented in Table 11-22.

Table 11-22: Air pollution cost per pollutant in $ per metric ton

Pollutant	Cost $ per metric ton
GES	$96,22
CO	$562
HC	$2,581
NOx	$19,009
SOx	$22,049
PM2,5	$274,723
PM10	$109,894

Economic resources consumed by the travel demand

Freight transport's modal shift leads to vehicles being withdrawn from the road network. The monetary value of these benefits is calculated using the freed-up resource method. To translate these benefits into monetary values, the number of vehicle kilometres and travel times avoided by the BDHR and the GCR must be calculated.

The market survey evaluates the freight demand at 1,578 million tons per year at the opening of the railways. The economic benefits are calculated by evaluating the distance the freight would travel by train.

Table 11-23: Annual Travel demand summary by freight market segment in tons

Market segment	BDHR	GCR	TOTAL
Forestry	90 000	174 020	264 020
Mining	858 250	393 400	1 251 650
Construction	1,667	3,333	5,000
Supply	51,406	6,667	58,073
Other	53,073	10,000	1,578,743
Total	**1,001,323**	**577,420**	**1,578,743**

The product density (Table 11-24) is used to calculate the number of trucks required for moving this demand by the alternate mode.

Table 11-24: Product density

Product Type	kg/m3	g/cm3 or kg/l
Spruce-Fir	450	0.45
Wood Chip	380	0.38
Copper Ore	2,250	2.25
Iron Pellets	2,500	2.50
Spodumene/lithium ore	1,430	1.43
Diesel	860	0.86
Gasoline	800	0.80

The yearly truck kilometer savings are estimated at 16.81 million truck kilometres for the BHDR and 11.54 for Grevet Chapais. These values translate into 186.7 and 128.3 thousand truck hours saved with BDHR and GCR.

For the shipper, the benefits come from a reduced cost per ton kilometer. The cost to the shipper by market segment is based on CN non-unit train fares per ton kilometres as shown in the table below:

Table 11-25:Total annual revenues by freight market segment

Train	$/tonne km	Tonnes-km BDHR	Revenues BDHR	Tonnes-km GCR	Revenues GCR
Forestier	0,075	21 240 000	$ 1,600,304	28 495 775	$ 2,146,983
Forestier	0,089	21 240 000	$ 1,885,655	28 495 775	$ 2,529,812
Mining	0,087	202 547 000	$ 17,717,731	64 419 250	$ 5,635,052
Construction	0.200	393,333	$78,668	545,833	$109,169
Subtotal		245,420,333	$21,282,359	121,956,633	$10,421,016
Total				**367,376,967**	**$31,703,375**

The total monetary value of benefits listed above is obtained by multiplying the vehicle kilometres and travel times freed up by the presence of the BDHR and GCR by the unit value of each.

Table 11-26: Detailed Benefit Present Value by Demand Segment for BDHR

Benefits	Truck	Train Passengers	Total
Time savings	132	-	132
Fuel costs savings	306	-	306
Operating cost savings	101	-	101
Pollution (reduction)	24	0.00	24
GES (reduction)	29	0.00	29
Accidents (reduced risk)	127	0.02	127
Shipping cost/consumer utility	120	2.06	122
Subtotal	838	2.08	840

Discounted at 2.37% as of 2030

Table 11-27: Detailed Benefit Present Value by Demand Segment for GCR

Benefits	Truck	Train Passengers	Total
Time savings	90	-	90
Fuel costs savings	210	-	210
Operating cost savings	69	0.01	69
Pollution (reduction)	16	0.00	16
GES (reduction)	20	0.00	20
Accidents (reduced risk)	87	0.03	87
Shipping cost/consumer utility	59	2.29	61
Subtotal	**552**	**2.33**	**554**

Discounted at 2.37% as of 2030

Table 11-28: Total Benefit Present Value by Railway project

Benefits ($2023)	BDHR	GCR
Driving time	132	90
Fuel costs	306	210
Operating costs	101	69
Pollution (reduction)	24	16
GES	29	20
Accidents	127	87
Shipping cost/consumer utility	122	61
Subtotal	840	554
Total		**1,394**

Discounted at 2.37% as of 2030

11.1.11 Results

11.1.11.1 Economic Project Indicators

KPIs are used to help decision makers evaluate the financial feasibility of a project and determine whether the expected benefits of the project justify its costs. By comparing different projects based on their NPV, BCR, EIRR, and payback period, decision-makers can prioritize investments and allocate resources effectively. Let's take a look at these indicators and how they should be interpreted :

Net Present Value (NPV) - NPV is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. A positive NPV indicates that the project is expected to generate value and is economically feasible, while a negative NPV indicates that the project is not expected to generate value and may not be desirable socially.

Benefit-Cost Ratio (BCR) - BCR is the ratio of the total benefits to the total costs of a project. If the BCR is greater than 1, it means that the benefits of the project outweigh the costs, while a BCR of less than 1 indicates that the costs outweigh the benefits.

Economic Internal Rate of Return (EIRR) - EIRR is the discount rate at which the net present value of a project is zero. If the IRR is greater than the cost of capital, it means that the project is expected to generate a return higher than the economic cost of capital and is therefore economically viable. However, if the EIRR is lower than the economic discount rate, the project may not be economically feasible. In this case, the project may result in a negative cost-benefit ratio or present value. The IRR is an important indicator of the economic viability of a project.

Payback Period - Payback period is the length of time it takes for a project to generate enough cash inflows to cover its initial investment. A shorter payback period is generally preferred as it indicates that the project will generate returns more quickly. However, the payback period requires a positive economic return for the project.

These KPIs are interpreted as follows:

NPV : A positive NPV indicates that the project is expected to generate a profit, while a negative NPV indicates that the project is expected to result in a loss.

BCR : A BCR greater than 1 indicates that the benefits of the project outweigh the costs, while a BCR less than 1 indicates that the costs outweigh the benefits.

IRR : If the IRR is greater than the cost of capital, it means that the project is expected to generate a return higher than the social cost and is thus economically viable.

Payback Period : A shorter payback period is generally preferred as it indicates that the project will generate returns more quickly.

In summary, these KPIs are used to help decision makers evaluate the financial feasibility of a project and determine whether the expected benefits of the project justify its costs. By comparing different projects based on their NPV, BCR, IRR, and payback period, decision-makers can prioritize investments and allocate resources accordingly.

The calculations are base monetary values expressed in 2032 dollars after being discounted at a 2.37% rate. The discounted cash flows account for the year in which the cost, benefit, or residual value is expected to occur. That is the initial investment programmed during the 5-year construction period. During the course of the 30 years of operations, both replacement costs and maintenance costs are programmed. The results of the BDHR and GCR are presented in Table 11-29.

The expected annual benefits are the annual revenue or savings generated by the investment or project from a societal point of view. Again, the values are expressed in today's dollars after being discounted.

The Residual Value is the expected value of the infrastructure at the end of the period, expressed in today's dollars. Finally, the Net Present Value (NPV) is the sum of all discounted costs and annual benefits and represents the overall social value of the project. In general, a positive total NPV indicates that the project is expected to generate a profit, while a negative total NPV suggests that the investment or project is expected to result in a loss.

The economic analysis of Phase 1 of the current study returns a negative NPV. This indicates that the project's costs outweigh its anticipated benefits.

The CBR is another financial metric used to evaluate the economic feasibility of a project by comparing the present value of its anticipated benefits to its costs. A CBR of 0.51 suggests that for every dollar invested in the project, only 51 cents in benefits is expected to be returned, which is not a favourable ratio. The slightly higher CBR of 0.64 for GCR indicates that it may be slightly more economically feasible than BDHR when evaluated independently.

Table 11-29: Phase 1 Economic results

Net present value (M$)	BDHR	GCR	TOTAL
Costs	-2,760	-1,366	-4,126
Annual Benefits	840	554	1394
Residual value	568	320	888
Net Present Value	-1,352	-492	-1844
Benefit/Cost RATIO	0,51	0.64	0.55

11.1.12 Sensitivity Analysis

Sensitivity analysis is a technique used to determine how changes in a single assumption impact the analysis outcome. To perform a sensitivity analysis, all other variables must be kept constant, and one hypothesis is changed at a time. This approach makes it easier to identify which variable has the most significant impact on the cost estimate. In some instances, sensitivity analysis can also evaluate the effect of multiple assumptions changing relative to a specific scenario.

Whether the analysis focuses on a single cost driver or multiple drivers within a single scenario, the primary difference between sensitivity analysis and risk or uncertainty analysis is that sensitivity analysis isolates the effects of changing one variable at a time. In contrast, risk or uncertainty analysis considers the impact of multiple variables changing simultaneously. The goal of sensitivity analyses is to assess the impact of a specific assumption on the results and, if possible, identify the switching values required to influence the analysis outcome. The sensitivity analysis results are presented in Table 11-30 and Table 11-31.

The sensitivity analysis revealed that a change of ± 30 % of the initial capital expenditure only slightly modified the current cost-benefit ratio of 0.51, between 0.42 to 0.66. Similarly, changes in freight demand to both pessimistic and optimistic scenarios had a similar impact on the cost-benefit ratio.

The sensitivity analysis on the discount rate showed that the net present value (NPV) was highly impacted. Given that the NPV was negative at 2.37%, the focus of the sensitivity analysis was to explore a reduction in the discount rate. However, the lowest value explored was close to zero, indicating that the expected internal rate of return (EIRR) was negative or that the BDHR did not generate sufficient traffic to justify the investment in the railway.

Table 11-30: BDHR sensitivity analysis

Phase 1	Costs	Benefits	B/C ratio	NPV
CAPEX +30%	(3,383)	840	0.42	(1,975)
CAPEX -30%	(2,137)	840	0.66	(729)
Freight volume - Pessimistic	(2,759)	638	0.44	(1,552)
Freight volume- Optimistic	(2,765)	1,095	0.60	(1,102)
Increase Passenger revenues (0.4$/km)	(2,760)	842	0.51	(1,350)
Discount rate @0.0001%	(3,257)	1,330	0.80	(637)
Discount rate @1	(3,020)	1,089	0.66	(1,021)
Discount rate @2.37 (base case)	(2,760)	840	0.51	(1,352)
Discount rate @5	(2,399)	534	0.32	(1,631)
Discount rate @10	(1,972)	260	0.15	(1,666)

We also conducted similar sensitivity analyses on the GCR, which showed slightly better results than those obtained for the BDHR. This outcome can be attributed to the lower cost per kilometer and the shorter railway length. The sensitivity analysis that yielded the highest NPV was one where the discount rate was close to zero. This sensitivity analysis returned a B/C ratio of 1.02, indicating a positive return on investment.

Table 11-31: GCR sensitivity analysis

Phase 1	Costs	Benefits	B/C ratio	NPV
Capex +30%	(1,706)	554	0.51	(832)
Capex -30%	(1,027)	554	0.85	(153)
Freight volume - Pessimistic	(1,358)	346	0.49	(693)
Freight volume - Optimistic	(1,373)	804	0.82	(249)
Increase Passenger revenues (0.4$/km)	(1,366)	556	0.64	(490)
Discount rate @0.0001%	(1,569)	877	1.02	35
Discount rate @1%	(1,473)	718	0.84	(243)
Discount rate @2.37 (base case)	(1,366)	554	0.64	(492)
Discount rate @5%	(1,211)	352	0.40	(727)
Discount rate @2.37%	(1,015)	171	0.19	(818)

We conducted a comprehensive analysis of freight traffic, as presented in Figure 11-6. Our findings reveal that a turning point is reached when there is a 136 % increase in demand. This is a significant increase, as it is equivalent to doubling the anticipated tonnage. It is noteworthy that this specific sensitivity analysis affects both the operating costs and annual revenues, highlighting the importance of considering demand fluctuations in business planning.

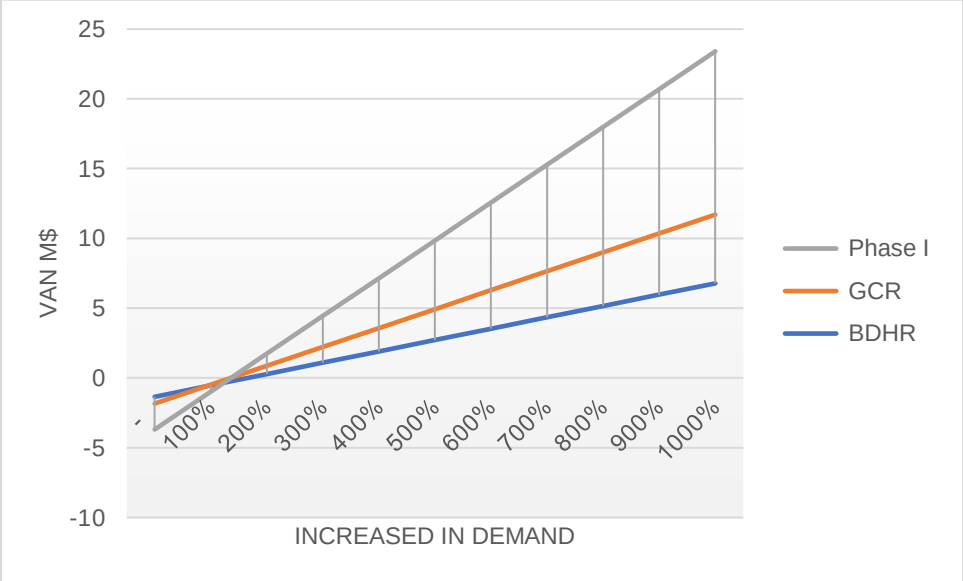

Figure 11-6: Sensitivity of freight demand on net present value

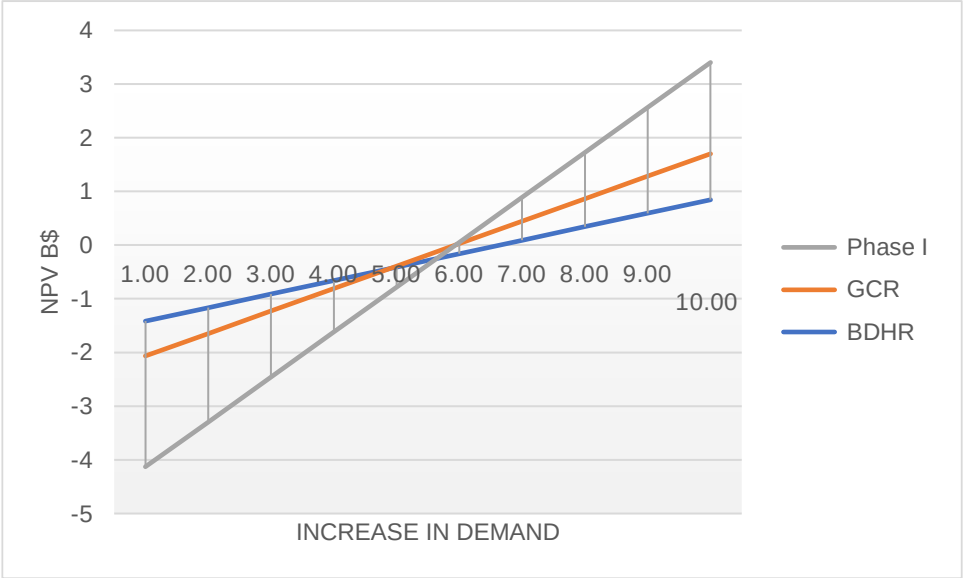

Figure 11–7: Freight traffic sensitivity analysis with a 10 % discount rate

11.1.13 Summary Results

The Phase I ***BDHR and CGR*** project, despite having a B/C ratio of 0.55 and negative NPV, should still be seriously considered, especially as resource development strengthens. The analysis indicated that using trucks for transportation would lead to more pollution and increase the risk of accidents on the road network, and trucks generate more greenhouse gases and air pollution than trains for large volumes.

The cost analysis of paving the **Access Roads** demonstrated that after the initial investment, the differential maintenance costs are of minimal when considering that 10% of accidents were related to mud and wet conditions, 3.8 % to sand and that 3 of the 11 fatal accidents occurred in these conditions over the last 5 years.

The Market Study report highlights the critical importance of access roads for the success and sustainability of Cree communities and railway infrastructure. Therefore, any development project should prioritize the development of efficient and safe access roads that facilitate the transportation of goods and people.

Since freight traffic is vital to railway revenue and the most populated communities to the north are currently not served, it is crucial to ensure the development of efficient access roads that allow for the safe and reliable transportation of goods and services to all communities and enable them to take part in economic development.

The developing lithium mining sector could create economic opportunities for local communities. Therefore, having access to economic activities that drive job creation is crucial. Access roads and transportation infrastructure can play a vital role in facilitating this development. Similarly, the rehabilitation of the Grevet-Chapais Railway could contribute to the development of copper mines and the forestry industry. Access roads can improve the efficiency of transportation and logistics, which can boost economic activity in these industries.

Most stakeholders have expressed the view that the existing transportation infrastructure is obsolete and needs to be upgraded. The rehabilitation of the BDH is a part of solving this issue. Future socio-economic development in Eeyou Istchee Baie-James relies greatly on the efficiency of the transportation infrastructure.

It is important to note that financial metrics such as B/C ratio and NPV should not be the only factors considered when evaluating the feasibility of a project. Other factors such as risk, time to market, strategic importance, and alignment with company goals and objectives should also be taken into account to make an informed decision.

11.2 ECONOMIC IMPACTS

11.2.1 Objective and Methodology

11.2.1.1 Objective

The implementation of the BDHR and GCR, as well as the renewal of access roads and of the Route du Nord, in Eeyou-Istchee Baie-James generates significant economic impacts stemming from capital expenditures, asset maintenance expenses, as well as necessary operating expenses. This section provides the quantification of economic impacts for Québec resulting from the realization and operation (including maintenance) of the railway and roadway infrastructure.

More specifically, the objectives of this section consist of estimating the standard indicators of the economic activity generated by the project, in terms of employment, income (value added) at basic and market prices, Québec and federal fiscal revenue (tax and paradox), and imports, for the entire Québec, and of providing an indication of the impacts for Eeyou Istchee Baie-James.

Economic impact analysis is an important tool in project or activity assessment in that it measures the value added or income that remains in Québec or in the region from the expenditure or investment, to workers, companies, and governments, compared to the economic leakage which is a loss to the Québec economy. From the public point of view, it may be sensible for public authorities to invest or subsidy a project or an activity

11.2.1.2 Impact Categories.

The main different categories of impacts, which correspond to the standard indicators of generated economic activity, include:

- ***Jobs*** that are created or supported, usually expressed in equivalent full-time workers (person-years), both employees and self-employed people.

- ***Value added*** at basic and market prices, including salaries and other income for the workers who filled those jobs, as well as the profit generated by the companies who employ them.
- ***Government revenue***, for both Québec and federal, including income tax, sales tax, excise tax, and incidental taxes, including for example contributions to the Régime des rentes du Québec (RRQ) and employment insurance (EI).
- ***Imports*** or expenses for goods and services provided outside of Québec, thus economic leakage.

11.2.1.3 Periods

The economic impacts associated with the presence of the railway network in Québec's economy comes from three periods:

- ***During construction***, i.e., the realization of capital expenditures, which will extend over a period of five years. These expenditures relate to the earthworks, the purchase of material, equipment, and services as well as the implementation of structure, track, signalling and communications, rolling stock, buildings, yards, and environmental measures, necessary to receive the infrastructure; and earthworks,
- ***During the operation*** of the railways and roads, which requires hiring personnel and purchasing goods and services from local, regional, or foreign suppliers (outside of Québec's territory) – the impacts are calculated for a representative year***.***

The economic impacts of operating expenses are recurring, meaning that they will take place year after year. In contrast, the impacts from capital expenditures are punctual : they only occur during the period in which these expenses are incurred. To continue to have such recurring benefits, managers must invest money annually in renovations, expansions, etc. For this reason, and if we project the economic impacts of a railway's presence in a given economy over time, one does not add the economic benefits resulting from capital expenditures to operating expenses.

The introduction of the railway network will allow the trucks to transfer freight that is currently forwarded by route. This network redesign will avoid substantial capital and operating expenses, while their economic impacts will not be realized. This means that economic impacts are estimated on a gross basis, i.e. not considering the reduction of economic impacts on trucking.

11.2.1.4 Effects

Economic impacts of an expenditure are the sum of direct, indirect, and induced effects. These effects are:

- ***Direct effects*** correspond to the fact that the company (here the promoter, the constructor and the owner/operator) incurs direct expenses in the form of salaries and social benefits for its employees, and in the form of the profit for the company. From salaries and profit from which are derived government revenue, including income tax and incidental taxes. A share of the company's expenditures is awarding contracts to firms, which in turn pay salaries to their employees and purchase goods and services from other suppliers in the Québec economy and even outside of it (these are imports). This company is therefore directly responsible for creating or supporting jobs and increasing activity for various suppliers or companies in Québec.
- ***Indirect effects*** are explained by the fact that suppliers of goods and services to a company themselves create a demand for goods and services from their own suppliers, thereby leading to increased activity among the latter. This succession of purchases of goods and services from different levels of suppliers (the supply chain) as well as the increase in hours worked by employees and self-employed workers results in what we call indirect effects or benefits. In our context, these impacts are generated by purchases made, among others, by construction companies, material and equipment suppliers, etc.

- ***Induced effects*** are generated by the fact that a portion of the salaries paid to employees in sectors related to the different productive sectors affected by railway and road expenditures (both direct and indirect effects) is spent again in the Québec economy, creating additional demand for goods and services. Induced effects are estimated as follows. First, these expenditures result in an increase in pre-tax wages and salaries in the Québec economy, from which taxes paid to governments to obtain wages and salaries available for consumption and savings. From this available income, the consumption amount is assessed by deducting the saving rate.

11.2.1.5 Québec Intersectoral Model

The instrument used to quantify the economic impacts is the Québec Intersectoral Model (QIM), developed by the Institut de la statistique du Québec (ISQ). The QIM is capable of calculating direct and indirect effects resulting from any type of expenditure related to any project or economic activity, whether it is in agriculture, forestry, mining, industry, infrastructure, construction, transportation, tourism, culture, consumption, government or para-government. This model is commonly used, among other things, by various Québec ministries, state-owned companies such as Hydro-Québec, economic sector associations, private or community promoters, to accurately measure the economic impacts of a project or expenditure.

The QIM is an economic analysis tool that allows for the evaluation of the direct and indirect impacts on Québec as a whole, including job creation, resulting wages, value added (a measure of domestic production in the Québec economy), and government revenues at both levels. The latest detailed version, released in 2018, enables the quantification of the impact on the 235 productive sectors of the Québec economy, as well as the 479 categories of goods and services, five primary sectors, and 287 final demand sectors (including imports).

These categories, along with jobs, pre-tax wages, and other gross income, are used to set the input spending vector. This vector is then multiplied by the input-output matrix to obtain the impacts. The matrix provides information for a given good/service or demand sector purchase, including the quantity of labour, income, demand for other sectors, taxes, and imports at a specific year (in this case, 2018). This new demand for other sectors is iterated several times to reproduce the total indirect effect of the initial expenditure. From this calculation, the model produces the output economic impact.

11.2.1.6 Keynesian Multiplier

The Québec Intersectoral Model (QIM) is used to quantify the direct and indirect effects resulting from any type of expenditures of a project or economic activity, such as agriculture, forestry, mining, industrial, infrastructure, construction, transportation, tourist, culture, consumption, governmental or para-governmental. The QIM calculates induced effects by applying a Keynesian-type multiplier to the sum of direct and indirect effects. The multiplier is the factor that translates the consumption spinoff compared to the initial effect. For instance, a multiplier of 1.5 applied to employment means that for each direct/indirect job created or supported, 0.5 jobs are created or supported in the consumption sector, for a total of 1.5 jobs. Similarly, the income multiplier can be applied to salaries or value added. An income multiplier of 1.23 means that for every thousand dollars injected into the Québec economy for a project or activity (value added or direct and indirect effects net of imports), additional activities with a value added of $230 are created or supported in the various economic sectors of Québec due to the spending of households. The employment and income multipliers may be the same or different.

The Keynesian multiplier can be estimated from the results of the expenditure of Québec households using the QIM. Economists have also derived Keynesian multipliers from the composition of the Québec and regional economies, based on differentiating the base or export sectors (mainly primary, manufacturing, motor tertiary,

tourism, etc.) from the local consumption/service sectors (retail, primary/secondary education, health, local public administration, etc.)

11.2.2 Construction Period

11.2.2.1 Railways

The total amount of capital expenditures is $3.2B, such as detailed in Table 11-32. This amount excludes GST and QST. The structure of this cost by nature that affect the economic impact (labour use, local inputs, imports) is divided this way : local works (earthworks, forest road/trail, drainage and culverts, ballast) representing 38.0% of total cost; bridges and structures with 11.7% of total cost; railway equipment (rail, ties, level crossings, signalling and telecommunications) with 46.2% of total cost; and buildings and storage with 4.1%. Thus, the cost structure uses a large share of local resources but also a large share of procurement susceptible to generate imports.

Table 11-32: Railway Capital Expenditure

Million dollars	BDHR	GCR	Total	%
Earthworks	571.2	157.8	729.0	22.6%
Forest road / snowmobile trail	0.0	115.3	115.3	3.6%
Drainage and Culverts	84.0	24.0	108.0	3.4%
Bridges and structures	256.4	120.7	377.2	11.7%
Ballast	165.0	106.1	271.1	8.4%
Rail and turnouts	553.3	360.5	913.8	28.4%
Ties	284.4	183.3	467.7	14.5%
Level crossings	2.7	1.4	4.1	0.1%
Signalling and telecoms	13.8	14.4	28.2	0.9%
Stations and buildings	36.1	6.3	42.3	1.3%
Stocking spaces	57.6	24.9	82.6	2.6%
Environmental measures	5.6	0.0	5.6	0.2%
Rolling stock	52.1	22.7	74.8	2.3%
Total	2,082.1	1,137.6	3,219.7	100%
%	64.7%	35.3%	100%	

Note : Due to rounding, the sum of the elements may not correspond to the total.

Table 11-33 details the economic impact of the railway construction generated by the CAPEX expenditure of $3.2B, divided into direct, indirect and induced effects, and for the different aspects of the economic impact including employment, value added (wages and profits), grants and imports and, government revenue.

In terms of ***employment***, railway construction creates or supports nearly 15,246 person-years of direct and indirect jobs. A person-year is equivalent to hiring one person for a full year or two people each working an average of six months per year, or one person over six months a year for two years, or any other combination. Just over 91% of these jobs are employees, while the others are other workers (mainly self-employed people). The induced effects, i.e., the wages and salaries that are spent again in the economy of Québec, add 2,950 pers-years for a total of 18,196 pers-yrs.

Table 11-33: Railway Construction, Phase I, Economic Impact

(000$)	Direct Effects	Indirect Effects	Direct and Indirect Effects	Induced Effects	Total Effects
Workforce (pers-yr)*	8,960	6,286	15,246	2,950	18,196
Employees	8,253	5,665	13,918	2,684	16,603
Other workers	706	621	1,328	266	1,593
Value added	1,095,797	613,044	1,708,842	299,378	2,008,220
Wages before taxes	575,069	329,710	904,778	125,867	1,030,645
Net income of individual companies	37,970	24,256	62,226	29,555	91,781
Other gross income before taxes	482,759	259,079	741,838	143,956	885,794
Other productions	4,140	11,035	15,175	2,447	17,622
Grants	-7,448	-10,176	-17,624	-10,799	-28,424
Indirect taxes	0	19,942	19,942	57,198	77,140
Imports	720,040	773,949	1,493,989	181,340	1,675,329
Gouvernement du Québec Revenue	172,841	96,856	269,698	64,208	333,906
Tax on wages	58,871	29,885	88,757	7,248	96,004
Sales tax	0	5,449	5,449	23,607	29,056
Specific taxes	0	8,916	8,916	14,272	23,188
Québec incidental taxes (RRQ, FSS, CSST, RQAP)	113,970	52,606	166,576	19,081	185,658
Canada Government Revenue	53,597	33,224	86,821	27,213	114,034
Tax on wages	38,281	17,964	56,245	4,073	60,318
Sales tax	0	804	804	13,981	14,785
Excise taxes	0	4,773	4,773	5,338	10,111
Federal incidental taxes (EI)	15,316	9,683	24,999	3,821	28,820

Note : Due to rounding, the sum of the elements may not correspond to the total. *Not in thousands

The ***value added*** at basic prices generated by the railway construction amounts to $2.0B. This value includes a total payroll of $1.0B, from which $0.9B in direct and indirect effects, and $125M in induced effects. These wages and salaries and the jobs associated with them are mainly related to engineering work, engineering and related services, and non-residential construction.

Apart from salaried employees and other workers, two other factors of production must be remunerated. First, individual owners of their own businesses, independent members of liberal professions (such as doctors, dentists, lawyers, artists, etc.), and finally the net rental income of individuals. These different elements are grouped under the heading of "net income from individual businesses". In the context of the tramway capital expenditures, this remuneration totals $92M.

The last factor of production to be remunerated is the entrepreneur of a business (except for the individual entrepreneur) as well as the capital, both financial and physical, that each business uses. This includes depreciation, depreciation of equipment and buildings, interest, as well as other expenses (employer contributions, benefits,

production taxes) and finally subsidies for production. In the context of the tramway capital expenditures, these "other gross income before taxes" amount to $885M.

It is important to note that in the calculation of total effects, the two sources of remuneration, namely net income from individual businesses and other gross income before taxes, do not generate any additional economic impact in the Québec economy since we assume that we do not know where and how these revenues will eventually be spent. For example, a business may decide to invest a portion or all of this remuneration in expanding its activities outside of Québec. The induced effect is calculated from the wages less income tax on wages fewer incidental payments less the saving rate.

In addition to estimating the economic activity resulting from capital expenditures, any study of economic impacts seeks to estimate the fiscal impacts, which is the number of various taxes and fees that will enter the coffers of both levels of government. Indirect taxes are payments made to governments as a result of purchases of goods and services by various productive sectors of the Québec economy and consumers. These taxes consist of the Québec Sales Tax (QST), the federal Goods and Services Tax (GST), as well as Québec-specific taxes and federal excise taxes and duties.

The induced effects explain 86% of the indirect taxes collected by these two levels of government. Two reasons explain the relative importance of the origin of these taxes. First, the net taxes paid by the chain of suppliers of goods and services to the first suppliers, the direct effects, and to other suppliers, the indirect effects, are very low due to tax refunds on input costs. Second, almost all purchases of goods and services made by employees are taxed at the full rate, which explains the relatively strong importance of the number of these taxes that come from induced effects in the calculation of indirect taxes.

It is important to note that by adding the number of indirect taxes of $43.8M to the "value added at basic prices," we obtain the "value added at market prices" (or Gross Domestic Product at market prices). In the context of capital expenditures, this amounts to $2.05B.

Imports represent the value (at production prices) of purchases made by Québec companies from external suppliers (outside Québec). These imports can be competitive or non-competitive (goods not manufactured in Québec). In both cases, this results in a leakage of money from the Québec economy. In the context of railway investment projects, these imports total $1.7B. An important part of this amount comes from the expenses related to rail material and equipment. Induced effects account for 11% of total imports.

The final element that an economic impact study seeks to quantify is the amount of additional tax revenues that the two levels of government (Québec and Ottawa) will receive as a result of the analyzed project. Of course, the indirect taxes we just discussed are an important component of these additional revenues. Payroll and benefit taxes, as well as parafiscal charges, are the other components that must be considered to have a comprehensive picture of the fiscal benefits for each of the two levels of government.

Government revenues include tax on wages, sales taxes, specific taxes (on gasoline, tobacco, and alcohol), excise taxes, and incidental revenue or employee and employer contributions to parafiscal charges (RRQ, FSS, CSST, RQAP, EI). The rail construction investment spending will generate an additional $334M in revenue for the Québec government. Of this amount, $92M is generated by taxes on wages while $52M comes from sales taxes and specific taxes. The difference, $186M, comes from parafiscal charges. The induced effects are responsible for 21% of the Québec government revenue.

Additional tax revenues for the federal government amount to $114M. Payroll and benefit taxes, as well as employment insurance, account for 78% of this amount, with the remaining portion coming from indirect taxes (sales taxes, specific taxes and excise duties). Induced effects account for 23% of these additional revenues.

11.2.2.2 Roads

The total expenditure for road construction amount to $1.2B, before taxes, as detailed in Table 11-34. Like for most road projects, a major part of the expenditure is local by nature.

Table 11-34: Road Capital Expenditure

(M$)	Waska-ganish	Eastmain	Wemindji	Nemaska	Mistissini	RDN	Total	%
Work preparation	39.9	36.0	36.4	6.8	16.9	119.0	254.8	20.7%
Earthworks	15.6	11.3	11.7	1.3	17.1	39.9	96.8	7.9%
Roadway and pavement	92.1	79.7	78.7	8.9	36.6	259.4	555.5	45.1%
Drainage and structures	20.0	13.9	18.7	1.5	3.1	54.2	111.5	9.1%
Traffic maintenance and signalling	0.8	1.1	1.1	0.1	0.7	3.2	7.0	0.6%
Other works	7.7	5.4	5.9	0.7	1.5	19.7	41.0	3.3%
Landscaping	0.2	0.2	0.2	0.0	0.1	0.5	1.1	0.1%
Environmental measures	0.4	0.5	0.4	0.1	0.0	1.3	2.6	0.2%
Administration and profit	26.5	22.2	23.0	2.9	11.4	74.6	160.5	13.0%
Total	**203.1**	**170.4**	**176.0**	**22.3**	**87.4**	**571.7**	**1,230.8**	**100%**
%	16.5%	13.8%	14.3%	1.8%	7.1%	46.5%	100%	

Note : Due to rounding, the sum of the elements may not correspond to the total.

Table 11-35 presents the economic impacts of the road construction expenditure. As for ***employment***, road construction creates or supports 8,522 person-years of direct and indirect jobs, and 1,577 pers-years of induced jobs for a total of 10,099 pers-yrs.

Table 11-35: Road Construction, Phase I, Economic Impact

('000)	Direct Effects	Indirect Effects	Direct and Indirect Effects	Induced Effects	Total Effects
Workforce (pers-yr)*	**5,013**	**3,509**	**8,522**	**1,577**	**10,099**
Employees	4,531	**3,141**	**7,672**	**1,435**	**9,107**
Other workers	482	**367**	**849**	**142**	**992**
Value added	**508,598**	**347,960**	**856,558**	**83,065**	**939,623**
Wages before taxes	302,074	**185,624**	**487,698**	**67,269**	**554,967**
Net income of individual companies	45,738	**15,336**	**61,075**	**15,796**	**76,870**
Other gross income before taxes	160,785	**147,000**	**307,785**	**0**	**307,785**
Other productions	0	**10,819**	**10,819**	**1,308**	**12,127**
Grants	0	**-6,068**	**-6,068**	**-5,772**	**-11,840**
Indirect taxes	0	**8,924**	**8,924**	**30,569**	**39,493**
Imports	0	**360,626**	**360,626**	**96,917**	**457,543**
Québec Government Revenue	**100,425**	**50,477**	**150,902**	**34,316**	**185,218**
Tax on wages	27,386	**15,299**	**42,686**	**3,873**	**46,559**
Sales tax	0	**2,622**	**2,622**	**12,617**	**15,238**
Specific taxes	0	**4,111**	**4,111**	**7,628**	**11,739**
Québec incidental taxes (RRQ, FSS, CSST, RQAP)	73,038	**28,445**	**101,483**	**10,198**	**111,681**
Canada Government Revenue	**25,257**	**16,801**	**42,058**	**14,544**	**56,602**
Tax on wages	16,875	**9,207**	**26,082**	**2,177**	**28,258**
Sales tax	0	**394**	**394**	**7,472**	**7,866**
Excise taxes	0	**1,809**	**1,809**	**2,853**	**4,662**
Federal incidental taxes (EI)	**8,382**	**5,391**	**13,773**	**2,042**	**15,815**

Note : Due to rounding, the sum of the elements may not correspond to the total. * single units

The ***Value Added*** at basic prices generated by the road construction amounts to $940M. This value includes a total payroll of $555M, from which $488M in direct and indirect effects, and $67M in induced effects. The net income from individual businesses totals $77M. Other gross income before taxes, mainly corporate profits, amount to $308M. By adding the amount of indirect taxes of $40M to the value added at basic prices, the value added at market prices, may be estimated at $979M.

Imports outside Québec imports total $458M. Induced effects account for 21% of total imports.

Government revenues amount to $185M for the Gouvernement du Québec. Of this amount, $47M is generated by taxes on wages while $27M comes from sales taxes and specific taxes while parafiscal charges generate $112M. The induced effects are responsible for 19% of the Gouvernement du Québec's revenue. Additional revenues for the federal government amount to $57M. Payroll and benefit taxes, as well as employment insurance, account for 44M$ with the remaining portion ($13M) coming from indirect taxes. Induced effects account for 26% of federal revenues.

11.2.2.3 Total Construction

Table 11-36 detailed the economic impacts of all Phase I infrastructure construction, including railways and roads. The total number of jobs created or supported is 28,295 person-years. The value added at basic prices amount to $2.9B while imports are worth $2.1B. Government revenues are $519M for Québec and $170M for the federal.

Table 11-36: Railway and Road Construction, Phase I, Economic Impact

('000)	Direct Effects	Indirect Effects	Direct and Indirect Effects	Induced Effects	Total Effects
Workforce (pers-yr)*	**13,972**	**9,795**	**23,768**	**4,527**	**28,295**
Employees	**12,784**	**8,807**	**21,591**	**4,119**	**25,710**
Other workers	**1,189**	**988**	**2,177**	**408**	**2,585**
Value added	**1,604,395**	**961,005**	**2,565,400**	**382,443**	**2,947,843**
Wages before taxes	**877,143**	**515,334**	**1,392,477**	**193,136**	**1,585,613**
Net income of individual companies	**83,708**	**39,592**	**123,300**	**45,351**	**168,652**
Other gross income before taxes	**643,544**	**406,079**	**1,049,623**	**143,956**	**1,193,579**
Other productions	**4,140**	**21,854**	**25,994**	**3,754**	**29,748**
Grants	**-7,448**	**-16,244**	**-23,692**	**-16,571**	**-40,263**
Indirect taxes	**0**	**28,865**	**28,865**	**87,768**	**116,633**
Imports	**720,040**	**1,134,574**	**1,854,614**	**278,257**	**2,132,871**
Québec Government Revenue	**273,266**	**147,333**	**420,599**	**98,524**	**519,123**
Tax on wages	**86,258**	**45,185**	**131,442**	**11,121**	**142,564**
Sales tax	**0**	**8,070**	**8,070**	**36,224**	**44,294**
Specific taxes	**0**	**13,027**	**13,027**	**21,900**	**34,927**
Québec incidental taxes (RRQ, FSS, CSST, RQAP)	**187,008**	**81,051**	**268,060**	**29,279**	**297,339**
Canada Government Revenue	**78,854**	**50,025**	**128,879**	**41,757**	**170,637**
Tax on wages	**55,156**	**27,170**	**82,327**	**6,250**	**88,576**
Sales tax	**0**	**1,198**	**1,198**	**21,453**	**22,651**
Excise taxes	**0**	**6,582**	**6,582**	**8,191**	**14,773**
Federal incidental taxes (EI)	**23,698**	**15,075**	**38,772**	**5,864**	**44,636**

Note : Due to rounding, the sum of the elements may not correspond to the total. *single units

11.2.3 Operation Period

11.2.3.1 Railways

The annual operating expenses for the two railway lines amount to $44.6M, as shown in Table 11-37. A large share of this expenditure is explained by the workforce (70%). This labour-intense cost structure affects the nature of economic impacts.

Table 11-37: Railway Annual Operating Expenditure

(M$/yr)	BDHR	GCR	Total	
Management and Administration	**1.3**	**0.9**	**2.2**	**4.9%**
Personnel, management and administration	1.2	0.8	2.0	
Administration expenses	0.1	0.0	0.2	
Train Operation	**4.8**	**2.5**	**7.3**	**16.4%**
Personnel. trains	0.9	0.6	1.5	
Fuel and lubricants	1.5	0.6	2.2	
Accommodation and food	1.0	0.8	1.8	
Insurance	1.4	0.4	1.8	
Yard and Station Operation	**10.0**	**4.2**	**14.2**	**31.8%**
Personnel, yards and stations	10.0	4.2	14.2	
Maintenance of Way	**8.1**	**3.6**	**11.7**	**26.2%**
Personnel, maintenance of way	5.0	1.6	6.5	
Grinding, tamping, geometry, structure inspection	3.1	2.0	5.1	
Rolling Stock	**6.5**	**2.7**	**9.2**	**20.7%**
Personnel, rolling stock maintenance	4.9	2.1	7.0	
Material and pieces, locomotives and wagons	1.6	0.7	2.3	
Total	**30.8**	**13.8**	**44.6**	**100%**
Personnel	22.0	9.2	31.2	70.0%
Expenses	8.8	4.6	13.4	30.0%
Total	**30.8**	**13.8**	**44.6**	**100%**
%	69.1%	30.9%	100%	

Note : Due to rounding, the sum of the elements may not correspond to the total.

The annual operation of the two railway lines (BDHR and GCR) in phase I should create or support 214 direct jobs, 73 pers-yrs. in indirect effects and 89 in induced effects, for a total ***employment*** of 375 pers-yr, as detailed in Table 11-38.

Table 11-38: Railway Annual Operation, Phase I, Economic Impact

('000)	Direct Effects	Indirect Effects	Direct and Indirect Effects	Induced Effects	Total Effects
Workforce (pers-yr)*	**214**	**73**	**287**	**89**	**375**
Employees	214	**66**	**280**	**81**	**360**
Other workers	0	**7**	**7**	**8**	**15**
Value added	**23,034**	**9,825**	**32,859**	**5,491**	**38,350**
Wages before taxes	23,034	3,534	26,568	3,793	30,360
Net income of individual companies	0	250	250	891	1,141
Other gross income before taxes	0	6,042	6,042	808	6,849
Other productions	0	48	48	74	122
Grants	0	-134	-134	-325	-459
Indirect taxes	0	109	109	1,723	1,832
Imports	0	11,499	11,499	5,464	16,963
Gouvernement du Québec Revenue	**6,179**	**925**	**7,105**	**1,935**	**9,040**
Tax on wages	2,342	**311**	**2,653**	**218**	**2,871**
Sales tax	0	**23**	**23**	**711**	**735**
Specific taxes	0	**48**	**48**	**430**	**478**
Québec incidental taxes (RRQ, FSS, CSST, RQAP)	3,838	**543**	**4,381**	**575**	**4,956**
Canada Government Revenue	**2,122**	**329**	**2,451**	**820**	**3,271**
Tax on wages	1,504	**191**	**1,695**	**123**	**1,818**
Sales tax	0	**7**	**7**	**421**	**428**
Excise taxes	0	**30**	**30**	**161**	**191**
Federal incidental taxes (EI)	619	**100**	**719**	**115**	**834**

Note : The numbers have been rounded, so the sum of the elements may not correspond to the total. *Single units

The ***value added*** at base prices amount to $38.4M annually. From this amount, more than half (60%) is generated directly by wages, while 26% comes from indirect effects and 14% from induced effects. The value of total wages is estimated at $30.4M or 79% of the value added. Net income of individual companies account for a value of $1.1M and other gross income before taxes is $6.8M. Considering that annual indirect taxes amount to $1.8M, the value added at base prices is estimated at $40.2M annually.

Imports are estimated at $17.0M annually, from which 68% comes for the needs of the railway through indirect effects, and 32% from induced effects by consumption.

Government revenues amount to $9.0M annually for the Gouvernement du Québec. Out of this amount, $2.9M is generated by taxes on wages while $4.1M comes from sales taxes and specific taxes while parafiscal charges generate $5.0M. The induced effects are responsible for 21% of the Gouvernement du Québec's revenue. Additional revenues for the federal government amount to $3.3M annually. Payroll and benefit taxes, as well as employment insurance, account for 2.6M$ with the remaining portion ($0.6M) coming from indirect taxes. Induced effects account for 25% of federal revenues.

11.2.3.2 Roads

The additional annual road maintenance cost due to the upgrading of access roads and of the Route du Nord, as well as the additional Mistissini access road, is estimated at $1.4M, from which more than half ($0.8M) for the RDN. Given this cost is marginal in view of the total infrastructure maintenance and operating cost, the economic impact is considered marginal and thus has not been estimated.

Table 11-39: Road Annual Net Maintenance Cost

(M$/yr)	RDN	AR	Total
Annual Maintenance Cost	0.8	0.6	1.4

Note : Due to rounding, the sum of the elements may not correspond to the total.

11.2.4 Regional Impact

The regional impact of the construction and operation of railways and roads considered in Phase I should be important in view of the large share of possible local works, except for the railway material and equipment procurement, the intensity of the workforce required during both construction and operation periods, the provisions of the JBNQA and of CCQ regulation, the experience of Cree companies and communities in major construction projects and, the commitment of the CNG and the CDC towards the Grande Alliance infrastructure program as a tool for economic development of the Cree communities.

The size of these railway and road projects shall require a lot of humans, physical, and organizational resources during construction, beyond regional capability. The construction schedule would enhance the likelihood of maximizing the Cree participation in terms of employment and procurement.

The management and operation of BDHR and GCR railways, by the Cree, as well as their participation to road maintenance, are objectives to aim at. The Innu-Naskapi operation of Transport ferroviaire Tshituetin (TFT) is an experience that would be useful to the Cree.

The next section explores employment opportunities and training approach to achieve this purpose.

11.3 WIDER ECONOMIC BENEFITS

11.3.1 Objective and Methodology

Wider economic benefits refer to the positive impacts that an economic activity or policy can have on the overall economy beyond the immediate beneficiaries of the activity or policy. These benefits can take many forms, including increased economic growth, employment and income, improved trade and investment, and enhanced competitiveness.

For example, if a company invests in new technology or equipment, it may experience increased productivity and profitability as a result. This in turn can lead to increased wages and employment opportunities for workers, and increased demand for goods and services from suppliers. This can have a ripple effect throughout the economy, contributing to overall economic growth and development.

Similarly, government policies and programs that support economic development and growth can also have wider economic benefits. For example, infrastructure investment can create jobs, stimulate demand for goods and services, and improve the efficiency and competitiveness of businesses. Education and training programs can improve the skills and employability of the workforce, leading to increased productivity and economic growth.

Overall, wider economic benefits can contribute to the well-being and prosperity of a community or region and help create a more balanced and sustainable economy.

New railways and roads can bring various economic benefits to a northern community. Here are some potential benefits:

1. **Increased trade** : A new freight railway can provide a more efficient and cost-effective way to transport goods to and from the northern community, which can help local businesses become more competitive in the global marketplace. This can lead to increased trade and investment and help attract new businesses to the area.
2. **Job creation :** The construction of a new freight railway can create jobs for local workers, and once the railway is operational, it can support additional jobs in related industries such as logistics and transportation.
3. **Reduced transportation costs :** A new freight railway can provide a more cost-effective way to transport goods, which can help to reduce transportation costs for local businesses and consumers. This can help improve local businesses' competitiveness and make goods more affordable for local consumers.
4. **Improved infrastructure** : The construction of a new freight railway can lead to improved infrastructure in the northern community, which can help to support additional economic development in the area and increase safety for users of the railway and roadway.
5. **Reduced traffic congestion** : A new freight railway can help reduce traffic congestion on local roads and highways, improving the overall quality of life for residents and making the community a more attractive place to live and work.

Overall, a new freight railway can provide a range of economic benefits to a northern community, including increased trade, job creation, reduced transportation costs, improved infrastructure, and reduced traffic congestion. These benefits can help to stimulate economic growth, create new opportunities for local businesses and workers, and improve the overall quality of life in the community.

Quantitative benefits of a new freight railway for the Cree community may include measurable impacts such as:

- **Increased income** : A new freight railway can create employment opportunities, leading to increased income for individuals and families in the community. This can be measured through factors such as average income per capita or the percentage of the community's workforce that is employed.
- **Increased economic activity** : A new freight railway can stimulate economic activity in the region, leading to increased business investment, production, and consumption of goods and services. This can be measured through metrics such as Gross Domestic Product (GDP) or regional economic output.
- **Improved transportation efficiency** : A new freight railway can provide a more efficient mode of transportation for goods, leading to cost savings and increased business competitiveness. This can be measured through metrics such as transportation costs per unit of product or the percentage of goods transported by rail.
- **Increased access to markets** : A new freight railway can improve access to regional, national, and international markets for goods produced in the community. This can be measured by factors such as the number of businesses exporting goods or the value of regional exports.
- **Improved community infrastructure** : A new freight railway can provide an opportunity for infrastructure investment in the community, leading to improved residents' quality of life. This can be measured through metrics such as the number of new infrastructure projects or the value of infrastructure investments in the region.

Overall, the quantitative benefits of a new freight railway for the Cree community can include increased income, increased economic activity, improved transportation efficiency, increased access to markets, and improved

community infrastructure. These benefits can be measured through a variety of metrics and can help to provide a quantitative understanding of the impact of the railway on the community.

Qualitative impacts in addition to the economic benefits, a new freight railway can bring a variety of qualitative benefits to an indigenous community in the following ways:

- Enhanced cultural connections : Indigenous communities have strong cultural and historical ties to the land, and a new freight railway can provide an opportunity for the community to strengthen its connections to its traditional lands and territories. The railway may also provide access to areas of cultural or spiritual significance that were previously difficult to reach.
- Improved access to services : A new freight railway can help to improve access to essential services such as healthcare, education, and food. This can be particularly important in remote and isolated indigenous communities that may have limited access to these services.
- Increased employment opportunities : The construction and operation of a new freight railway can create employment opportunities for members of the indigenous community, providing a source of income and helping to reduce unemployment and poverty.
- Increased contacts between members of different communities by reducing the journey duration and risk or discomfort.
- Environmental protection : Indigenous communities often have a deep connection to the natural environment and the land. A new freight railway can be designed and operated with consideration for the environment, minimizing its impact on the land, water, and wildlife. This can help to protect the environment and preserve the natural resources that are important to the community.
- Increased community engagement : A new freight railway can provide an opportunity for the Cree community to own or engage with the railway company and other stakeholders, helping to build positive relationships and promote mutual understanding.

Overall, a new freight railway can bring a variety of qualitative benefits to the Cree community, helping to strengthen cultural connections, improve access to services, create employment opportunities, protect the environment, and foster positive community engagement.

11.3.2 Regional Economy

The traditional way of life for the Cree population often involves a strong connection to the land and reliance on natural resources for subsistence, cultural practises, and spiritual well-being. Economic development associated with mining and forestry can bring benefits and trade-offs to the Cree population. The trade-offs must be carefully considered to ensure that the benefits of development are realized without undermining the well-being of the Cree population and their traditional way of life.

Benefits of mining and forestry for the Cree population may include increased employment opportunities, increased income, and improved access to goods and services. Economic development can also bring investments in infrastructure, such as roads and power lines, which can improve access to remote communities and reduce the cost of living.

However, there can also be trade-offs associated with economic development in the form of environmental degradation and disruption of traditional land use practises. Mining and forestry can cause damage to the natural environment, including waterways, wildlife habitat, and vegetation, which can in turn impact the traditional way of

life of the Cree population. This can include impacts on hunting, fishing, and trapping, as well as impacts on spiritual and cultural practices that are tied to the land.

Furthermore, mining and forestry can also lead to the loss of traditional knowledge and practices as younger generations may be drawn to wage labour rather than traditional livelihoods.

To minimize negative impacts and maximize benefits of mining and forestry for the Cree population, it is important for governments, industry, and Indigenous communities to work together to ensure that development is conducted in a way that is respectful of traditional land use practises and incorporates Indigenous knowledge and perspectives. This can involve the use of traditional ecological knowledge to inform land-use planning and the development of impact and benefit agreements that provide for the sharing of benefits associated with resource development. It can also involve the creation of monitoring and mitigation programs to address environmental impacts and protect the natural resources that are important to the traditional way of life of the Cree population.

The following section provides an overview of the opportunities generated by the Grande Alliance project for people and companies based in the James Bay Cree communities. The training requirements with respect to each type of job will be discussed in the context of the level of education and skills available within the communities, and general recommendations will be provided.

11.3.2.1 Cree Participation in Employment and Contracts

As per the James Bay and Northern Québec Agreement (JBNQA) article 28.10.3 provisions, *"for projects initiated or conducted by Canada or Québec or their agencies, delegates, or contractors, and for projects by any proponent a major purpose of which is to provide goods or services to or for the benefit of Cree communities the governments shall take all reasonable measures to establish Cree priority in respect to employment and contracts created by such projects, [by i) interpreting] requirements for various categories of jobs so that Cree people able to perform the work shall be deemed to be eligible; ii) [advertising] available jobs in the Cree Community […]; iii) [… hiring] a qualified Cree person before hiring a non-Native person for each available job; iv) [providing] Cree employees on-the-job training needed for job advancement.*

[…] In respect to contracts arising from such projects, including requirements that the proponents : i) design contract packages to provide to the Crees a reasonable opportunity to submit competitive tenders; ii) post calls for tenders in a public place in all Cree communities on the date on which the general public is made aware of such calls for tenders; iii) set the date, location, terms and conditions for tendering so that Cree individuals or groups may reply with reasonably ease."

Following the JBNQA, under the *Regulation Respecting the Hiring and Mobility of Employees in the Construction Industry* (ANQ, 2022, R. 20, r. 6.1, s. 36) a preference in hiring must be given to the Indigenous people of; James Bay, those north of this territory and those in other Indigenous territories. An increased involvement of the Cree communities in the Project will result in significant benefits for the Indigenous people in the region with respect to employment opportunities and the local economy.

11.3.2.2 Regional Workforce

There are several Cree construction companies in Eeyou Istchee Baie-James with experience in civil engineering works which can participate in LGA road and rail infrastructure development. These include smaller construction contractors, and larger companies comprised of hundreds of employees, such as the Cree Construction and Development Company (CCDC), that can participate with significant involvement during the construction phase.

There are also Cree companies providing transportation services, which can participate in various roles, such as transportation of workers and materials.

In 2021, 85% of the indigenous workforce in the construction industry were holders of a competency certificate recognized by the Commission de la construction du Québec (CCQ), with heavy equipment operators being a significant portion of this pool. In addition, at least one third of the indigenous workers in Eeyou Istchee Baie-James are involved in civil/road construction projects. Thus, there will be significant opportunities to involve the Indigenous regional workforce both during the construction and operating phases of the Project.

There may be some indigenous workers with railway-specific skills gained from experience with nearby railway operations, however, there will be few workers with such skills available for LGA in comparison with the total required. As such, it will be necessary to bring some of this expertise from outside the region and establish training programs.

Table 11-40 presents the number of workers in fields that can be related to railway and road construction or operation, as per the 2021 Census. In 2021, there were more than 1,100 Cree workers whose profession was trade, transport and equipment operators and related occupations. There were 460 workers in construction, a number comparable to those trained in construction (405). The transportation sector employed 110 people. Approximately 450 Cree people studied in engineering and applied science, mostly at the technician level. Approximately 300 workers occupied professions in the primary sector while slightly more than 100 worked in professional, scientific, and technical services. There were 1,205 people occupying business, finance and administration occupations (820 with such education), which is not surprising since more than half of the Cree workforce work in public administration, education and health sectors. Thus, although most of this workforce is already employed, the human resource pool in Cree and Jamesian communities respond as a basis to the needs of transportation infrastructure construction and operation. The Table 11-40 details Cree and Jamesian workforce statistics detailed by communities, professions and sectors can be found in Appendix A.

Table 11-40: Number of Workers, Branches related to Construction, Engineering and Management, Cree and Jamesian, 2021.

	Cree	Jamesian	Total
Fields of study			
Business, management and public administration	820	1,050	1,870
Physical and life sciences and technologies	45	170	215
Mathematics, computer and information sciences	65	100	165
Engineering	20	110	130
Engineering/engineering-related technologies/technicians	130	680	810
Mechanic and repair technologies/technicians	140	650	790
Precision production	55	290	345
Construction trades	405	345	750
Partial Total	1,680	3,395	5,075
All Fields of Study	3,700	8,435	12,135
Profession			
Legislative and senior management occupations	90	75	165
Business, finance and administration occupations	1,205	1,025	2,230
Natural and applied sciences and related occupations	140	435	575
Trades, transport and equipment operators and related occupations	1,150	1,645	2,795
Natural resources, agriculture and related production occupations	285	400	685
Partial Total	2,870	3,580	6,450
All professions	6,915	7,660	14,575
Sector			
Agriculture, forestry, fishing and hunting	220	185	405
Mining, quarrying, and oil and gas extraction	140	695	835
Utilities	70	160	230
Construction	460	350	810
Transportation and warehousing	110	240	350
Professional, scientific and technical services	110	235	345
Partial Total	1,110	1,865	2,975
All sectors	6,925	7,610	14,535

Source : VEI Calculation from Statcan (2022).

In 2021, construction workers living in Baie-James region (Mistissini, Waskaganish, Eastmain, Nemaska, Wemindji, Chisasibi and, Whapmagoostui) worked mostly in public works and roads (80 workers) and the residential sector (48) with a few in commercial, institutional, or industrial sector (CCQ, 2022). The demand for construction workers in the Baie-James region represents an average of 1M hours annually, as shown in the following table. This demand is satisfied only at 10% by regional workers. It is to be noted that this supply rate does not include workers from Waswanipi, Oujé-Bougoumou nor Jamesian workers.

Table 11-41: Construction Worked Hours, Baie-James Region, according to Workplace and Residence, 2012-2021

(thousands)	Workplace	Residence	Difference	% R/W
2012	2,442	303	2,139	12.4%
2013	2,293	201	2,092	8.8%
2014	2,795	111	2,684	4.0%
2015	1,425	77	1,348	5.4%
2016	1,402	77	1,325	5.5%
2017	1,045	104	941	10.0%
2018	1,085	100	985	9.2%
2019	1,189	104	1,085	8.7%
2020	676	77	599	11.4%
2021	1,044	102	942	9.8%

Note : Baie-James CCQ region excludes Waswanipi and Oujé-Bougoumou as well as Jamesian communities (included in Nord-Ouest and Saguenay-Lac-Saint-Jean).
Source : CCQ (2022).

It must be noted that there are not many institutions providing higher education (university-level) near the Cree communities. The generally low rates of higher education in the Eeyou Istchee communities (less than 6% for the indigenous population of the James Bay region) is one of the consequences of this significant educational barrier. Because of this, there is low availability of local labour well suited for positions in fields requiring higher education, such as financing, higher management, accounting, and human resource management.

The limited availability of higher education institutions in the Eeyou Istchee communities has resulted in a shortage of skilled labour, particularly in fields that require higher education. However, there are other areas where local knowledge and expertise may be valuable, including civil works, services to forestry and mining companies, air transportation, knowledge of the territory, and history.

Local workers have valuable experience in civil works, such as road construction and maintenance, water and sewer infrastructure, and other essential infrastructure projects. They also have experience providing services to forestry and mining companies, such as operating heavy equipment, conducting site surveys, and providing logistical support.

Additionally, local knowledge of the territory and history is valuable in fields such as tourism, cultural heritage, and environmental management. Local workers have knowledge of traditional land-use practises, cultural sites, and natural resources that could be leveraged in these fields.

Overall, while the shortage of skilled labour in fields requiring higher education is a significant challenge in the Eeyou Istchee communities, there are other areas where local knowledge and expertise may be valuable and could be leveraged to support economic development in the region.

11.3.3 Project Employment Opportunities and Training

11.3.3.1 Employment Opportunities

The employment opportunities created by the Grande Alliance program will be numerous for both the construction and operation phases. Currently, the following project timeline has been proposed:

Figure 11-8: Grande Alliance general timeline

Please note this timeline may change.

11.3.3.2 Construction Period

To estimate the required workforce for the construction of the roads and railways, the Total Project Cost (TPC) model was used. The TPC model is a commonly used tool in construction projects that consider various factors such as project scope, timelines, available resources, and potential risks and uncertainties. Based on these inputs, the TPC model estimated the number of workers needed to complete the project within the specified time and budget.

The estimated workforce requirements for direct labour in road and railway construction are provided in Table 11-42 and Table 11-43, respectively. Note that for railway construction, an equivalent number of positions will be required indirectly in contractors' teams. Table 11-39 provides a breakdown of the estimated direct workforce for road construction, which includes various job types such as assistant project manager, land surveying, foreman, data processing, specialized labour, and equipment operators, among others. The total number of positions required for road construction is estimated to be 238, which includes three site superintendents and three office superintendents. Table 11-43 provides the equivalent for the railway construction.

It is to be noted that according to the economic impact analysis (Section 11.2), the $4.5 billion total investment in Phase I would create the equivalent of 14,000 direct person-years during the construction period. This corresponds to 2,800 full-time workers over five years, or 4,800 workers if each worked for 7 months per year. For comparison, the size of the LGA building site is similar to that of several major infrastructure projects currently underway in Montreal, including:

- The Réseau express métropolitain (REM) ($6.9 billion): a 67 km, 26-station unmanned light rail line linking the airport and Montreal metropolitan area to the downtown area;
- The metro blue line extension ($6.4 billion): a 6 km tunnel extension with 5 metro stations and 2 bus terminals;
- The renovation of Louis-Hippolyte-La Fontaine, Viger, and Ville-Marie ($4.3 billion): a major renovation of the tunnel bridge that connects the South-Shore to the Island of Montreal's downtown area.

Table 11-42: Estimated Workforce, Road Construction

Job Type	Number of positions
Assistant Project Manager	4
Land surveying	13
Foreman (office)	3
Foreman (site)	8
Data processing (surveying)	8
Project manager	6
Project manager (office)	2
Project manager (site)	4
Specialized labour	41
Site mechanic	8
Shovel operator	25
Heavy equipment operator	65
Signal maintainers	9
Road flagman	36
1 x Superintendent (site)	3
1 x Superintendent (office)	3
Total	**238**

Table 11-43: Estimated Required Direct Workforce, Railway Construction

Job Type	Number of positions
Assistant Project Manager/Team Leader	2
Executive Officer	1
Land surveying	9
Data processing (surveying)	5
Carpenter	33
Foreman	9
Project Director	2
Project Manager	2
Specialized labour	42
Site mechanic	5
Structural steel erector	4
Journeyman Erector Group Leader	1
Shovel operator	30
Heavy vehicle operator	128
Superintendent	3
Quality Control	5
Total	**281**

Table 11-44 provides a list of the more significant fields of work and economic opportunities, and the anticipated training requirements.

Table 11-44: Opportunities and Training Requirements, Construction Phase

Work Field or Partnership Opportunity	Availability of Cree Expertise	Training Requirements
Construction foremen and supervisors	It is expected that Cree construction foremen with experience will be available within the community. However, there are likely few or no construction foremen with railway-specific experience, which will be required for some of the jobs.	Construction foreman on-the-job training as well as relevant project experience.
Engineering: • Design • Quality Control • Project Management	There may not be sufficient individuals with the appropriate education and experience, in the Cree communities, available for some aspects of this type of work.	University degree (bachelor's degree or higher, depending on the position).
Civil works, such as: • Clearing and grubbing • Earthworks • Rock excavations • Structures and buildings • Drainage works • Operation of heavy machinery	Cree construction companies in the region already have the expertise required for this type of work. This field alone will provide many opportunities for the local workforce, as it constitutes a significant portion of the project's labour. In addition, many Cree are already holders of a CCQ competency certificates, which are required for most of the job opportunities related to this field.	A CCQ competency certificate is required for most of the positions in this field. For more information on training requirements for the intention of a competency certificate, please refer to section *11.3.3.6 : Long-term training* below.
Land surveying	People and companies within the Cree communities in the region may already have the skills required for this type of work.	College-level degree.
Asphalt and concrete workers for road construction	Cree construction companies in the region already have the expertise required for this type of work. This field alone will provide many opportunities for the local workforce, as it constitutes a significant portion of the project's labour. In addition, many Cree are already holders of a CCQ competency certificate, which is required for most of the job opportunities related to this field.	A CCQ competency certificate is required for most of the positions in this field. For more information on training requirements for the intention of a competency certificate, please refer to section *11.3.3.6* : Long-term training below.
Environmental protection : • Pollution management • Wildlife management and protection	Cree with knowledge of the regional fauna who already possesses relevant knowledge and skills should be involved in the project. Environmental engineers will be responsible for preparing the pollution management and general environmental protection plan for this project, there may not be sufficient candidates, with the relevant education and experience, available in the Cree communities.	For technicians, a college-level specialization. For environmental engineers managing the environmental protection plan for the project : a university bachelor's degree in environmental engineering as well as multiple years of experience with this type of work. It may be possible to carry some of these positions forward to the railway operations phase.
Production and transportation of construction materials:	Cree construction companies in the region already have the expertise and equipment required for this type of work.	The production of construction materials involves excavation activities where a CCQ competency certificate is required for many of the positions

Work Field or Partnership Opportunity	Availability of Cree Expertise	Training Requirements
• Ballast and sub-ballast production • Gravel and other materials required for road surfaces • Transportation of materials to the work sites	There are also already Cree companies in the transportation sector. In addition, many Cree are already holders of a CCQ competency certificate, which is required for many of the job opportunities related to this field.	involved. For more information on training requirements for the intention of a competency certificate, please refer to section *11.3.3.6 : Long-term training* below. With respect to transportation of materials, drivers must obtain a Class 1 driver's licence.
Rental of work equipment	Cree companies in the region already provide services which may be employed during the construction period.	No project-specific training will be required for this type of work.
Construction camps: • Erection and staffing • Supply of consumables (food and others)	Many Cree construction companies have extensive experience. For the erection of the construction camps, many Cree are already holders of a CCQ competency certificate, which is required for most of the job opportunities related to this work.	The erection of the construction camps will be carried out either by the suppliers of the camps, or by the construction contractor with assistance from the suppliers. Cree workers involved in this type of work will need to be holders of a CCQ competence certificate. For more information on training requirements for a competency certificate, please refer to section *11.3.3.6 : Long-term training* below. For service staff (cafeteria, cleaning, laundry, etc.) little to no project-specific training will be required. For the supply of consumables, drivers will need to be holders of either Class 1 or Class 3 driver's licence.
Fuel transportation and supply	There are existing fuel supply channels in the region and Cree transportation companies including Petronor which may be employed during the construction phase of the project.	Drivers involved in the transportation of fuel must be holders of a Class 1 driver's licence.
Worksite security	People and companies within the Cree communities in the region might already have the skills required for this type of work.	Security guard training and permit. Also, a licence to carry a firearm.
Track laying: • Rail laying • Rail welding • Installation of ties and fastenings • Track surfacing • Ballast work	There may not be sufficient experience in the Cree communities for some aspects of this type of work, there are no Cree railway-specific construction contractors in Eeyou Istchee Baie-James. Some activities as part of track laying require only a limited amount of training and so local Indigenous workers with construction experience may be hired for some aspects of the track laying.	Some jobs require significant training and railway-specific experience for workers to obtain the necessary skill level. Training Cree workers on-railway-specific machinery in time to be fully qualified for the track construction may not be justifiable, due to the difficulty of access to the machinery, the materials and suitable training sites. These work activities include: • The operation of track laying machines • Placement of rail and ties • Installation of rails It must be noted that workers trained for some of these jobs may carry this experience forward to the operations phases where they can apply the same skills in the context of track maintenance. However, it may be challenging to train workers in time for the beginning of construction. These include: • Track surfacing • Rail welding • Ballast work In addition, some of the tasks involved in track laying may be carried out by workers with general

Work Field or Partnership Opportunity	Availability of Cree Expertise	Training Requirements
		construction experience and would require only a limited amount of training. This would also be a good opportunity to involve a Cree workforce in the project: • Installation of track fasteners (tie fastenings) • Tie distribution A CCQ competency certificate would be required for a lot of these jobs due to these generally being carried out using heavy machinery.
Installation of level crossings	Local Indigenous workers with general construction experience may be hired for this job. Also, there is likely local Cree workers holding a CCQ certificate for crane operation.	A small amount of training will be required for this type of work. General construction experience would be required for some of the labour involved here. However, the construction foreman will need to be experienced in this type of work and rail welders will need to be involved. CCQ competency certificate is required for crane operation.
Signalling and telecommunications systems installation and commissioning	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Signals and Communications Maintainer training and 2-3 years of hands-on experience. It must be noted that this experience can also be carried forward to signalling and telecommunications-related positions on the railway lines.
Health and safety management	People and companies within the Cree communities in the region already have the skills required for this type of work. However, there is likely a lack of expertise with regards to safety requirements specific to the railway industry.	At a minimum, a college degree (DEC) in health and safety at the workplace or significant experience in the industry. Railway-specific health and safety training. It may be possible to carry some of these positions forward to the railway operations phase.
Electricians and utility workers	People and companies within the Cree communities in the region already have the skills required for this type of work.	At a minimum, a college degree (DEC) and experience in the industry.
Road flagmen	People and companies within the Cree communities in the region already have the skills required for this type of work.	A small amount of training will be required for this type of work.

11.3.3.3 Operation Period

The operation phase of the project will provide longer-term opportunities for the community, where jobs and partnerships can last as long as the railway continues operation. This will allow the development of the expertise and skills which require more significant training and railway-specific experience which can only be gained with time, thus enabling Cree staff to become more independent of eternal expertise and the proportion of indigenous labour to increase over time. In addition, there will be job opportunities related to the additional labour required for the maintenance of the upgraded access roads. Table 11-45 provides a summary of the proposed staffing for the railway lines.

Table 11-45: Summary of the proposed railway staffing

Position	Matagami Yard / Station	Waskaganish Community	Waskaganish Yard / Station	Chapais Yard	Timber Siding	Waswanipi Station	Total
Administration							**14**
Railway General Manager		1					1
Admin Assistant	1	2		1			4
Payroll Officer / Contract Administrator		2					2
Health & Safety		1					1
Storekeeper / Procurement Officer	1	1					2
Regulatory / Training		1					1
Admin Officer	1	1		1			3

Position	Matagami Yard / Station	Waskaganish Community	Waskaganish Yard / Station	Chapais Yard	Timber Siding	Waswanipi Station	Total
Transportation (Freight)							**92**
Superintendent - Transportation			1				1
Trainmaster	1		2	1			4
Operations Coordinator			2				2
Yard Master	2		3	2			7
Intermodal Terminal Manager			2				2
Train Dispatcher			3				3
Gateman/Agent	5		5	4			14
Loader Operator			5		5		10
Yardmen/Labourer	1		2	1			4
Yard Jockey			2	1			3
Carload Manager			2				2
Carload Supervisor			1	1			2
Senior General Clerk			2				2
General Clerk	1			2			3
Timekeeper			5	5			10
Intermodal Reporting Clerk			5				5
Bulk Mineral Loading			1	1			2
Bulk Mineral Handling in Storage Shed			5	5			10
Train Crew Members			4	2			6

Position	Matagami Yard / Station	Waskaganish Community	Waskaganish Yard / Station	Chapais Yard	Timber Siding	Waswanipi Station	Total
Rolling Stock Maintenance							**49**
General Foreman	1						1
Foreman	3		2	2			7
Locomotive Maintenance	7						7
Maintainers (fuelling/servicing and standing inspection)	3		1	1			5
Car Maintenance	18						18
Fabrication shop Helper	3						3
MoW Equipment Maintenance	3						3
Shop Cleaning	1						1
Material Control	3						3
Admin	1						1
Infrastructure Maintenance							**46**
Maintenance Director		1					1
Maintenance Manager - Linear Infrastructure		1					1
Maintenance Manager - SIG/TEL		1					1
Foreman Linear Infrastructure	1		3	2			6
Foreman Heavy Track Gang			1				1
Other team			1				1
Senior Technicians - SIG/TEL	1			1			2
Senior Technicians' Mobile Team	2		2				4
Labourers - Linear Infrastructure	4		6	6			16
Labourers Heavy Track Gang			4				4
Labourers - SIG/TEL	2			2			4
Labourers' Mobile Team			6				6
Passenger Services							**13**
Superintendent - Passenger Operations		1					1
Train master - Passenger Operations		1					1
Manager - Station Operations		1					1

Position	Matagami Yard / Station	Waskaganish Community	Waskaganish Yard / Station	Chapais Yard	Timber Siding	Waswanipi Station	Total
Manager On-Board Services		1					1
Passenger On-Board Staff			2	1			3
Passenger Station Staff	1		1	1		1	4
Train Crew Members			2				2
Total							**214**

Table 11-46 expands on the opportunities, for the Cree communities, which will be available during the operation phase of the project, as well as the anticipated training requirements related to each field. It must be noted that some of the opportunities are not listed in the proposed staffing structure above because the jobs may not be offered directly as part of the railway organization but be subcontracted out. Also, some of the job responsibilities may be combined into a single employment position.

Table 11-46: Opportunities and Training Requirements, Operation Phase

Work Field or Partnership Opportunity	Availability of Expertise	Training Requirements
Train crews	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Locomotive engineer training, CROR certification.
Requiring higher education (university or college-level): • Engineers (Rolling stock, track, structural) • Management • Human resource management (HR) • Accounting • Finance • Procurement manager • Administrative assistants	There may not be sufficient individuals, with appropriate education and experience in the available in the Cree communities for some aspects of this type of work.	University degree (bachelor's degree or higher, depending on the position) for managing positions. College-level degree will be required for supporting positions (technicians and assistants).
Other administrative positions (not requiring higher education), such as: • Clerks • Document control	It is expected that local Cree with relevant experience will be available to fill these positions.	OMOT training only (see section *11.3.4 : Operations Mobilization Orientation and Training* for more details).
Environmental protection: • Pollution management • Wildlife management and protection	Cree with knowledge of the regional fauna who already possess relevant knowledge and skills should be involved in the project. Environmental engineers will be responsible for preparing, adapting, and managing the pollution and general environmental protection plan for this project. There may not be enough candidates with the relevant education and experience available in the Cree communities.	For technicians, a college-level specialization. For environmental engineers managing the environmental protection plan for the project : a university bachelor's degree in environmental engineering as well as multiple years of experience with this type of work.
Client services, including touristic services provided within the passenger train service	It is expected that local Cree with relevant experience will be available to fill these positions.	OMOT training only (see section *11.3.4 : Operations Mobilization Orientation and Training* for more details).

Work Field or Partnership Opportunity	Availability of Expertise	Training Requirements
IT management and staff	It is uncertain whether local Cree with relevant experience will be available to fill these positions.	Requires IT-specific training, college-level education.
Operations control / train dispatching	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Train dispatcher training, CROR certification.
Yard staff	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	CROR certification would be required for yard crews, as well as specialized yard crew training. Locomotive engineer training for personnel operating mainline and shunting locomotives around the yard, as well as CCQ competency certificate for the operators of heavy machinery.
Track maintenance: • Machine operators • Track labourers, track foremen, track managers • Welders	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Some positions will require a CCQ competency certificate (heavy machinery operation, welders). General track maintenance training will be required for all. Track supervisors and track inspectors need to receive track inspection training. and CROR certification CROR certification will also be needed for staff operating on-track machinery and vehicles.
Road maintenance	Cree construction companies in the region already have the expertise required for this type of work. Many Cree are already holders of a CCQ competency certificate, which is required for most of the job opportunities related to this field.	A CCQ competency certificate is required for most of the positions in this field. For more information on training requirements for a competency certificate, please refer to section *11.3.3.6 : Long-term training* below.
Rolling stock maintenance	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Only light maintenance will be carried out on the site. Specific rolling stock maintenance training will be required, as well as the possession of CCQ certificate.
Health and Safety	People and companies within the Cree communities in the region already have the skills required for this type of work. However, there is likely a lack of expertise with regards to safety requirements specific to the railway industry.	At a minimum, a college degree (DEC) in health and safety at the workplace or significant experience in the industry. Railway-specific health and safety training.
Security	People and companies within the Cree communities in the region might already have the skills required for this type of work.	Security guard training and permit. Also, a licence to carry a firearm.
Signalling and telecommunications maintainers	There may not be sufficient experience in the Cree communities for some aspects of this type of work.	Signals and Communications Maintainer training.
Vegetation control	It is expected that local Cree with relevant experience will be available to fill these positions.	OMOT training only (see section *11.3.4 : Operations Mobilization Orientation and Training* for more details).

Work Field or Partnership Opportunity	Availability of Expertise	Training Requirements
Cleaning	It is expected that local Cree with relevant experience will be available to fill these positions.	OMOT training only (see section *11.3.4 : Operations Mobilization Orientation and Training* for more details).
Housing/cafeteria support staff	It is expected that local Cree with relevant experience will be available to fill these positions.	A small amount of training is required for these positions.
Transportation and deliveries	There are also already local Cree companies in the transportation sector, as well as Cree with the required driver's licenses.	For the delivery of consumables and materials, drivers will need to be holders of either Class 1 or Class 3 driver's licence. For transportation of people, Class 2 driver's licence is required.
Railway materials production and supply (ballast, sub-ballast, gravel, fuel, etc.)	Cree construction companies in the region already have the expertise and equipment required for this type of work. In addition, many Cree are already holders of a CCQ competency certificate, which is required for many of the job opportunities related to this field.	The production of construction materials involves excavation activities where a CCQ competency certificate is required for many of the positions involved. For more information on training requirements for the intention of a competency certificate, please refer to section *11.3.3.6 : Long-term training* below.

The following figure provides an overview of a proposed timeline related to training for the construction phase.

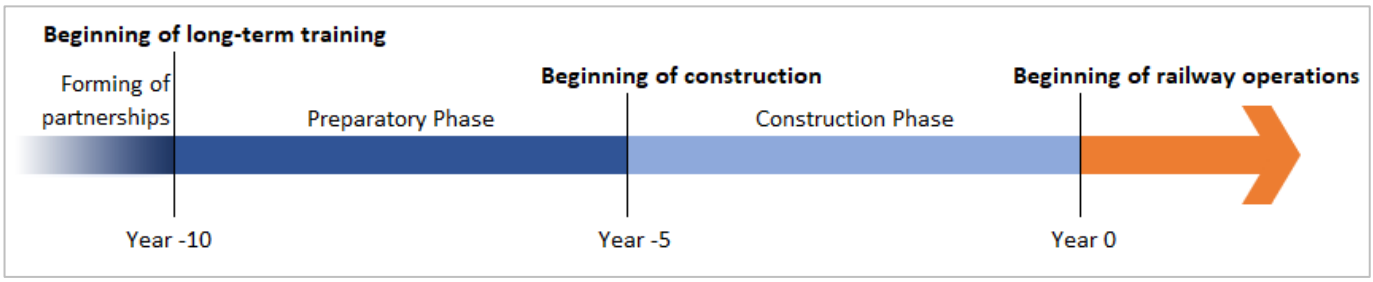

Figure 11-9: Proposed training timeline for construction

For all positions where this is not the case, the following timeline is proposed:

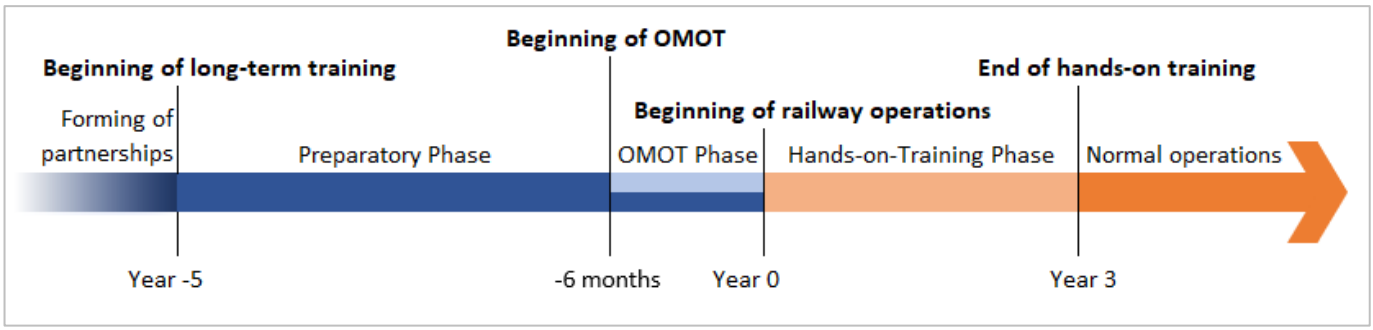

Figure 11-10: Proposed training timeline for construction

11.3.3.4 Training Approach

The timeline favoured by the Grande Alliance could provide an incentive for Cree youth to seek out higher education, but this will require effective communication, partnerships with relevant Cree regional institutions and possibly additional incentives to succeed.

The training approach includes two types of training:

- Long-term training
- Operations mobilization orientation and training (OMOT)

The long-term training would take place in the years leading up to the beginning of the project to ensure that there is enough qualified Cree labour to cover the workforce requirements for both the construction and operating phases. The OMOT will take place in the months leading up to the beginning of railway operations and it will prepare staff for their duties on the railways.

11.3.3.5 Proposed Timeline

To accelerate the integration of Cree individuals into railway operations and construction, training should commence as soon as possible. Some of the training will require long-term education and hands-on experience, which should continue even after operations begin. Succession plans, which are typically part of regional organizations, can be incorporated into the project setup. The project can be divided into six phases concerning workforce training and education:

1. Partnership Formation - This phase should begin promptly. Collaborating with educational institutions will enable the provision of training and educational pathways for Cree individuals in the region.
2. Preparatory Phase - During this phase, long-term training and education will take place.
3. Construction Phase - The project's construction activities will be carried out during this phase.
4. OMOT Phase - Operations mobilization orientation and training will be conducted during this period.
5. Hands-on Training Phase - In this phase, staff who are not part of the Cree community but possess the relevant expertise and experience will work alongside Cree individuals and members of the project training program, mentoring them to gain hands-on experience.
6. Normal Operations - At this point, all staff members have received full training and gained adequate experience to work independently in their roles. Normal Operations - At this point, all staff members have received full training and gained adequate experience to work independently in their roles.

Please note the timelines presented here are approximate and may be different for some positions. They may also be changed based on the agreements made with educational institutions and other partnerships, or due to other project factors. Also, it may not be possible to begin the preparatory phase 10 years before the beginning of operations due to financial or other constraints.

11.3.3.6 Long-term Training

As previously mentioned, it is expected that it will be difficult to find Cree in the James Bay region which is already fully qualified for some specific positions. To ensure the project involvement of the Cree population is in significant numbers, extensive training must be carried out.

The specialized training would be a long-term endeavour. It must be noted that there may be challenges to preparing candidates in time for some positions for the beginning of construction. However, considering that the horizon of railway operations is 30 years, there will be many opportunities to train Cree to cover most (if not all) positions supporting the railway over time.

The long-term training approach will be split into the following two categories:

- Jobs requiring higher education (a university degree)
- Jobs requiring specialized training

Higher Education (University-level)

Some positions, mainly ones involved in administrative management, as well as engineering positions, require that staff hold a bachelor's degree or higher in a field relevant to the specific field of work. These include:

- Professional Engineers (rolling stock, track, structural, drainage, environmental, etc.)
- Management and project management
- Human resources management (HR)
- Accounting
- Finance

Assuming that potential staff considered for these positions will have the pre-requisite education, it will take approximately 4 to 6 years for the individuals to obtain a university degree. Once complete, staff can be trained on the job until the ability to operate independently is gained. It may be possible to shorten the timeline for some of the education through specialized partnerships with certain educational institutions. Supporting technician roles in these fields will also need to obtain a college-level equivalent degree.

Considering that obtaining a university degree requires a significant amount of time (depending on the current level of education of the candidates), these positions can initially be filled by non-local staff on a short-term basis.

Specialized Training

Many of the jobs listed in Table 11-47 and Table 11-48 above do not require university-level education but will require either college-level education or other specialized professional training. These include:

- IT staff (college degree equivalent, 2-3 years, in addition to 2-3 years of on-the-job training for IT managers);
- Supporting staff – accounting, human resources, finance, engineering technicians (college degree, 2-3 years);
- Jobs requiring a CCQ competency certificate, including:
- Heavy equipment operators (2,000-4,000 hours of apprenticeship, depending on the specific position)
- Welders (6,000 hours or apprenticeship)
- Electricians and utility workers (8,000 hours of apprenticeship)
- Heavy equipment mechanics (10,000 hours of apprenticeship)
- Signalling and telecommunications maintainers (2-3 years formal training in addition to 2-3 years of on-the-job training);
- Train dispatching staff (railway operations training, about 4 months including both theory and on-the-job);
- Land surveying technicians (2-3 years of college-level degree);
- Track supervisors, foremen and track inspectors (2-3 months of formal training in addition to 2-3 years of on-the-job training);
- Train drivers (locomotive engineer training, about 2-3 months, in addition to 2-3 years of on-the-job training);
- Yard crews (yard staff training, about 2-3 months, in addition to 2-3 months of on-the-job training);
- Environmental protection technicians (2-3 years of college-level degree);
- Health and safety specialist (college degree equivalent, 2-3 years);

- Transportation and delivery drivers (about 1 year of training is required to obtain the relevant driver's licence - Class 1 or Class 3).

The estimates above are provided on the basis that candidates have a high-school level education at a minimum. The timeline for some of these training may be shortened through specialized partnerships with certain educational institutions.

11.3.4 Operations Mobilization Orientation and Training

There is various generalized training which most staff will need to undertake before fully taking charge of their respective positions. It will allow staff to become familiar with their responsibilities and the particularities of their positions. Also, it will ensure that staff has the necessary knowledge to carry out their work in safety and that their work will meet the appropriate industry standards. This training will need to be carried out in the months leading up to the start of railway operations. The following tables provide a proposed training plan for the operations mobilization period:

Table 11-47: Proposed operations mobilization training and orientation plan - Compliance

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Regulatory Compliance	Stage 1 : Theoretical	6	Regulatory, Compliance and H&S Manager	All managing staff
Communication	Stage 1 : Theoretical	6	Operations Coordinator	All Maintenance and Operation Staff

The health and safety training program contains 18 training subjects, including First Aid and Emergency Response. The required training typically ranges between 2 and 4 hours, and 15 of the subjects consist of theoretical sessions. The Personal Track Safety training is mandatory for personnel who are present on or around the railway infrastructure. In almost all instances, these sessions are provided by Regulatory, Compliance, and H&S Managers.

Table 11-48: Proposed operations mobilization training and orientation plan - Health and Safety Training

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Safety Induction	Stage 1 : Theoretical	4	Regulatory, Compliance and H&S Manager	All Maintenance and Operation Staff
Personal Track Safety	Stage 1 : Theoretical	8	Infrastructure Maintenance Supervisor/Engineer	Personnel who need to be on or about railway infrastructure
	Stage 2 : Practical	8	Infrastructure Maintenance Supervisor/Engineer	
Emergency Response	Stage 1 : Theoretical	8	Regulatory, Compliance and H&S Manager	All Maintenance and Operation Staff
	Stage 2 : Practical	24	Regulatory, Compliance and H&S Manager	
First Aid	External Certification	20	External Certification	Key Personnel + Some Technicians
Personal Protective Equipment, PPE	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Vehicular and Pedestrian Traffic	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Site Lighting	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Housekeeping and Material Storage	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
	Stage 2 : Practical	4		
Lone Working	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Control of Hazardous Substances and Chemicals	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Manual Handling	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Working at Height	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Working in Confined Spaces	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Fire Safety	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
	Stage 2 : Practical	4	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Drug and Alcohol Policy	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
On Track Plant	Stage 1 : Theoretical	2	Infrastructure Maintenance Supervisor/Engineer	Maintenance Staff as needed
Hot Work	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Yard Operations Safety	Stage 1 : Theoretical	4	Yard Master	Staff involved in railway yard operations

The environmental training requirements are mainly theoretical, last between 2 and 4 hours and are provided to staff members on an as-needed basis. The quantity training sessions are similar although they target all maintenance staff or customer-facing staff.

Table 11-49: Proposed operations mobilization training and orientation plan – Environmental training

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Environment Induction	Stage 1 : Theoretical	4	Regulatory, Compliance and H&S Manager	All Maintenance and Operation Staff
Dust Management	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Noise Control	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Spill Management	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Traffic Management	Stage 1 : Theoretical	4	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Occupational and Community Health and Safety	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed
Waste Management Plan	Stage 1 : Theoretical	2	Regulatory, Compliance and H&S Manager	Maintenance Staff as needed

Table 11-50: Proposed operations mobilization training and orientation plan – Quality training

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Quality Induction	Stage 1 : Theoretical	4	Regulatory, Compliance and H&S Manager	All Maintenance and Operation Staff
Customer Service Training	Stage 1 : Theoretical	4	Manager On-Board Services and Manager Station Operations	All Customer-facing Staff

Track maintenance training includes both theoretical and practical sessions and is provided by supervisors, engineers, or external suppliers

Table 11-51: Proposed operations mobilization training and orientation plan – Trackwork Maintenance

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
General Presentation of the Trackwork System	Stage 1 : Theoretical	8	Infrastructure Maintenance Supervisor/Engineer	Maintenance Trackwork Staff
Track Platforms, Running Rail and Fastening System	Stage 1 : Theoretical	8	Infrastructure Maintenance Supervisor/Engineer	Maintenance Trackwork Staff
	Stage 2 : Practical	24	External Supplier	
Maintenance Standards	Stage 1 : Theoretical	24	Infrastructure Maintenance Supervisor/Engineer	Maintenance Trackwork Staff
Turnout System	Stage 1 : Theoretical	8	Infrastructure Maintenance Supervisor/Engineer	Maintenance Trackwork Staff
	Stage 2 : Practical	24	External Supplier	
Buffer Stops	Stage 2 : Practical	6	External Supplier	Maintenance Trackwork Staff
Level Crossing	Stage 2 : Practical	8	External Supplier	Maintenance Trackwork Staff
Insulated Rail Joints	Stage 2 : Practical	4	External Supplier	Maintenance Trackwork Staff
Stray Current Collection System	Stage 2 : Practical	4	Infrastructure Maintenance Supervisor/Engineer	Maintenance Trackwork Staff

The rolling stock-related training subjects require more substantial training than the other subjects as shown in the following table.

Table 11-52: Proposed operations mobilization training and orientation plan – Operations and Maintenance

POI Training Subject	Training Type	Estimated Training Time in Hours	Instructors	Attendees
Railway Yard Operations	Stage 1 : Theoretical	8	Yard Master	Staff involved in railway yard operations
	Stage 2 : Practical	24	Carload Manager and Supervisor	
Railway Mainline Operations	Stage 1 : Theoretical	8	Train Master and Operations Coordinator	Train crews and train dispatchers
	Stage 2 : Practical	24	External Supplier	
Rolling Stock Maintenance	Stage 1 : Theoretical	16	Maintenance Foreman and the Rolling Stock Maintenance Managers	Locomotive and wagon maintenance staff
	Stage 2 : Practical	40		
Canadian Rail Operating Rules Certification (CROR)	Stage 1 : Theoretical	24	External Supplier	Personnel who need to be on or about railway infrastructure
Locomotive Operation	Stage 1 : Theoretical	16	External Supplier	Train crews and yard/maintenance staff operating locomotives
	Stage 2 : Practical	40		

The training outlined in the table above assumes that staff is already qualified for their positions. Some of the hires may already possess some of the certifications mentioned.

11.3.4.1 Regional Institutions and Other Potential Partners

Partnerships must be formed with educational institutions and other organizations to provide or assist with the necessary education and training programs. These partnerships must be formed as soon as possible, such that the necessary training and educational activities can be completed on time for the beginning of the project activities.

11.3.4.2 Meetings with Potential Partners

Multiple meetings took place with some of the potential educational and training partners with the objective of gauging their interest in being involved with the Grande Alliance program:

- Feb. 14th, 2023 : Université du Québec en Abitibi-Témiscamingue
- Feb. 15th, 2023 : Apatisiiwin Skills Development
- Feb. 15th, 2023 : CÉGEP Saint-Félicien
- Feb. 17th, 2023 : CÉGEP de l'Abitibi-Témiscamingue
- Mar. 8th, 2023 : Tshiuetin Rail Transportation

Tshiuetin Rail Transportation (TFT) expressed interest for the collaboration with the Grande Alliance program to aid in maximizing the involvement of the Cree. During the meeting, various points and specific challenges were brought up based on the railway's experience in hiring and staffing First Nations employees, such as the necessity for flexibility with respect to work hours, as well as the challenges related to retention. The railway can be a valuable partner in providing feedback with respect to the training and hiring approach envisioned.

The Cree School Board has yet to be interviewed. During these meetings, the potential role of each institution as it related to the training of Cree workers was discussed. In addition, the topics discussed included experience with previous projects in the region and the anticipated challenges.

11.3.4.3 Proposed Partnerships

The institutions presented in Table 11-53 may be potential partners for the creation of a training program.

Table 11-53: Potential Training Partners

Potential Partner	Description
Cree School Board	A school board which oversees the various schools in the Eeyou Istchee territory.
Apatisiiwin Skills Development	A department of the Grand Council of the Crees which offers services and programs with the aim of promoting and supporting employment and professional development for people of the Cree communities.
Commission de la construction du Québec	A government institution responsible for regulating the construction industry in the province of Québec.
Niskamoon Corporation	A not-for-profit organization which has the mission to provide a framework for cooperation between the Cree people and Hydro-Québec, as well as to aid the people of the Cree communities to access funds and programs associated with hydro-electric projects, including training a Cree workforce within Hydro-Québec, as per section 28 of the JBNQA.
Universities: • Université du Québec en Abitibi-Témiscamingue • Université du Québec à Chicoutimi	Universities which are part of the Université du Québec network and are located in Abitibi-Témiscamingue and Chicoutimi. These universities already have experience with integrating and supporting First Nations students during their education.
CEGEPS: • CÉGEP de l'Abitibi-Témiscamingue • CÉGEP de Saint-Félicien	Public CEGEPs located in the Saint-Félicien and Abitibi-Témiscamingue communities.
Labour unions	A labour union is an organization formed by workers in a particular industry or occupation to protect and promote their interests.
Tshiuetin Rail Transportation	A rail company that owns and operates a 217-kilometre railway that connects Sept-Îles, Québec to Emeril. It is the first railway in North America owned and operated by Indigenous peoples.
Other certifying partners	• CROR certification providers • First Aid certification providers
Specialized training partners	• Track component suppliers • Training providers for specific trades (welding, heavy equipment operation, heavy equipment mechanics, electricians and other) • Locomotive operation training providers • Railway signalling and telecommunications training providers • Railway dispatching equipment suppliers • Truck driving schools • Railway and other Contractors

The list of proposed partnerships provided above should not be considered as complete and may be updated as discussions with the various institutions take place and the training plan evolves.

Forming a partnership with Apatisiiwin Skills Development would be vital to ensure that the staffing needs, educational and training requirements are effectively communicated to the Cree communities. This organization can assist in reaching out to potential candidates and supporting their educational journey and career development.

To minimize delays in both the preparatory and operational phases, it is important to establish an ongoing relationship with the CCQ and ensure they allocate sufficient resources to support the Grande Alliance project. It is

also crucial to seek advice from labour unions regarding specific trade training and identify the right training providers.

In some cases, it may be necessary to form partnerships with contractors in the construction or railway industries to provide in-house training. These contractors may be willing to train and employ nominated candidates provided the project pays for their salary during training and for a period thereafter. However, this will require careful negotiations and support for the candidate while they are away from home.

Some types of specialized training will be provided by project suppliers or other external training suppliers. Some examples of this are : turnout installation, locomotive operation, and the training of train dispatchers to use operations control equipment.

A partnership with CEGEP de Saint-Félicien, CÉGEP de l'Abitibi-Témiscamingue, Université du Québec en Abitibi-Témiscamingue (UQAT) and Université du Québec à Chicoutimi (UQAC) would be beneficial in addressing college and university-level educational needs for the Grande Alliance program. These institutions already offer various programs relevant for the anticipated staffing needs, such as environmental protection, tourism, accounting, management, engineering, and IT degrees, among others.

Niskamoon's mandate is to remediate the long-term impacts of hydroelectric development via the implementation of various Impact-Benefit Agreements signed over the years between the Cree Nation and Hydro-Québec. One specific Agreement is called the Apitsiiwiin Agreement, which basically stems from Chapter 28 of the JBNQA, to target 150 permanent jobs within Hydro-Québec on the territory, specifically reserved for Crees, so long as they go through the required training to meet the technical qualifications of these positions. Specifically, four positions were targeted, requiring one of two DEP degrees (professional degrees at the secondary level) or one of two professional DEC degrees. Niskamoon put in place a comprehensive training program to assist students to achieve these milestones, through a wide variety of support measures including a student center in Rouyn-Noranda as well as coordinating on-the-job training during their program. Note that the conditions include French-language training, since technical work at Hydro-Québec is in a highly hazardous environment, such that one language of work must be followed by everyone. The Apitsiiwiin Agreement came to an end in March 2017 (it had a specific deadline).

This experience has allowed Niskamoon to leverage other training programs, all relevant to the core mission of remediating long-term impacts. The experience of the organization in training is well recognized and respected throughout the Cree Nation.

Niskamoon is not responsible for training people in general, but rather embraces the responsibility of training people and developing programs that are consistent with its mandate. In this regard, they are a relevant potential partner with the Grande Alliance with regards to any training programs that coincide with their own objectives and mandate.

The following graphic provides an overview of the proposed roles:

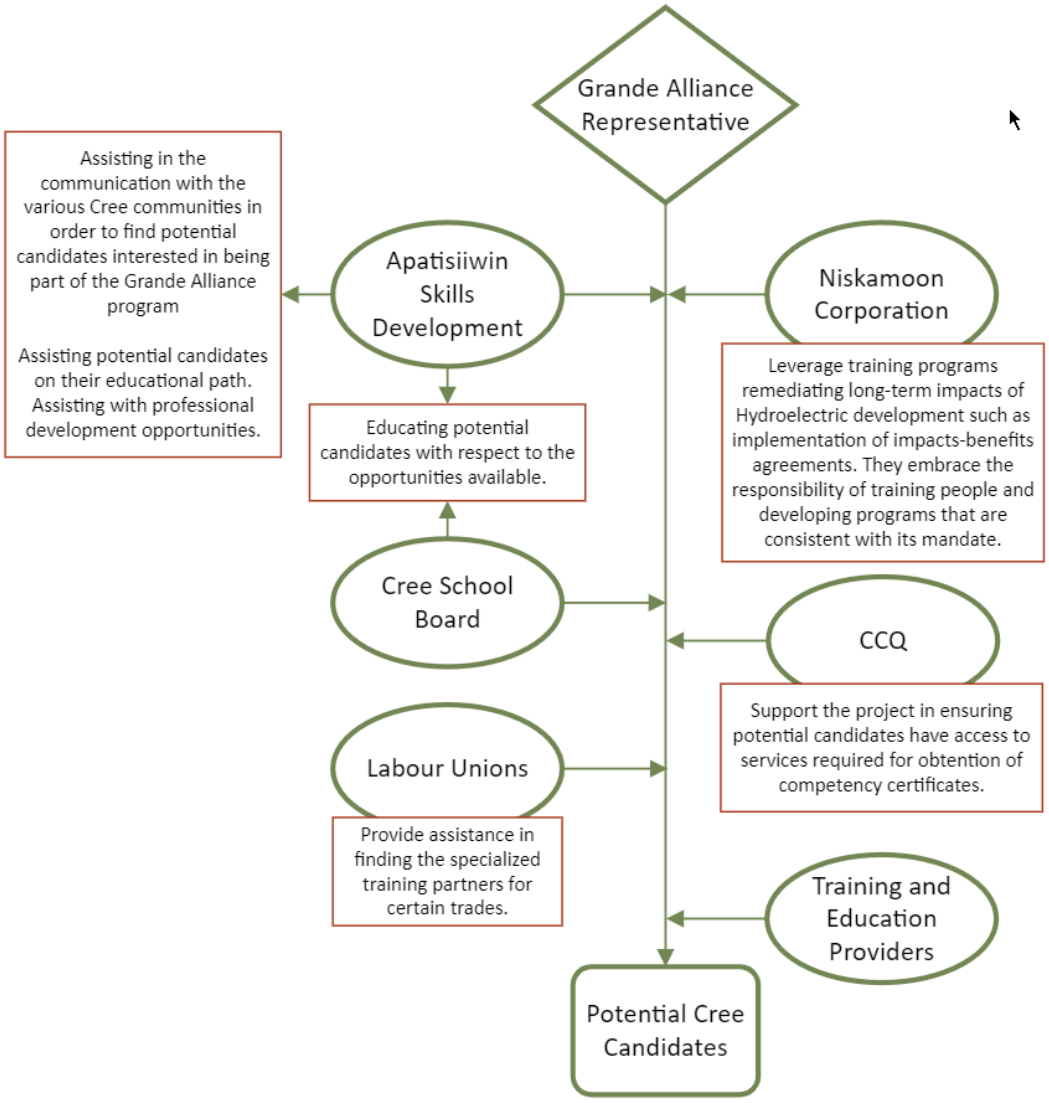

Figure 11-11: Proposed roles for the various education and training partners

11.3.5 Recommendations

11.3.5.1 Managing the Cree Involvement and Education Initiative

Given the critical role of the Cree community in the success of the Grande Alliance project, it is highly recommended that a dedicated project team or committee be established with the specific mandate of overseeing workforce training. This approach will ensure that the training plan is implemented consistently and without interruption. This is important because continuity in the training process is necessary to achieve the desired outcomes and having a dedicated team or committee responsible for it will help maintain that continuity. This will also facilitate effective communication and collaboration with the Cree communities. By establishing this team or committee, the project can ensure that the training plan is aligned with the project's goals and that the training efforts are consistently monitored and evaluated.

The following responsibilities have been identified for this team:

- Serve as the representative of the Grande Alliance initiative for all matters relating to employee training and education.
- Ensure a continuous collaboration with the educational institutions, other partnering organizations, and the Cree communities through regular meetings with the various representatives.
- Establish a concrete and specific training plan for the project.
- Assist in the preparation and signing of the various agreements relating to the employee training, employee education, and the involvement of the Cree in the project.
- Monitor the training and education of the future workforce to ensure that all commitments of the Grande Alliance program are followed through.
- Work to address the challenges related to the training, education, and involvement of the Cree.

11.3.5.2 Training and Employment Recommendations

The following points must be considered as part of the training plan for the Grande Alliance program as it relates to the Cree:

- Potential candidates must be educated about the opportunities available and what a given job will entail. This must be done early in the recruitment process and will help to ensure that candidates have a long-term interest for the position they are being trained for, and it will help to lower the chance of people dropping out of the program before completion.
  - A part of this approach would be to put in place a recruitment program which will give potential candidates the opportunity to get hands-on experience for a specific job before deciding to enroll.
  - Considering the proposed timeline for the Grande Alliance program, some of the potential Cree candidates are currently enrolled in elementary or high school education. A program should be put in place where these potential candidates can be exposed to and educated about the opportunities offered by the Grande Alliance program. This can be done in partnership with the Cree School Board.
- There are specific challenges related to providing training and education to Cree candidates due to a variety of historical and cultural factors. As such, ensuring successful outcomes will require adaptations when it comes to the specific training and education approaches. While some of the proposed training and educational partners already have experience with Cree and other First Nations students, some of the partners will need to be guided in adapting their training.
- The opportunity to learn the French language should be offered during the preparatory phases of the Grande Alliance program.

Supporting the Cree at the workplace, ensuring the continuity of their involvement in the Grande Alliance program, as well as ensuring that the newly created jobs remain an enticing opportunity for them, will constitute an ongoing effort for the life of the project.

The following recommendations have been established in view of these efforts:

An agreement should be signed by the Grande Alliance initiative and the Cree communities to:

- **Define the minimum percentage :** The agreement should specify a clear minimum percentage of Cree people to be involved in the construction and operation phases of the program. This percentage should be based on realistic targets that take into account the availability of qualified candidates and the specific needs of the program.

- **Ensure equitable opportunities :** To meet the minimum percentage requirement, it will be necessary to ensure that Cree people have equitable opportunities to apply for and obtain jobs within the program. This can be achieved through targeted recruitment efforts, training programs, and support services to help Cree workers succeed in the workplace.
- **Monitor progress :** Regular monitoring and reporting on the progress towards meeting the minimum percentage target will be necessary to ensure accountability and identify any areas that may require additional support or intervention.
- **Adjust the agreement as necessary :** The agreement should be reviewed periodically to ensure that it remains relevant and effective in achieving the desired outcomes. If necessary, the minimum percentage target may need to be adjusted to reflect changing circumstances or new information.
- **Provide Career progression :** Provide clear pathways for career advancement within the program, with transparent criteria for promotion and opportunities for skill development and training. This can include mentorship programs, on-the-job training, and access to relevant educational programs.
- **Salary equality and non-discriminatory hiring practices** : Establish clear policies and procedures for hiring and compensation that promote fairness and equity. This can include regular salary reviews, equal pay for equal work, and anti-discrimination policies and training.
- **CCQ competency certificate services :** Work with the CCQ to establish service points in proximity to Cree communities, or provide transportation and accommodation support for Cree workers to access CCQ services in other locations.
- **Presence and acceptance of Cree culture :** Incorporate Cree culture into the workplace through policies that support cultural events, holidays, hunting seasons, and other traditions. This can include the provision of cultural awareness training for non-Indigenous staff, as well as the hiring of Cree language speakers and cultural advisors.
- **Tailored assistance for first-time workers :** Offer customized support to Cree workers who are entering the workforce for the first time, including training in workplace expectations, safety protocols, and communication skills. Provide access to peer support networks and mentors to help them navigate the challenges of the work environment.

11.3.5.3 Challenges

There are still various challenges to ensuring that the Cree will take, and remain, an important part of the project workforce. These must be addressed for the successful execution of the Grande Alliance program, and so that its benefits to the Cree communities may be maximized. These challenges include:

- The CCQ program must be further adapted to ensure Cree access to the construction industry and the necessary adjustments must be made to ensure that Cree candidates have access to the necessary training programs to acquire and keep their status.1
- More work must be done for the provision and adaptation of administrative resources to ensure that Cree workers receive the proper support that they need to remain current with the regime through the CCQ or through partnership with entities such as Apatisiiwin Skills Development (ASD).
- It may be difficult to find Anglophone teachers and trainers for the various training programs which will be considered for this project. It may be necessary to find teachers from outside of Québec (CCQ, 2022).
- It will be difficult to ensure a high-level of involvement of Cree in the project due to the challenges in finding qualified staff and individuals with the necessary level of education, concern communicated by Cree Liaison

[1] EEYOU ISTCHEE Annual Report 2021-2022

Officers. This problem will be exacerbated during the construction phase and may extend the time required to train the necessary workforce to support railway operations independently.

- The Cree often have different learning styles when compared to the approaches used within modern education systems. The adaptations required may result in the completion of training programs in a longer period than what is dictated by typical timelines.

11.3.5.4 Next Steps

The proposed next steps as relating to the project opportunities and training:

- Meetings and presentations with the GACIOs to obtain their views and recommendations.
- Formation of a committee which will oversee the Grande Alliance training initiative with the responsibilities outlined in section 11.3.5.1 Managing the Cree Involvement and Education Initiative.
- Establishment of a specific training plan, outlining the various training and educational paths for each job opportunity.
- Establishment of an ongoing, collaborative relationship with educational institutions and other potential partners.
- Definition of specific inputs needed by the project's educational partners to ensure the success of the training and educational program.
- Adaptation of the training plan based on recommendations from Cree community representatives and key educational partners.
- Adaptation of the project delivery necessary to maximize Cree involvement.
- Initiation discussions, between the Grande Alliance program and the Cree communities, on the various agreements which should be put in place.

11.3.6 Other Business and Employment Opportunities

Business and employment opportunities may be made possible or more likely with improved access and regional roads or with the train service. These wider benefits could include:

- Creation and integration of new tourism attractions or services, notably along with COTA/TBJ tourism development planning elements, as tourist circuits declining many themes, or tourist/service nodes for example at the Waskaganish Junction that could integrate a train station, a yard, rest area services, tourist information, art craft shop, stop or start of circuits, etc. This needs the development of competencies in entrepreneurship, tourism, and services for example.
- The development of Cree forestry activity and territorial knowledge more in phase with the preservation of the environment and the transmittal of the Cree culture, more responsive to local population's needs, and in a comprehensive approach so as to allow herds of caribou to get maintained.
- The consolidation of mining projects and their likelihood to get realized, in a proper way and to maximize the participation of the Cree workforce in these activities. The use of railways rather than roads to carry minerals, fuel and supplies would limit disturbances along the roads. The mining sector offers the most employment opportunities in Eeyou Istchee Baie-James while currently Cree workers are only a few in this sector.
- To develop these activities, training and transmittal of knowledge and know-how for wildlife protection officers and assistants, park rangers and guardians, research field assistants, guides, tourism, craft persons, salespeople, machinery operators, drivers, mining, engineering.

11.3.7 Social Aspects

The extension of the road up north to Whapmagoostui and of the R167 to the Trans-taiga Road, as well as the improvement road access and of the Route du Nord, shall facilitate the access to the traplines for those who hunt and fish, especially those who benefit from the Economic Social Program. The beneficiaries of this program are mostly among the group of youths and elderly people. These infrastructure elements shall thus enhance the inclusion of these age groups and less rich people.

In addition to contribute to improving the physical access to employment locations, the improvement of the road network, especially the access road and the RDN would allow for easier exchanges with other Cree communities. More especially, the new hospital centre and a possibly collegial studies centre in Chisasibi would be regional service centres more accessible to the members of other Cree communities and consequently contribute to a higher use of these installations and more education opportunities to the Cree.

12. FINANCIAL ANALYSIS

The following chapter presents the financial case assumptions and methodology used in the financial case analysis of the Project.

12.1 OBJECTIVES AND METHODOLOGY

The financial analysis identifies expected financial outcomes from a proposed investment. This is taken from the point of view of a hypothetical institutional entity that will build, manage and operate the infrastructure. The financial analysis compares revenues and expenses, including capital and operational costs, to work out the corresponding financial equilibrium and return ratios.

12.1.1 Cash flow Components

The financial analysis is carried out on the cash flow projections over thirty-(30) years of the project life span. The initial capital expenditure is distributed over the planned implementation period (5 years starting from 2030). With this, an itemized cost estimate has been developed, taking note of the data developed in Volume 2 the Technical Study and Volume 4 the Market Study.

The OPEX estimated for the transportation of 1,58 million tonnes of freight has been adjusted annually to reflect the respective traffic levels over the life of the project. The annual OPEX calculations are integrated in the financial model. The methodology and the assumptions used for the OPEX estimates are discussed in the respective Chapters of the LGA-1-GN-F-FRN-RT-0004_02.

A financial model has been developed with input data and is used as a tool to carry out the financial analysis, to obtain financial results included in this section. This includes the consideration of Capital Expenditure (CAPEX), forecasts of traffic volumes (passenger and freight), revenues (for both passengers and freight), Operational Costs (OPEX) and life-cycle costs to maintain the railways.

The analysis has been separated into two cases : BDHR and GCR. This allows for the financial assessment of each case separately and combined. However, it should be noted that the assumptions and the resulting outputs in the financial analysis for GCR assume that BDHR is fully operational and therefore results for the GCR are complementary upon the operations of BDHR. For this reason, the results should not be considered completely independent of one another.

12.1.2 Financial analysis metrics and key concepts

12.1.2.1 Equity, internal rate of return and net present value

Equity, the IRR and project NPV are financial metrics used in evaluating investment opportunities, but they measure different things.

Equity represents ownership in a company or project and refers to the residual value of the assets after deducting liabilities. Equity holders are entitled to the profits and losses of the business, and their returns are based on the appreciation of the value of their shares over time. In the context of the LGA Infrastructure study, equity refers to the amount of money that investors contribute to the Railway Company in exchange for ownership or shares in the project.

The Financial **Internal Rate of Return** (IRR) is specified in percentage terms to demonstrate the rate at which the sum of discounted cash inflows equates to the discounted cash outflows i.e. the discount rate at which NPV=0.

In the current context, the IRR is included to further explain the potential returns for equity holders in the LGA Infrastructure study. Equity holders are entitled to the profits and losses of the business, and their returns are based on the appreciation of the value of their shares over time.

The IRR provides a more comprehensive understanding of the potential returns for equity holders in the LGA Infrastructure study. It highlights the importance of the IRR in financial analysis and the potential value that equity holders can receive from their investment in the project. In other words, it provides the expected return on equity invested in the BDHR and the GCR Railway company. The higher the IRR the easier it will be to attract equity holders.

On the other hand, **NPV** is a measure of the present value of all the expected future cash flows from a project or investment, minus the initial investment. It is used to assess the profitability of a project or investment opportunity. The formula for NPV considers the time value of money, which means that cash flows in the future are discounted to reflect their lower value compared to cash flows received today.

Therefore, the main difference between equity and project NPV is that equity refers to the ownership stake in a project, while project NPV is a measure of the profitability of the project. Equity holders are entitled to a share of the project's NPV, but the NPV is calculated based on the expected cash flows and costs of the project and does not consider the ownership structure of the project.

In summary, the NPV and IRR are two discounted cash flow methods used for evaluating investments or capital projects.

12.1.2.2 Weighted Average Cost of Capital and financial discount rate

In this section of the report, financial outputs include the testing of the financial viability for the different scenarios through financial returns indicators including the Internal Rate of Return and Net Present Value against targets such as the Weighted Average Capital Cost (WACC) at both a project and equity level. The WACC value is calculated and defined in Section 12.3.1. The WACC represents the blended cost of capital across all sources and, in other words, represents the minimum rate of return which should be earned by the project to create value for investors. From the investor's point of view, they treat the WACC value as the opportunity cost of their capital.

The Net Present Value refers to the difference between the total costs (both positive and negative) of a project, and its present value, in this case at the start of Construction in 2030, by using a discount rate of the WACC value for unlevered cashflows of 6.15%.

12.1.3 Sensitivity testing methodology

Sensitivity testing has also been undertaken, including the testing of parameters such as CAPEX, OPEX, revenues, financing assumptions, etc. Sensitivity testing is an important aspect of financial modelling and analysis because it helps decision makers to understand how changes in key assumptions or inputs can impact the financial outcomes of a project. By testing different scenarios and assumptions, decision-makers can gain a better understanding of the risks and uncertainties associated with the project and make informed decisions based on a range of possible outcomes.

The provided sensitivities allow for the evaluation of a plausible range of scenarios, providing a view of the financial viability of the BDHR and the GCR under both worst-case and best-case scenarios to provide decision makers and stakeholders with a robust evidence base.

In the context of the statement provided, sensitivity testing has been undertaken on parameters such as CAPEX, OPEX, revenues, financing assumptions, etc. This means that different scenarios have been tested to evaluate the

financial viability of the project under various conditions. By testing a range of scenarios, decision-makers can identify the range of outcomes that are likely to occur and assess the financial risk associated with the project.

Furthermore, sensitivity testing can help decision makers to identify the key drivers of financial performance and focus on managing these areas to maximize the financial outcomes of the project. This allows for a more comprehensive evaluation of the project's financial viability, as decision-makers can consider a range of scenarios and assess the potential impact of different assumptions and inputs.

12.1.4 Sensitivity scenarios

This sensitivity testing includes addressing questions such as:

- Will Governmental support be required during construction?
- Will it be possible to consider different financial structures for financing needs?
- Will a financial surplus be available during the operational phases of the railways?

The financial analysis considers all cash flows related to the scenario to identify the financial impacts clearly. Cash flows are a function of the following:

- The timing and costs of infrastructure (capital) construction;
- The cost of regular maintenance of capital assets;
- Life cycle asset replacement costs;
- Train service delivery costs; and
- The new railway's funding methodology.

The financial analysis is presented in such a way to identify and quantify the annual financing needs during the construction period, the cash flows when the project enters the operational phase and, finally, the costs related to capital maintenance throughout the life cycle of the project (namely in this report as the sustaining capital costs).

The initial scenario is namely the "Base Case" which is modelled without any government support or further funding to understand the project's performance based on the total project cost and revenues. This base case sets an initial scenario to allow for any further impacts to changes in assumptions or parameters to be assessed against the overall project (and equity).

12.1.5 Objective

The **first objective** of the financial analysis was therefore to obtain the Project NPV and IRR. The project values represent the OPEX, CAPEX and Revenue cash flows. This means that in this first approach, no public budget contributions were considered. This means that:

- If the Project IRR is below the target IRR (or even negative), then an estimation of a source of funds during operations, covering financing needs during the operational period, could be carried out. This has been referred to as an annual operational grant, which is assumed to reduce the NPV with no additional cost.
- This is calculated by increasing the optimal level of subsidy during operations by targeting the Project IRR, which in this case is targeted to be ≥ 0%.

Similar to the above, the second objective was to obtain the Equity IRR and NPV. The equity values represent the cash in and cash out, accounting for further investments to achieve the required equity IRR to generate a return to appear attractive to an investor.

- If the Equity IRR is below the target IRR (or even negative), then an estimation of public subsidy during construction could be carried out.
- Public subsidy requirements are calculated by reducing financing needs / negative cashflow during construction, so financial viability is reached when the IRR obtained reaches the Target Equity IRR, with the specified gearing ratio.

The **third and final objective** is to model other sensitivity scenarios to test the robustness of the model and underlying assumptions.

- Analysis has been undertaken assuming an increase in revenues driven by changes in fare levels charged by the increase in tonnage. This also includes an assessment of a breakeven point of increasing revenues to achieve NPV=0.
- Analysis has been undertaken to test a decrease in the OPEX and CAPEX to test the impact on the NPV and IRR values.
- A more comprehensive approach to the funding can be carried out regarding the possibility to use a mix of public subsidy and equity and debt. With this, various tests have led to providing financial results in scenarios which meet the debt estimated terms and conditions and target cost of equity.

12.1.6 General institutional assumption

It has been assumed that the railway in vertically integrated with a standard build own operates transfer approach. Other funding strategies are detailed in section 12.8.

For the end-state-entity of the project, it has been assumed in the modelling that there is a 'New Railway Entity' which takes the role of the Rail Infrastructure Operator, who would build the New Railway asset and then is assumed to:

- Give access to the New Rail Infrastructure to Railway Operators
- Charges fares to passenger users on the New Railway
- Charges tariffs to freight and bulk shippers using the New Railway services
- Manages maintenance, life cycle investments, and operation of the New Railway - Rail Infrastructure and the Road, in the Rail & Road scenario.

The diagram below shows theoretical details of the cashflow during both the construction and operational phases.

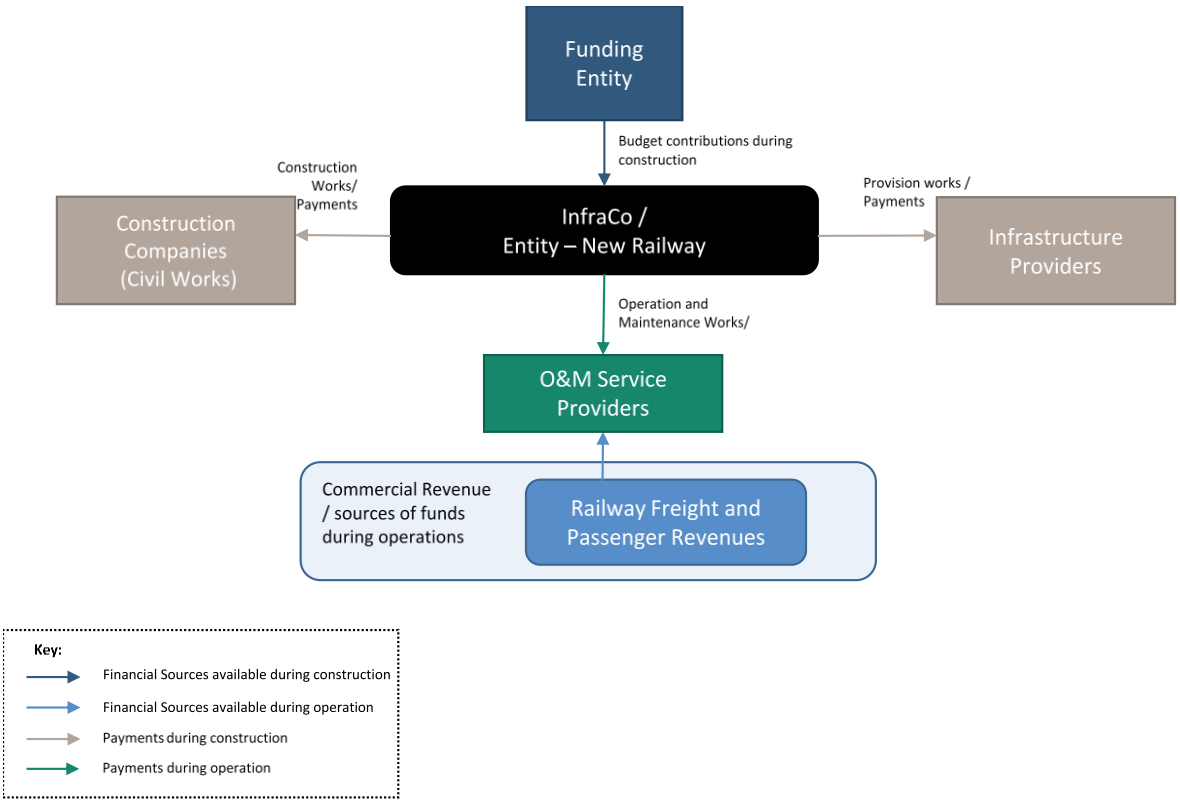

Figure 12-1: Financial Analysis : Assumed entities, contractual relations and financial flows for the New Railway.

The above diagram shows the financial contributions during both the construction and operational phases of the project. This combines commercial revenues and sources of funds during operations to obtain financial results, with separate public funding being introduced at the start of construction. The above diagram also represents the various companies/providers who would receive income from the theoretical entity of the new railway. The roles and responsibilities of the entities are detailed in Section 12.10 Funding strategies.

12.1.7 Main Principles of the Model

The financial model has been built to analyze the projected cash flows considering CAPEX, revenues, operating expenditure (OPEX), and life cycle (LC) cost through the appraisal period. It provides monthly and annual values across a timeline up until the operational end date of 2064, which is calculated as the 2035 operational start date plus 30 years.

The model has been constructed around a "base case," which is a run using a set of data built from target values and reasonable assumptions for all items, for both Rail scenarios. Additionally, the model can be used to run various sensitivities to explore alternative assumptions and obtain more favourable results.

To obtain the findings in this report, the financial model has been used as a reference in terms of design, structure, concepts, calculation mechanisms, etc. The financial modelling aims to meet standards accepted by financial advisors, banks, promoters, and international institutions, thereby adding credibility to the study's conclusions.

12.1.8 Model Parameters

The approach adopted in relation to various financial assumptions and parameters have been recorded in Table 12-1, Table 12-2 and Table 12-3. These assumptions are in line with the economic case model, including the dates, contingencies, and risk values.

Table 12-1: Date values and assumptions

Parameter	Assumption
Dates – Construction	01-January-2030
Dates – Operation	01-January-2035
Price base year	All inputs are in 2023 prices and outputs in nominal prices, unless specified
Inflation rates	2% for annual target inflation
Discount values	6.15% discount rate (WACC value as per Table 12-2)
Discount Period	30 years
Contingency and Risk values	20% contingency for CAPEX 15% contingency for OPEX 20% risk for CAPEX (excluding sustaining capital costs)

Table 12-2: Financing assumptions

Financing period	Assumptions
Investment Grant	Investment grant injection date : 01-January-2030 (aligned with the construction start date)
Tax Assumptions	• No applicable taxes applied
Terminal Value	• Terminal values have not been considered in this analysis
Depreciation and amortization	• No depreciation nor amortization has been assumed

Table 12-3: Cost of capital and tariffs

Parameter	Assumption
WACC	6.15% on unlevered cashflows
Equity Discount Rate	12% on levered cashflows with 90% debt gearing ratio
Cost of Debt	5.5%
Cost of Equity	12%
Passenger Revenues	$0.20 per Passenger km
Freight Revenues	• BDHR - $21.3M annually • GCR - $10.4M • These values are assumed to be constant across the timeline, in real terms
Revenues Lag/Ramp-up	Assumed to be 100% from date of operation
Gearing Ratio	90% debt (10% equity)

12.2 FINANCIAL EQUILIBRIUM AND FINANCIAL RATIO REQUIREMENTS

As part of the analysis and requirements of the terms set out by the CIB, the model is set to achieve a financial equilibrium. This financial or “operating equilibrium” is reached when Earnings before interest, taxes, depreciation, and amortization (EBITDA) is greater than zero. EBITDA is a measure to understand the company’s financial position

and ability to generate cash. In the model, it therefore combines the nominal revenues and costs during the operational period to understand the cashflow during operations and therefore the "Positive EBIDTA" is achieved when revenues cover the operating costs.

The following financial ratios are considered for each of the Scenarios:

- Project Internal Rate of Return (Project IRR)
- Project Net Present Value (Project NPV)
- In the sensitivity analysis, financial and economic equilibrium is investigated and is achieved if:
- If project IRR is equal to or greater than the calculated WACC
- If equity IRR is equal to or greater than the estimated Cost of Equity.

12.2.1 WACC Calculations

For the calculation estimate of the WACC, the Capital Asset Pricing Model (CAPM) is adopted as international standard and most generalized methodology. The CAPM is used to calculate the cost of equity and therefore the below is derived to calculate the WACC:

$$WACC = [\%\ of\ Equity + Cost\ of\ Equity] + [\%\ of\ Debt + Cost\ of\ Debt] * (1 - Tax\ Rate)$$

Where,

$$Cost\ of\ Equity = 12\%, Cost\ of\ Debt = 5.5\%, Tax\ Rate = 0$$

So,

$$WACC = [\%\ of\ Equity + 12\%] + [\%\ of\ Debt + 5.5\%]$$

Where the percentage (%) of equity and percentage (%) of debt are dependent on the specified gearing ratio, which is used in the model to specify the percentage value of debt versus equity.

The cost of equity is a measure of an investment's profitability and is typically calculated as a percentage. It is referred to widely depending on the specific investment, its industry, and its performance over time.

The target and realized IRR for the investors may not be publicly available or may be subject to confidentiality agreements. However, the following tables present a few yield statistics.

The historical yields are listed in the table below:

Table 12-4: Historical yield on Government Retirement funds, 2022

Pension fund	1 year	5 years	10 years	20 years
Government and Public Employees Retirement Plan (RREGOP)	-7.6%	5.6%	7.9%	7.2%
Pension Plan of Management Personnel Fund (PMP)	-7.9%	5.4%	7.6%	7.2%
Pension Plan of Elected Municipal Officers (PPEMO)Fund	-4.7%	6.0%	8.2%	7.5%
Pension Plan of Peace Officers in Correctional Services PPPOCS Fund	-7.1%	6.2%		

Source : Retraite Québec 2023

The targeted and realized IRR of the major public investors in Canada for 2022 are shown in Table 12-5.

Table 12-5: Targeted and realized IRR in Canada for 2021

Investor	Realized	Target
Caisse de dépôt et de placement du Québec	9.6%	8.9%
Public Sector Pensions Investment Board	13.9%	8.6%
Ontario's teachers pension plan	7.9%	1.2%
Alberta Investment Management Corp (AIMCo)	19.0%	6.8%
BD Investment Management Corp	12.1%	6.4%
Average	**12.5%**	**6.4%**

Source : Most recent respective annual reports available.

12.3 MINIMUM PUBLIC SUBSIDY CALCULATIONS

Railway infrastructure projects usually require subsidies to meet construction phase cost and are sometimes required during the operational phase to cover any deficit in the project cashflow. This applies to this project, for both BDHR and GCR, as IRR results are significantly below the target Project IRR.

The methodology for calculating the minimum public subsidy involves the amount of 'financing needs' to be reduced for the project to achieve the target IRR. The IRR results obtained in all the base cases have been significantly below the target and even negative – resulting in a requirement for public budget contributions. Therefore, a financial structure based on 10% equity has been considered in Table 12-3.

In all the cases, public budget contributions have been defined to be paid to the Infra Co/New Railway Entity during the construction phase in line with the construction schedule for the investment grant, and during the operational phase in line with the operational schedule for the operations grant.

12.4 SCENARIOS

12.4.1 Targeting Funding

The scenarios include the assessment of targeting the funding through specifying IRR values and terms of funding. This has been individually assessed for BDHR and GCR where each of which includes an evaluation of their financial outcomes.

The scenarios are:

1. Base scenarios with no funding : This scenario assumes that there is no public funding for their project and evaluates their financial outcomes under this condition.
2. Optimal operational grant funding with 0% Project Return : This scenario holds the assumption that the annual funding covers the ongoing operational costs of the project, but with no expectation of a return on investment.
3. Optimal operations grant funding with 0% Project Return with an optimal upfront public funding : This scenario is similar to the previous one, but also includes an assumption they receive the maximum amount of annual public funding available, with an expected return on investment.

12.4.2 Targeting Project Parameters

A key assumption remains in the base case that the project will not be funded and therefore the tests of targeting the project parameters assess the impacts to the Project NPV.

The sensitivity testing also includes varying CAPEX, OPEX and revenues individually to assess the impacts on the project:

Capital Contribution

Base scenario with financial outcomes (with no change in capital contribution) : This scenario assumes that there is no change in capital contribution and evaluates the financial outcomes of the project under this condition.

1. A 50% capital contribution : This scenario assumes that there is 50% of total CAPEX and evaluates the financial outcomes of the project under this condition.
2. A 60% capital contribution : This scenario assumes that there is 40% of total CAPEX and evaluates the financial outcomes of the project under this condition.
3. A 70% capital contribution : This scenario assumes that there is 30% of total CAPEX and evaluates the financial outcomes of the project under this condition.
4. A 80% capital contribution : This scenario assumes that there is 20% of total CAPEX and evaluates the financial outcomes of the project under this condition.
5. Decrease in capital contribution to achieve breakeven (i.e. the upfront public funding not being necessary at the start of construction) : This scenario assumes that the CAPEX is deceased to the point where the project breaks even, and no funding is required. The financial outcomes of the project are evaluated under this condition.

Revenues

Base scenarios with financial outcomes (with no increase in commercial revenue) : This scenario assumes that there is no increase in commercial revenue and evaluates the financial outcomes of the project under this condition.

1. An increase of 10% of the commercial revenue : This scenario assumes that there is a 10% increase in commercial revenue and evaluates the financial outcomes of the project under this condition.
2. An increase of 20% of the commercial revenue : This scenario assumes that there is a 20% increase in commercial revenue and evaluates the financial outcomes of the project under this condition.
3. An increase of 30% of the commercial revenue : This scenario assumes that there is a 30% increase in commercial revenue and evaluates the financial outcomes of the project under this condition.
4. Increase of commercial revenue to achieve breakeven (i.e., the operational grant not being necessary during the operational phase) : This scenario assumes that the commercial revenue is increased to the point where the project breaks even, and no annual operational grant is needed. The financial outcomes of the project are evaluated under this condition.

Operational Costs

Base scenarios with financial outcomes (with no change in OPEX) : This scenario assumes that there is no increase or decrease in operational costs and evaluates the financial outcomes of the project under this condition.

1. A decrease of 10% of operational costs : This scenario assumes that there is a 10% decrease in operational costs and evaluates the financial outcomes of the project under this condition.
2. A decrease of 20% of operational costs : This scenario assumes that there is a 20% decrease in operational costs and evaluates the financial outcomes of the project under this condition.
3. A decrease of 30% of operational costs : This scenario assumes that there is a 30% decrease in operational costs and evaluates the financial outcomes of the project under this condition.
4. Decrease of operational costs to achieve breakeven (i.e., the operational grant not being necessary during the operational phase) : This scenario assumes that the operational costs are decreased to the point where the project breaks even, and no annual operational grant is needed. The financial outcomes of the project are evaluated under this condition.

12.5 CASE RESULTS

Prior to sensitivity analysis in the financial model, an initial review of the project costs and revenues in the base case has been undertaken and documented. This section therefore elaborates on the findings to gain a clear understanding of the financial position of the project before any funding and/or changes to the project assumptions are considered.

12.5.1 Capital Costs

As part of the base case review, the first element involves the review of the construction costs of the project. The construction costs of the project described in this report, namely the Capital Expenditure (CAPEX) includes all capital spending during the construction phase of the project and any life-cycle costs incurred throughout the project lifecycle. This includes capital maintenance and renewals during the operational phase, where required, and when assessing the construction costs each year, there are evident spikes in the costs which correspond to these renewals.

For financial analysis purposes, the results are inclusive of contingency, risk and inflation values as per the Parameters table. This allows for the review of costs in nominal terms, which considers the assumed level of inflation each year. The values also allow for the risk and contingency values to account for any uncertainties built into the cost estimates, which reduces the level of risk exposure to stakeholders, and in this case, with potential investors.

From reviewing the Figure 12-2 which demonstrates the cumulative costs over the entire analysis period for BDHR, it is evident that in Year 2032, there is a large increase in CAPEX with a substantial level of costs being incurred due to Trackworks.

The graph also shows that almost a third of the construction costs are from including risk and contingency cost categories. This aligns with the expected outcomes of the analysis as the assumption of a 20% contingency and a 20% risk value for construction costs (with risk during the construction phase only).

The NPV value for construction costs on the BDHR project (with a 6.15% discount rate) gives a total value of $(2,746.12)M. In annual terms, the average annual construction costs are $633.5M (undiscounted, nominal) during construction with an additional average of $24.4M on sustaining capital costs (on years where this is incurred during the construction phase).

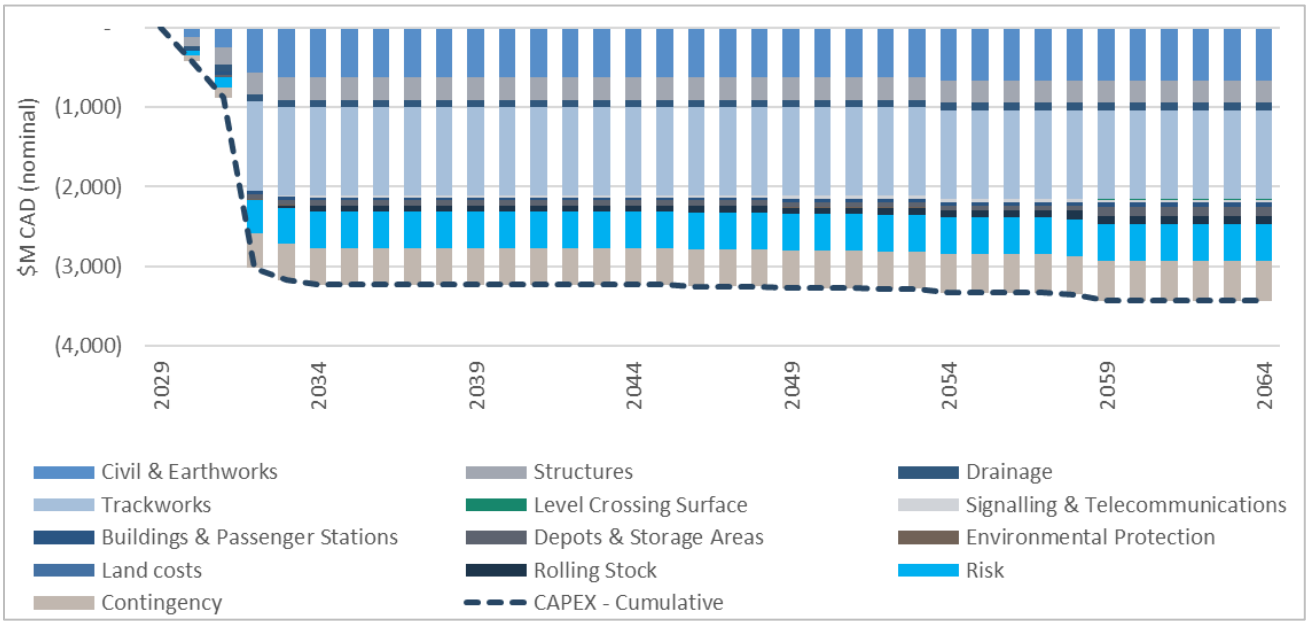

Figure 12-2: Base Case BDHR : Cumulative Construction Costs, Undiscounted

For Figure 12-3 of the cumulative costs for the GCR, similar results can be found. It is evident that substantial costs are incurred over the 5-year construction period, with values being more staggered over the years compared to BDH. It is also noticeable that there is minimal inflation impact as the graph does not show large increases in each cost category over the timeline. This is due to most costs being incurred at the start of construction and are therefore subject to lower inflation.

The NPV value for construction costs on the GCR project (with a 6.15% discount rate) gives a total value of $(1,488.7)M. In annual terms, the average annual construction costs are $347.4M (undiscounted, nominal) during construction with an additional average of $9.7M on sustaining capital costs (on years where this is incurred during the construction phase).

The lower total CAPEX costs for GCR compared with BDHR suggests that the GCR would be more financially affordable, but this cannot be assessed without the review of the operational costs and the revenues to understand the total project cashflow, which are reviewed in the next section.

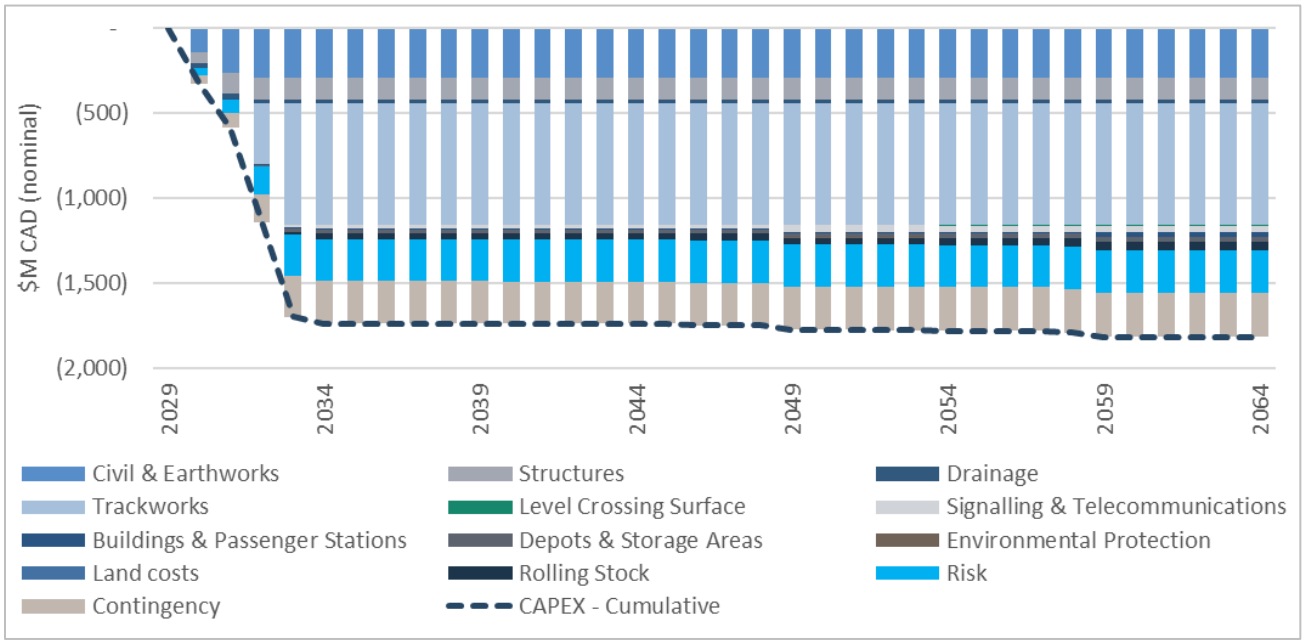

Figure 12-3: Base Case GCR : Cumulative Construction Costs, Undiscounted

12.5.2 Operational Costs

The second element of the base case review is of the operational costs of the project. The operational costs of the project described in this report, namely the Operational Expenditure (OPEX) includes all spending during the operational phase of the project to account for the costs incurred with running the railway throughout the project life cycle. This includes outgoings including paying for costs such as the workforce, insurance and fuel.

For financial analysis purposes, the results are inclusive of contingency, risk and inflation values as per the Parameters table. This allows for the review of costs in nominal terms, which considers the assumed level of inflation each year which is noticeable in the figures presented below as the operational costs remain fairly constant, in real terms. This, however, is not perfectly linear due to the spikes in operational costs, corresponding to the increase in the subcontracted activities cost category in 2038 and 2039. The values also allow for the specified contingency values to account for any uncertainties built into the cost estimates.

From reviewing the

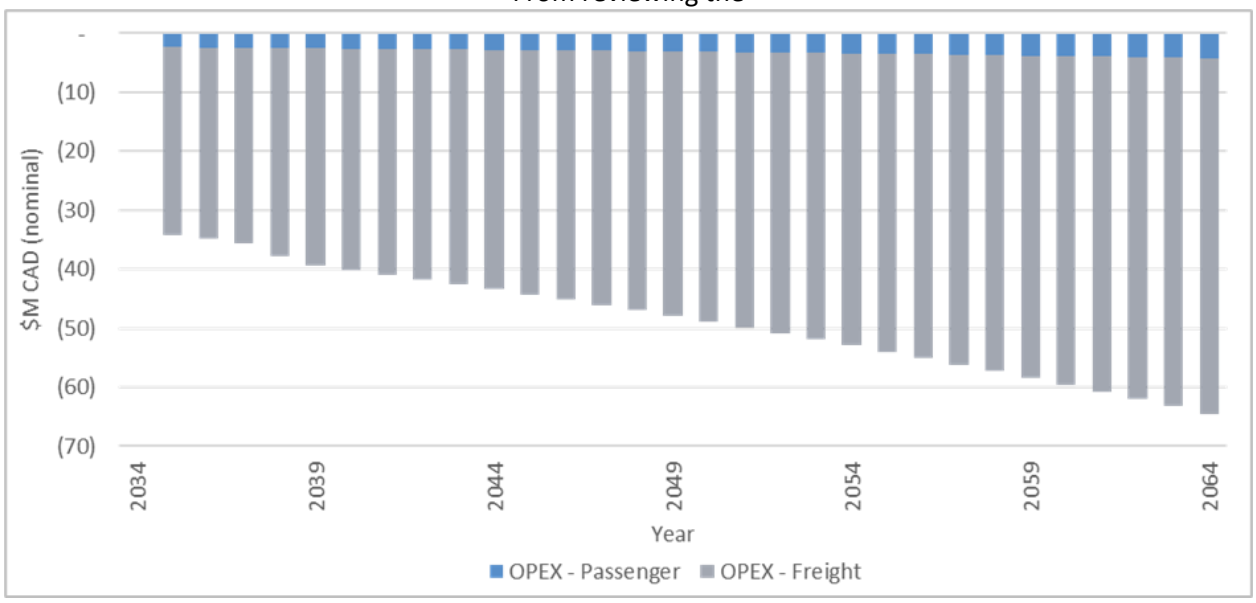

Figure 12-4 which demonstrates the costs each year over the entire analysis period for BDHR, it is evident that the costs for the passenger railway are much smaller compared with the freight costs. The average annual operational costs are $3.1M for passenger rail, compared with $44.8M for freight rail during the operational phase. Freight rail therefore makes up 93.5% of total costs for the Billy Diamond Highway Railway.

The total NPV value of BDHR for the operational costs totals $(439.6)M with $(410.77)M accounting for freight.

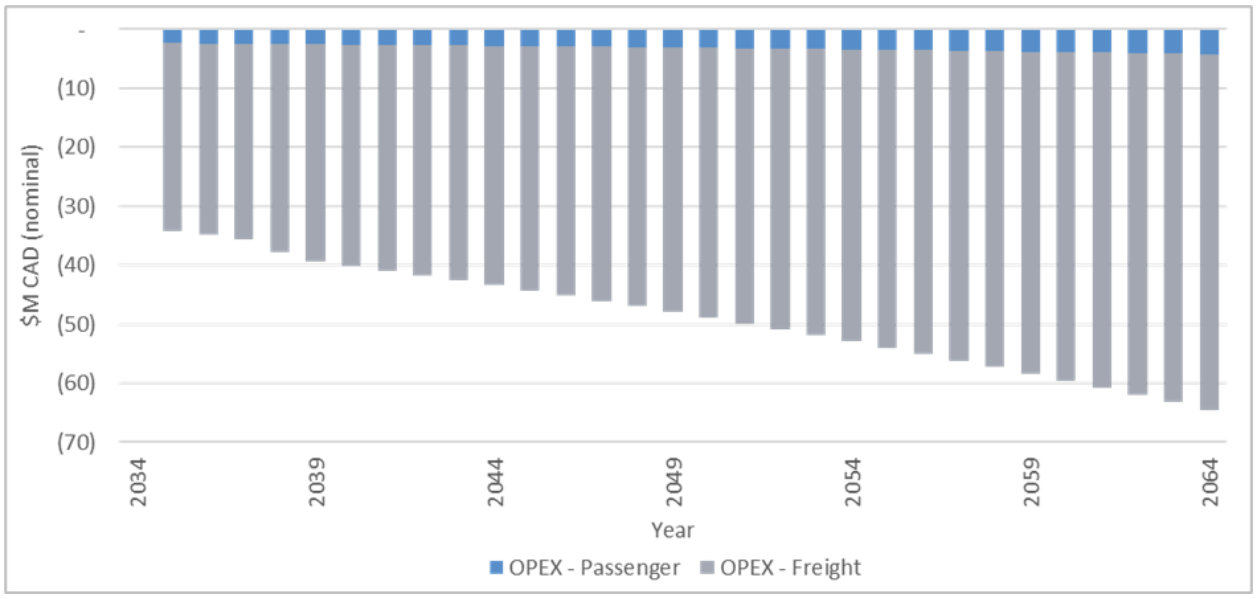

Figure 12-4: Base Case BDHR : Operational Costs, Undiscounted

The Figure 12-5 for GCR, shows similar results with the average annual operational costs are $1.2M for passenger rail, compared with $15.1M for freight rail during the operational phase. Freight rail therefore makes up 92.6% of total costs for the Grevet Chapais railway.

The total NPV value of GCR for the operational cost's totals $(148.9)M with $(137.9)M accounting for freight.

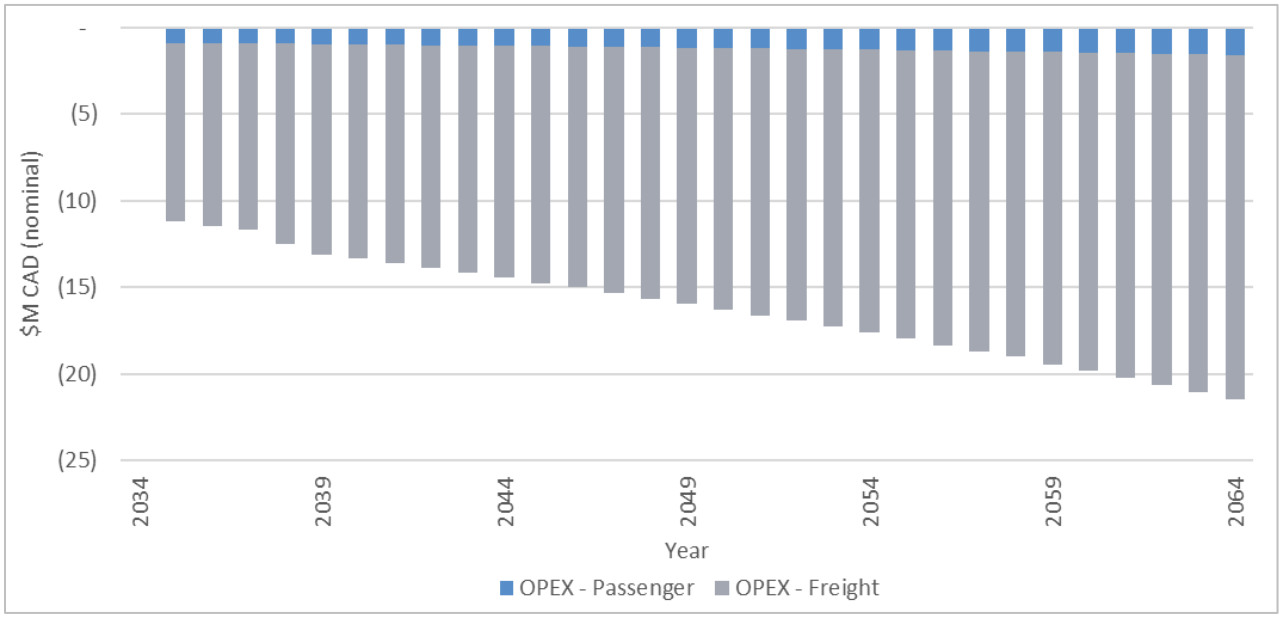

Figure 12-5: Base Case GCR : Operational Costs, Undiscounted

12.5.3 Revenue

This section includes a review of the revenues of the project, for both passenger and freight. The revenues of the project described in this report, includes all ingoings during the operational phase of the project which increase the total project cashflow during operations by offsetting some (if not all) of the outgoings.

For revenues, the results are in nominal terms, which means that the values are inclusive of the assumed level of inflation as per the Parameters table to account for. This allows for the review of revenues which consider the assumed level of inflation each year, which is noticeable in the figures presented below given the increase in revenues over the appraisal period, as well as due to an increase in forecasted demand for passengers.

From reviewing the figure below which demonstrates the revenues each year over the entire analysis period for BDHR, it is evident that the revenues for the passenger railway are much smaller compared with the freight revenues. Average annual revenues are $0.20M for passenger rail, compared with $36.5M for freight rail. Freight rail therefore makes up 99.5% of total revenues for the BDHR. This is as expected, although the freight revenues are treated as constant in real terms and therefore the increase over the timeline from around $28M to $49M is primarily due to inflation.

It is clear from comparing these values with the operational costs that the revenues do not completely offset the operational costs of the railway and therefore will require a financial intervention to ensure that the project is financially affordable.

The total NPV value of BDHR for the revenue's totals $(338.4)M with $(336.7)M accounting for freight.

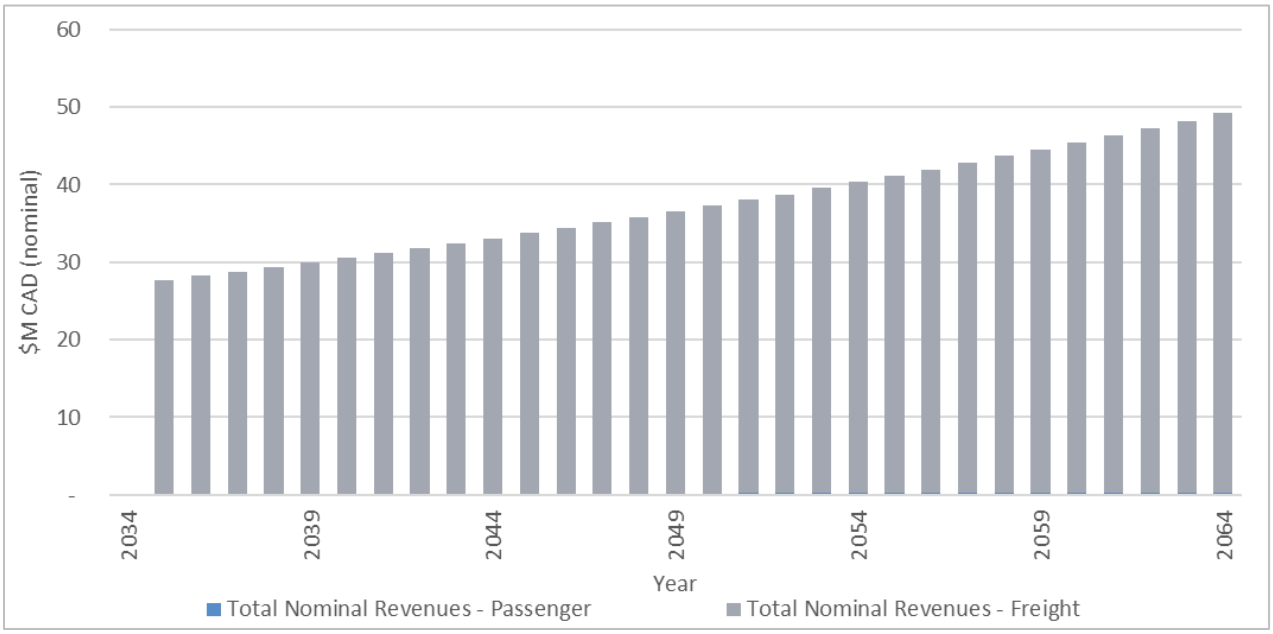

Figure 12-6: Base Case BDHR : Total Revenues, Undiscounted

The graph below for GCR, shows similar results with the average annual revenues of $0.2M for passenger rail, compared with $17.9M for freight rail. Freight rail therefore makes up 98.9% of total revenues for the Grevet Chapais Railway.

The graph below for GCR, shows similar results with the average annual revenues of $0.2M for passenger rail, compared with $17.9M for freight rail. Freight rail therefore makes up 98.9% of total revenues for the Grevet Chapais Railway.

It is clear from comparing these values with the operational costs that the revenues do offset the operational costs of the railway and is therefore affordable over the operational phase of the railway. However, with the negative total project NPV, GCR will still require a financial intervention to ensure that the project is financially affordable across the entire project lifecycle.

The total NPV value of GCR for revenues totals $(166.7)M with $(164.9)M accounting for freight.

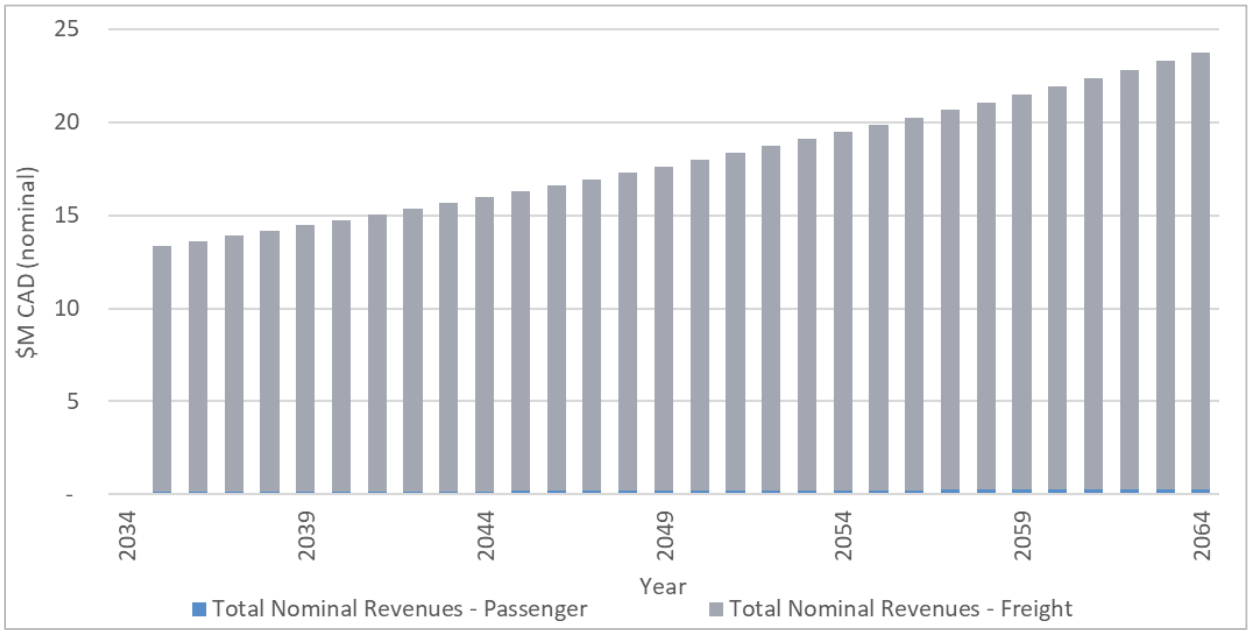

Figure 12-7: Base Case GCR : Total Revenues, Undiscounted

Average annual revenues are $0.2M for passengers, compared with $17.9M for freight. Freight therefore makes up for 98.9% of total revenues for the Grevet Chapais Railway.

12.5.4 EBITDA

As described in Section 12.2, the model is set to achieve a financial equilibrium which is assessed with the EBITDA. The graphs below for both BDHR and GCR demonstrate the EBITDA values and the EBITDA margin which show the company's financial position and ability to generate cash.

For the BDHR, this is negative, which indicates that the project does not achieve the financial equilibrium required by the CIB as the revenues do not cover the operating costs.

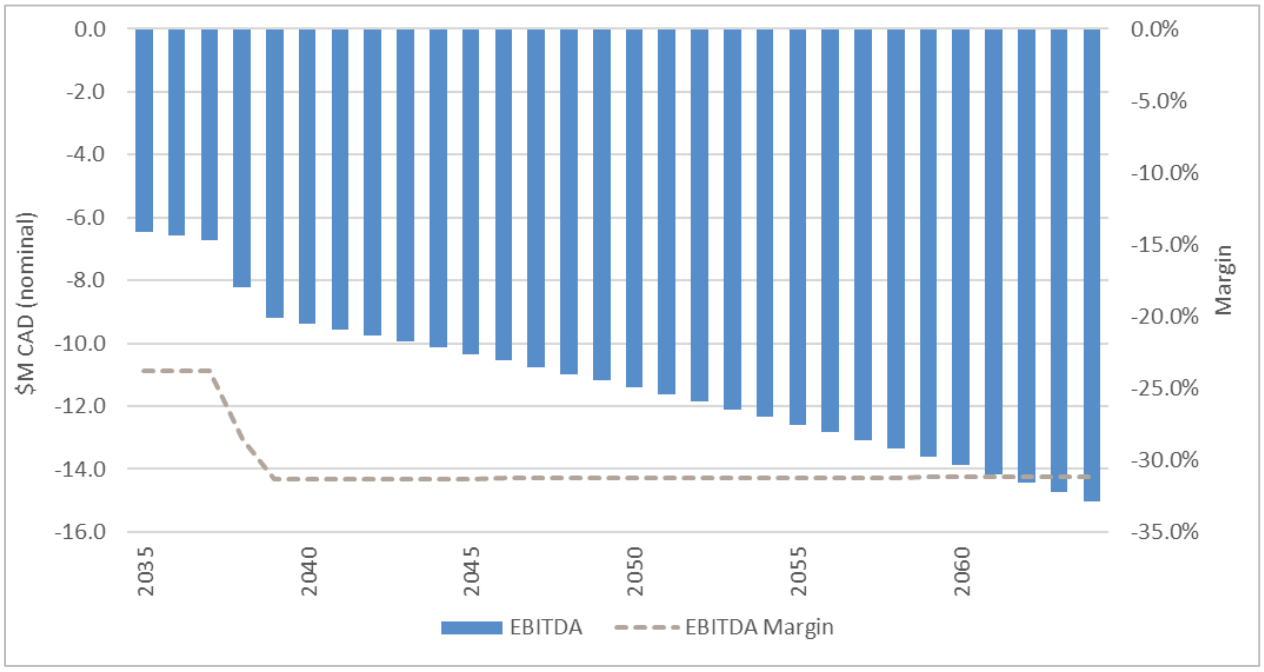

Figure 12-8: Base Case BDHR : EBITDA & EBITDA Margin

For the GCR, this is positive, which indicates that the project does achieve the financial equilibrium required by the CIB. With this, the project makes a return during operations as the revenues are higher than the operational costs, but this does not mean that the project is making an overall return, when considering the capital costs. This is investigated in the sensitivity testing of the funding. To put these results into context, with an assumption of no public funding available, the project would be required to be operational with the same level of OPEX and revenues for another ~1,000 years to account for its initial capital outlay.

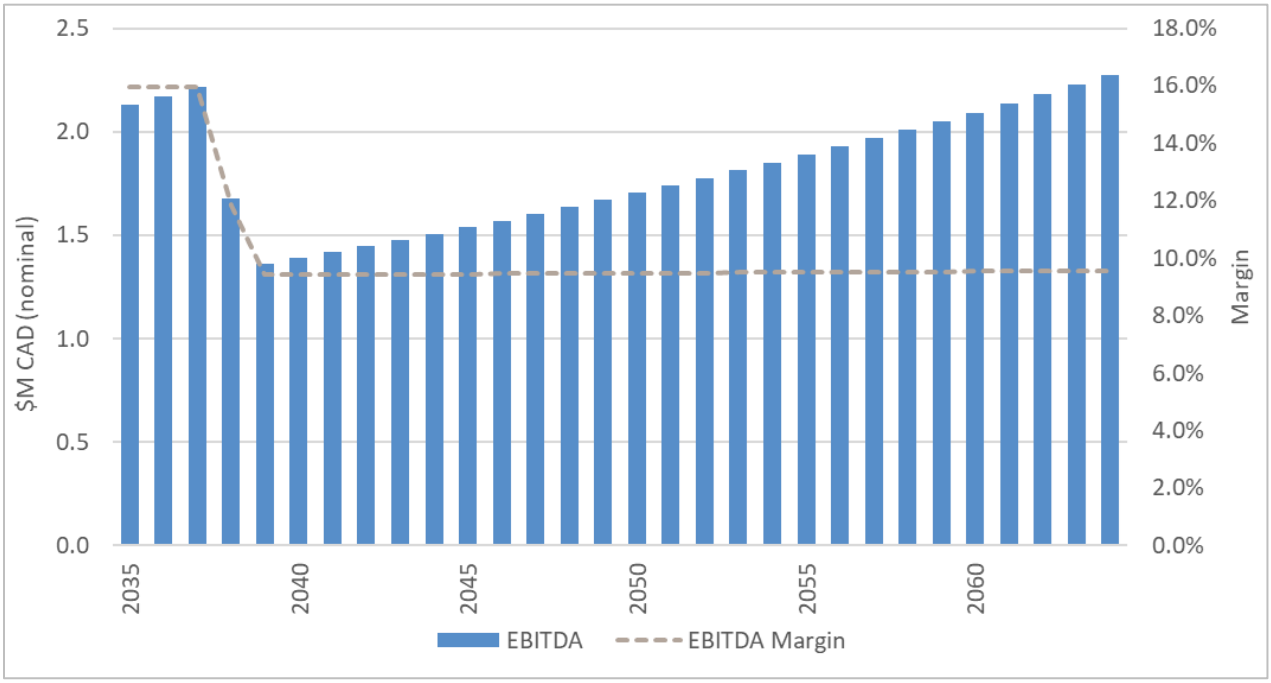

Figure 12-9: Base Case GCR : EBITDA & EBITDA Margin

12.5.5 Project Cashflows

The project cash flow graphs assess the ingoing and outgoing across the entire timeline. The cost and revenue categories have been split up into real costs and their associated index (which shows the cost of inflation).

The cumulative discounted cash flow (DCF) represents the value of an investment today, based on projections of how much money it will generate in the future and allows for an assessment as to whether an investment is worthwhile.

For both BDHR and GCR, the graphs show that the DCF is negative and is not profitable without further financial interventions.

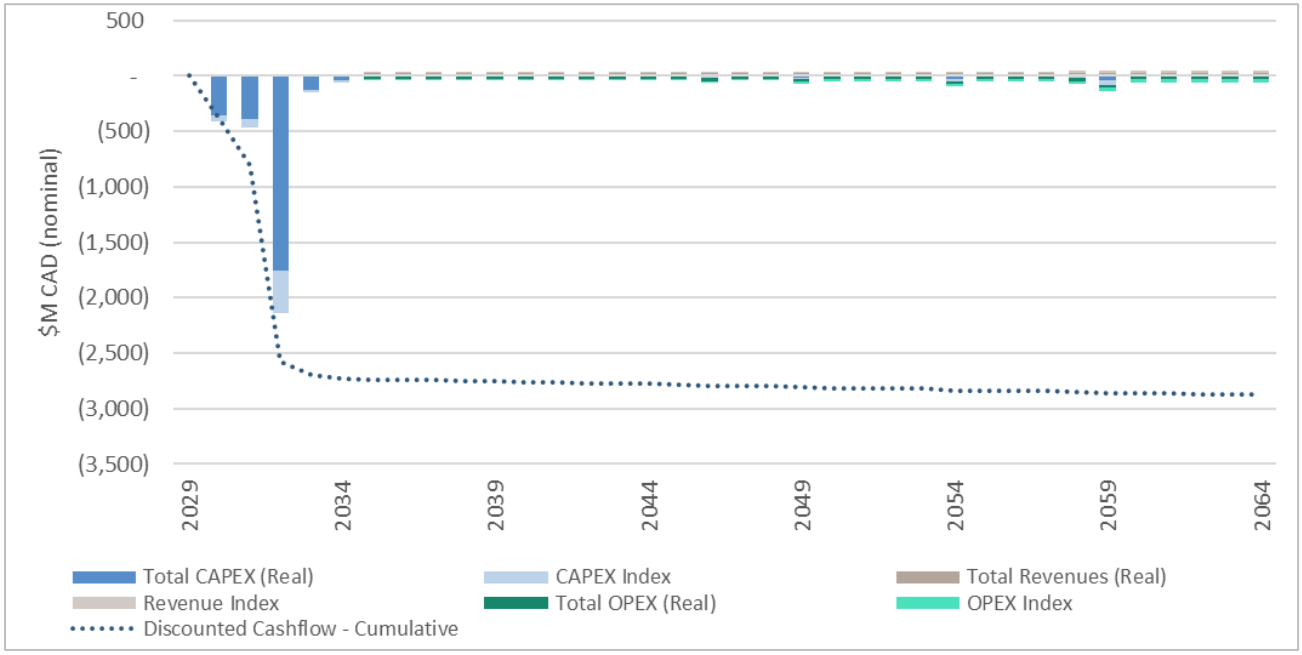

Figure 12-10: Base Case BDHR : Project Cashflows

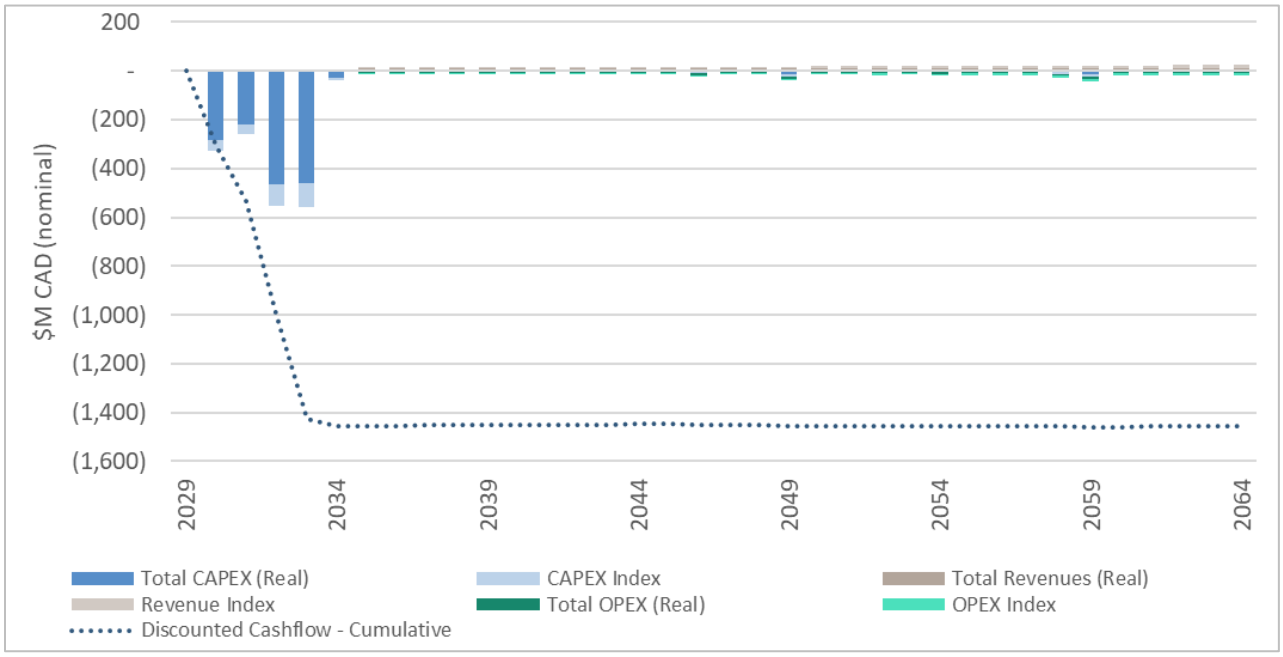

Figure 12-11: Base Case GCR : Project Cashflows

12.6 RESULTS

The table below summarizes the average annual cost for each cost and revenue category. Values include contingency and risk, where applicable, and account for a compound annual growth rate for inflation of 2%.

Table 12-6: Average Annual Costs by Railway Undiscounted – $M

	BDHR	GCR	Combined
Construction costs (construction phase)	633.5	347.4	980.9
Sustaining capital costs	24.4	9.7	34.1
Operational costs	47.9	16.3	64.2
Total revenues	36.7	18.1	54.8

The table below summarizes the average annual cost for each cost and revenue category. Values include contingency and risk, where applicable, and account for a compound annual growth rate for inflation of 2%. Net Present Values have been calculated in the below using the discount rate of 6.15% throughout the appraisal period.

Table 12-7: Total NPV Costs by Railway – $M

	BDHR	GCR	Combined
Total construction costs	(2,746.1)	(1,488.7)	(4,234.8)
Operational costs – Freight	(410.8)	(137.9)	(548.7)
Operational costs – Passenger	(28.8)	(11.0)	(39.9)
Revenues – Freight	336.7	164.9	501.6
Revenues – Passenger	1.6	1.8	3.4
Total project	(2,847.4)	(1,471.0)	(4,318.3)

The figures below demonstrate how a large proportion of project costs are from construction, with a larger proportion for Grevet Chapais Railway.

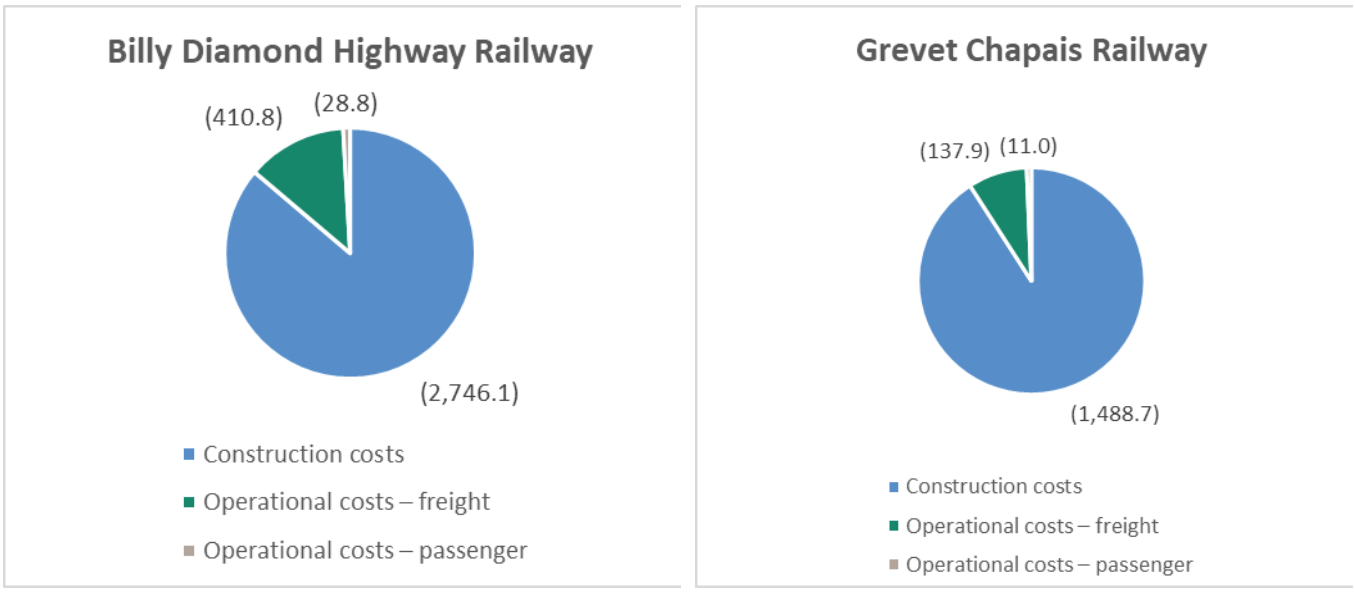

Figure 12-12: Total project NPV breakdown by project - base case

12.7 SENSITIVITY TESTS

12.7.1 Funding

To meet the requirements of the Canadian Infrastructure Bank (CIB), it is important to assess whether the projects are returning a positive NPV. This would demonstrate that the project is profitable. It is evident that the projects are not profitable without any funding and therefore funding sensitivities have been included to assess the assumptions which are required to make the project profitable.

The tables below include various scenarios, including:

- A test against the base of including an operations grant (tariff). This is to achieve a Project IRR of 0% to ensure the project is achievable over the operational phase of the railways.
- A test which includes the operational grant and further aims for the project to be more attractive to investors by assuming an upfront public funding to ensure a rate of return of 12% Equity.
- The test of this has assumed there is 10% Equity (using 90% debt gearing ratio). This is to understand if there was 90% debt and 10% equity for the project, what the investment grant would be where the investor requires a 10% equity with a target value equity IRR of 12%.

Table 12-8: BDHR : Total NPV Costs, $M

BDHR Scenario	Base	Base + Tariff	Base + Tariff + Investment Grant (90% debt gearing)
Project IRR	N/A	0.1%	0.1%
Total Project NPV	(2,847.4)	(1,693.9)	(1,693.9)
Equity IRR	N/A	0.5%	12.0%
Equity NPV	(236.1)	(227.93)	0.1
Annual Tariff Required for Funding (Operations Grant) with 0% Project IRR (2023 Prices) – $M	N/A	72.9	72.9
Investment Grant required for 12% Equity IRR (2030 Prices) – $M	N/A	N/A	1,762.3

Values have been rounded to the nearest $0.1M.

Table 12-9: GCR: Total NPV Costs [CAD $M]

GCR Scenario	Base	Base + Tariff	Base + Tariff + Investment Grant (90% debt gearing)
Project IRR	N/A	0.1%	0.1%
Total Project NPV	(1,471.0)	(921.7)	(921.7)
Equity IRR	N/A	0.4%	12.0%
Equity NPV	(127.5)	(123.2)	0.8
Annual Tariff Required for Funding (Operations Grant) with 0% Project IRR (2023 Prices) – $M	N/A	34.7	34.7
Investment Grant required for 12% Equity IRR (2030 Prices) – $M	N/A	N/A	959.0

For both projects, the tariff results in a project IRR of just above 0% but do not result in a positive Project NPV. This is due to the IRR being less than the cost of capital (WACC values). The Project IRR represents the value that the WACC would be required to be to return NPV=0, where in all cases for the funding sensitivities it would have to be 0.1%.

The level of annual operations grants for the projects to return a Project IRR of 0%, are $72.9M and $34.7M for BDHR and GCR respectively. The figures below show the large proportion of operating grants which contributes to the revenues to achieve the targeted project IRR in these sensitivities.

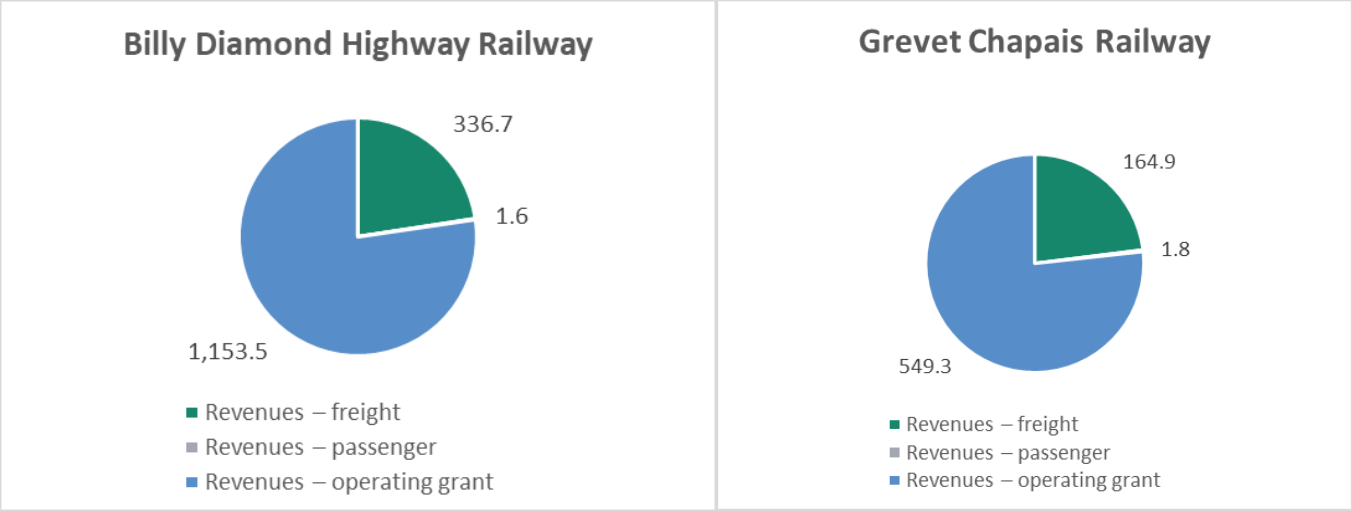

Figure 12-13: Total NPV revenues breakdown by project – Tariff Sensitivity

The level of upfront funding required for the projects to return a target Equity IRR of 12% with 90% debt to equity ratio, are $1,762.3M and $959.0M for BDHR and GCR respectively.

Note that the Investment Grant values are in 2030 prices as this represents the drawdown date, whereas the Operations Grant value is an annual grant which is modelled across the timeline with inflation applied.

12.7.2 Capital Contribution Tests

The tables below show the impacts when changing the levels of required capital contributions, by changing the percentage of CAPEX. These tests evaluate what happens if CAPEX was possible to reduce and if the project becomes more realistically affordable consequently.

With the tables below, as well as the other project parameter sensitivities, the project and equity IRR have not been calculated as an IRR cannot be calculated if the project is not making a return.

The results in the tables below show that for both projects, the total project NPV reduces significantly with each 10% increment of decreasing the CAPEX costs.

Table 12-10: BDHR: CAPEX Sensitivity Table

BDHR Scenario	Base	50% Capital Contribution	60% Capital Contribution	70% Capital Contribution	80% Capital Contribution
Total Project NPV	(2,847.4)	(1,474.3)	(1,199.7)	(925.1)	(650.5)
Equity NPV	(236.1)	(118.0)	(94.4)	(70.8)	(47.2)

Table 12-11: GCR: CAPEX Sensitivity Table

GCR Scenario	Base	50% Capital Contribution	60% Capital Contribution	70% Capital Contribution	80% Capital Contribution
Total Project NPV	(1,471.0)	(726.6)	(577.7)	(428.9)	(280.0)
Equity NPV	(127.5)	(63.8)	(51.0)	(38.3)	(25.5)

12.7.3 Revenue testing

As part of the sensitivity testing, changes to the revenues have been modelled to understand how affordable the projects are when increasing revenues.

The results in the tables below suggest that for both projects, the total project NPV does not significantly reduce when increasing the revenues. To reach a project NPV of zero, the revenues would be required to be around 10 times their current value (1,000%).

Table 12-12: BDHR: Revenues Sensitivity Table

BDHR Scenario	Base	+10% Revenues	+20% Revenues	+30% Revenues
Total Project NPV	(2,847.4)	(2,813.5)	(2,779.7)	(2,745.9)

Table 12-13: GCR: Revenues Sensitivity Table

GCR Scenario	Base	+10% Revenues	+20% Revenues	+30% Revenues
Total Project NPV	(1,471.0)	(1,454.3)	(1,437.6)	(1,421.3)

12.7.4 OPEX Sensitivities

Finally, as part of the sensitivities, changes to the OPEX costs have been modelled to understand how affordable the projects are when decreasing costs during the operational phase.

It is evident that for both projects, the total project NPV does not significantly reduce when reducing the OPEX costs, given the small proportion of costs of OPEX contribute to the overall project costs.

Table 12-14: BDHR: OPEX Sensitivity Table

BDHR Scenario	Base	-10% OPEX	-20% OPEX	-30% OPEX
Total Project NPV	(2,847.4)	(2,803.4)	(2,759.4)	(2,715.5)

Table 12-15: GCR: OPEX Sensitivity Table

GCR Scenario	Base	-10% OPEX	-20% OPEX	-30% OPEX
Total Project NPV	(1,471.0)	(1,456.1)	(1,441.2)	(1,426.3)

12.8 FUNDING Strategies

12.8.1 Institutional Issues

The term “institutional structure” when used in connection with a railway refers to the form of organization of the railway : which entity or entities own the railway infrastructure, which entity or entities are responsible for maintaining and operating the railway infrastructure, which entity or entities operate trains on the railway, and what is the nature of the relationship between these entities. The institutional structure of a railway clearly will have a significant effect on how the railway conducts its business and experience shows that the institutional structure also affects the efficiency of the railway.

The institutional structure also affects the financing options for the railway. If all aspects of the railway are lumped together into one entity, even though the railway as a whole may be financially viable, the financial markets may be reluctant to finance such a large enterprise. On the other hand, if the railway as a whole is not financially viable, if it is broken into segments, some of which are financially viable, those segments may be financed in the private financial markets.

Finally, the institutional structure of the railway affects the regulatory requirements. The regulatory requirements of a single integrated railway are considerably different from those of a railway that is disaggregated into several different enterprises that have to work and interact together to provide railway services.

12.8.2 Structural options for the railway

There is a close relationship between the institutional structure of a railway and the required regulatory structure. Because the institutional structure of a railway drives the appropriate regulatory regime, we will begin by describing the structural options the Railway which comprise:

- Vertical integration or vertical separation, and / or
- Horizontal integration or horizontal separation

The following section presents different funding strategies currently used for railway infrastructure projects.

12.8.2.1 Vertically Integrated Railways

Vertical integration:

A vertically integrated railway is one where the infrastructure and train operations are managed and controlled by the same entity. That is the railway company that practises vertical integration owns or controls all aspects of the railway system, from the tracks to the rolling stock, stations, and terminals. This means that the company is responsible for designing, building, operating, and maintaining the entire.

The principal advantage of railway ownership of the infrastructure in a vertically integrated railway is that it facilitates financing of infrastructure construction and improvements. Infrastructure can be financed by the issuance of bonds which are secured by a lien or mortgage on the infrastructure, including the right-of-way. In the event of default, the bond holders can foreclose and take possession of the infrastructure and any other rail assets subject to the lien or mortgage. A mortgage, and the associated power to foreclose and take the assets, reduce the risk to the lender and consequently reduce the cost of financing the infrastructure. A second advantage of the railway owning its infrastructure is that it avoids the difficult investment and valuation issues that arise as a lease or concession period for the infrastructure draws to a close. In the final years of a lease or concession, a railway will

be reluctant to invest in assets which have a life span beyond the term of the lease or concession. Where the railway owns the infrastructure, this issue does not arise.

The characteristics described here are those that would be associated with the Build, Operate, and Transfer (BOT) model of public-private partnership discussed in subsequent sections of this Volume.

Horizontal integration:

A railway company that practises horizontal integration merges or acquires other railway companies to create a larger, more comprehensive railway network. This means that the company is able to offer more routes, services, and options to customers, and it may be able to achieve economies of scale by combining resources and infrastructure. For example, two regional railway companies may merge to form a national railway company that connects more cities and regions, or a passenger railway company may acquire a freight railway company to offer both passenger and freight services. This type of integration does not apply to the BDHR and the GCR.

Standard business models for railway infrastructure projects are:

Build-Own-Operate-Transfer (BOOT) Model : Under this model, a private entity designs, builds, and operates the railway infrastructure for a set period, after which ownership is transferred to the government or other public entity. The private entity receives revenue from operating the infrastructure and may recoup its initial investment through the transfer of ownership.

Public-Private Partnership (PPP) Model : This model involves a partnership between the government or other public entity and a private entity, with both parties sharing the risks and rewards of the project. The private entity typically contributes funding and expertise, while the public entity provides regulatory oversight and other support.

Concession Model : In this model, a private entity is granted a concession to operate the railway infrastructure for a set period, usually between 30 and 50 years. The private entity is responsible for financing, building, and maintaining the infrastructure, and may recoup its investment through fees charged to users of the infrastructure.

Joint Venture Model : Under this model, two or more entities collaborate to design, build, and operate the railway infrastructure. Each entity brings its own expertise and resources to the project and shares in the risks and rewards of the venture.

12.8.3 Detailed business model options

12.8.3.1 *Build-Own-Operate-Transfer agreement*

BOOT stands for Build-Own-Operate-Transfer, which is a type of agreement commonly used in infrastructure projects such as railway operations. In a BOOT agreement, a private company is granted a contract to design, build, operate, and maintain a railway project for a specified period of time, after which ownership and control of the project is transferred back to the government or another public entity.

The BOOT agreement typically specifies the terms and conditions of the project, including the duration of the agreement, the project scope, the payment structure, and the performance targets. The private company is responsible for financing the project and assuming the risks associated with its construction and operation. In return, the private company is granted certain rights and benefits, such as the right to collect user fees or tolls and the ability to earn a profit.

At the end of the BOOT agreement, ownership and control of the project are transferred back to the government or another public entity, typically in a specified condition. This allows the government to benefit from the

infrastructure development without having to finance the project upfront, while the private company can earn a profit during the operation phase. BOT agreements are often used for large-scale infrastructure projects, including railway operations, where the upfront capital cost is high, and the risks associated with the project are significant.

The railway operations will involve transporting three types of cargo : ores from the respective blocs, freight, and passengers. The rolling stock, which refers to the trains and other vehicles used to transport cargo and passengers, will need to be designed and procured to meet the specific requirements of the project.

The railway assets will include civil works, railway track, signalling, rolling stock, and possibly stations.

In addition to the design and construction of the railway assets, the commercial arrangement will also include the maintenance and operations of the rail assets. This will involve ongoing upkeep and repairs to ensure that the railway infrastructure and rolling stock remains in good condition and operates efficiently.

12.8.3.2 Public-Private-Partnership (PPP)

The commercial arrangement is structured as a PPP (Public-Private Partnership) in order to address Government's budgetary constraints. This type of arrangement typically involves collaboration between a public sector entity (such as the government) and a private sector company to design, build, operate, and maintain infrastructure projects like railways. The specific terms and conditions of the PPP will be determined through negotiations between the parties involved. The type of PPP model will depend on a range of factors including the availability of funding, the regulatory environment, the level of risk tolerance of the parties involved, and the objectives of the project. The Affermage, the lease model, the availability model and the multi-rail operation

12.8.3.3 Affermage model

An afterimage model is a type of public-private partnership (PPP) model used in infrastructure projects. In this model, a private operator is contracted to operate and maintain a public utility (such as a transportation network) and collect user fees from customers. The private operator is responsible for the day-to-day operations and maintenance of the infrastructure, while the public entity retains ownership and overall control of the system.

The afterimage model is often used in situations where the public entity lacks the resources or expertise to operate and maintain the infrastructure effectively. By contracting with a private operator, the public entity can benefit from the private sector's expertise and efficiency in operating and maintaining the system, while still retaining overall control and ownership.

In the context of a railway project, the afterimage model could be applied by contracting with a private operator to operate and maintain the railway system and collect user fees from customers. The private operator would be responsible for managing the day-to-day operations of the railway system, including scheduling trains, maintaining the tracks and rolling stock, and ensuring that the system operates safely and efficiently.

The public entity (Cree Government) would retain ownership of the railway infrastructure and control over strategic decisions related to the system, such as setting tariffs and determining service levels. The private operator would be compensated through a fee structure that incentivizes them to operate the system efficiently and effectively.

Overall, the afterimage model can be a useful PPP model for infrastructure projects where the public entity lacks the resources or expertise to operate and maintain the system effectively, but still wants to retain overall ownership and control of the infrastructure.

Pros	Cons:
• Private sector expertise : By contracting with a private operator to operate and maintain the infrastructure, the public entity can benefit from the private sector's expertise and efficiency in managing the system. • Lower government spending : The afterimage model can allow the public entity to save money on infrastructure projects by transferring the operational and maintenance costs to the private operator. • Increased investment : Private sector involvement can attract investment and improve the quality and efficiency of the infrastructure. • Improved service delivery : Private operators are incentivized to operate the system efficiently and effectively, which can lead to improved service delivery. • Risk sharing : Risks associated with the operation and maintenance of the infrastructure are transferred to the private operator.	• Potential for conflict : Conflict can arise between the public entity and private operator over issues such as user fees, service levels, and infrastructure maintenance. • Short-term focus : Private operators may prioritize short-term profits over long-term sustainability, leading to deferred maintenance and reduced quality of service. • Lack of accountability : The public entity may have limited control over the private operator's actions and may be held accountable for the operator's actions. • Reduced public control : The public entity may lose control over the day-to-day operation of the infrastructure, which can lead to decreased transparency and accountability. • Potential for rent-seeking : Private operators may use their position to extract rents from customers, leading to higher user fees and reduced affordability

12.8.3.4 Lease Model

In a lease contract, the private partner assumes responsibility for providing the service and meeting quality and service standards. The public authority retains responsibility for new and replacement investments, while the private operator covers all other expenses and risks associated with providing the service. Typically, a lease contract lasts for 10 years and can be extended up to 20 years, during which time the private sector takes over the responsibility of service provision.

In the context of the project at hand, the Infrastructure Operator (IO) Users would pay a lease payment to InfraCo for the use of the infrastructure. This payment would provide InfraCo with a stable income stream, eliminating performance and operational risks and improving the bankability of the DBF arrangements. Under this model, the IO assumes the performance, operational, and demand risks, while the expenditures include maintenance and operational costs and fixed lease payments to InfraCo.

Revenues are generated based on railway usage, calculated by weight or tariff per ton. If Users pay for the lease, they also share the availability risk with the IO. This means that if the track is unavailable due to maintenance, Users would still have to pay the lease to InfraCo, even if they are unable to use the railway. The IO would not receive the corresponding Operational Charge since they cannot deliver the train operating service.

Pros	Cons:
Transfer of operational risk : • The private partner is responsible for operating and maintaining the infrastructure, which can reduce risk for the public entity. • Access to private sector expertise : The private partner can bring expertise and efficiency to the operation and maintenance of the infrastructure. • Stable income stream for private partner : A lease payment provides a stable income stream for the private partner, which can make the project more bankable. • -Flexibility : Lease contracts can be structured to include different levels of responsibility and risk sharing between the public and private sectors.	• Limited control for public entities : With a lease model, the private partner is responsible for day-to-day operations and maintenance, which can limit the public entity's control over the infrastructure. • The financial burden for public entities : Although the private partner is responsible for operational costs, the public entity may still be responsible for major capital expenditures, such as new or replacement investments. • Revenue risk for private partner : The private partner's revenue is based on user fees or other sources of income related to the infrastructure, which can be subject to demand fluctuations or other market risks. • Potential for conflicts of interest : The private partner's obligation to maximize profits may conflict with the public entity's goals for the infrastructure, such as ensuring equitable access to services.

12.8.3.5 Availability Model

Under an availability model, a private partner, typically called the "Operator," is responsible for the availability of the infrastructure asset or system. The Operator is contracted to design, build, finance, operate, and maintain the asset or system for a fixed period. In return, the public entity pays the Operator a regular payment, called an "availability payment," for the period of the contract.

The availability payment is made based on the availability of the infrastructure asset or system, rather than on actual usage. The public entity pays the Operator the availability payment if the asset or system is available for use, regardless of whether or not it is actually used. Conversely, if the asset or system is not available for use, the public entity may withhold the availability payment or impose penalties on the Operator.

The Operator is responsible for the performance and maintenance of the asset or system and must ensure that it is available for use according to predetermined standards. The Operator bears the risks associated with the asset or system, including demand risk, performance risk, and maintenance risk. This incentivizes the Operator to design, build, and maintain the asset or system to a high standard, and to ensure that it is available for use as much as possible.

The availability model can be particularly attractive for infrastructure projects where demand is uncertain, or where the public entity lacks the resources or expertise to operate and maintain the asset or system effectively. The model allows the public entity to transfer much of the risk associated with the asset or system to the private sector, while still retaining ownership of the asset or system.

Pros	Cons:
• Provides a strong incentive for the private partner to ensure high availability and performance of the infrastructure, as their revenue is tied to it. • Risks related to maintenance and operation are transferred to the private partner, relieving the public sector of these responsibilities. • Allows the public sector to benefit from the private partner's expertise and efficiency in infrastructure operation and maintenance. • Provides stable cash flow to the private partner, as payments are based on availability rather than usage.	• The public sector still bears the ultimate risk of financing the infrastructure, as they are responsible for making the availability payments. • The availability model can be complex to set up and manage, as the terms of the availability payments and the metrics used to measure availability must be carefully defined and monitored. • The private partner may prioritize availability over other aspects of the infrastructure's performance, leading to neglect of other important factors such as safety or sustainability. • The availability model may not be appropriate for all types of infrastructure projects, as some projects may not lend themselves to the measurement of availability in a meaningful way.

12.8.3.6 Multi-Rail operator

The multi-rail operator or European model can be adapted to allow for the involvement of multiple rail operators accessing the track, and the segregation of rail operations between the two railways (BDHR and GCR). This approach may be beneficial as it allows for the engagement of specialized service providers, recognizing the differences in business profiles and underlying value drivers, and related capability requirements such as rail freight and rail passenger transportation businesses.

For the current project, this would entail the awarding of separate operating concessions for freight transport, passenger transport, with the possibility of separating transport operators between phases, for example. The presence of multiple Train Operating Companies (TOCs) would necessitate traffic control to align the different operating regimes. This responsibility could be assigned to InfraCo as the railway Manager, one of the TOCs, such as the dominant operating company, an independent third party, or the government.

Pros	Cons:
• Implementing track access charges, where the owner is responsible for constructing and maintaining the railway track, enabling them to optimize the costs throughout its lifecycle. • Positively impacts the financial viability of their operations, as the operator's capital requirements are limited to acquiring rolling stock for its specific purpose	• Coordination challenges : When multiple operators are using the same railway infrastructure, there may be coordination challenges that can arise • Increased complexity : Multi-user operations can be more complex to manage than single-operator systems, as there may be additional stakeholders involved in decision-making and operations. • Potential for reduced quality : When multiple operators are using the same infrastructure, there is a risk that the quality of service could be impacted • Regulatory challenges : Multi-user operations can be more challenging to regulate than single-operator systems, as there may be multiple operators with different requirements and needs. • Potentially higher costs : While the use of track access charges can encourage competition and efficiency, there is a risk that costs could increase if operators are not able to optimize their operations effectively.

For example, different operators may have different schedules or operational requirements that need to be accommodated, which can create conflicts and delays. If one operator is not maintaining their rolling stock to the same standard as another, it could impact the overall performance of the system.

12.8.3.7 Joint venture

A joint venture agreement for a railway construction and operation is a legal contract between two or more companies that outlines the terms and conditions for their collaboration in building and running a railway system.

The agreement typically covers several key aspects of the joint venture, such as the sharing of costs, profits, and risks, the roles and responsibilities of each party, and the duration of the project.

Typically, the joint venture agreement will cover various aspects, such as the scope of the project, the ownership structure of the joint venture, the management structure, the funding arrangements, and the dispute resolution process. It will also specify the roles and responsibilities of each party, such as their contribution to the project, the appointment of a project manager, and the decision-making process.

The joint venture agreement aims to ensure that each party's interests are protected and that the project is completed successfully. It establishes the rules and regulations for the project, sets out the mechanisms for resolving any disputes, and provides a framework for decision-making and communication between the parties.

In conclusion, a joint venture agreement for a railway construction and operation is a legal contract that outlines the terms and conditions of a partnership between companies in the construction and operation of a railway system. It is an important document that helps to ensure the success of the project and the protection of the interests of all parties involved.

- Management : The roles and responsibilities of each party in managing the joint venture, including the appointment of a project manager, and the decision-making process.
- Costs and profits : The allocation of costs and profits between the parties, including how they will be shared and distributed.
- Duration : The expected duration of the joint venture, including any milestones, deadlines, or termination clauses.
- Dispute resolution : The process for resolving any disputes that may arise during the project.
- Confidentiality : Confidentiality and non-disclosure agreements to protect any sensitive information shared during the project.
- Governing law : The governing law that will apply to the joint venture agreement.

Overall, a joint venture agreement for a railway construction and operation is a critical document that outlines the framework for collaboration between companies. It is essential to carefully consider all aspects of the agreement to ensure that all parties' interests are protected, and the project's objectives are achieved.

12.8.3.8 Public Model

A public funding model for a railway infrastructure company would involve the government or a public entity providing financial support to the company for the development, maintenance, and expansion of the railway infrastructure.

In this model, the government could provide funding through various sources such as grants, loans, bonds, or direct investment. The funds would be used by the railway infrastructure company to build new tracks, upgrade existing infrastructure, purchase equipment, and hire personnel.

The railway infrastructure company would typically operate as a public-private partnership (PPP), with the government as a major shareholder or stakeholder. The company would be responsible for managing and maintaining the infrastructure, as well as providing services to the public.

The public funding model would require the railway infrastructure company to meet certain performance standards and targets, such as ensuring safety, improving efficiency, and reducing costs. The government or public entity providing funding would also have oversight over the company's operations to ensure that public funds are being used effectively.

Overall, a public funding model for a railway infrastructure company can provide an important source of funding and support for the development and maintenance of essential transportation infrastructure, while also ensuring accountability and transparency in its management.

The **Canadian Infrastructure Bank (CIB)** could serve as an example for a public funding strategy The CIB is a federal government-owned financial institution that was created in 2017 with the mandate of investing in and attracting private sector investment to infrastructure projects in Canada. The goal of the CIB is to help address Canada's infrastructure deficit by financing and providing expertise to projects that have the potential to generate revenue, provide economic and social benefits, and improve the quality of life for Canadians.

The CIB's role is to provide funding, expertise, and support to infrastructure projects that meet certain criteria. These criteria include:

- **Revenue-generating potential** : The CIB provides funding to infrastructure projects that have the potential to generate revenue. This can come from user fees, private investment, or other sources.
- **Private sector involvement** : The CIB's funding is designed to attract private sector investment to infrastructure projects. Projects must have a significant private sector investment component in order to be eligible for CIB funding.
- **Economic and social benefits** : Infrastructure projects must have a positive economic and social impact, including job creation, environmental benefits, and improved quality of life for Canadians.
- **Financial viability** : Infrastructure projects must be financially viable, meaning that they must be able to generate sufficient revenue to cover their operating costs and repay any loans or investments made by the CIB and its private sector partners.
- **Public interest** : Infrastructure projects must serve the public interest and be aligned with government priorities, such as promoting economic growth, reducing carbon emissions, and improving public transportation.

In addition to these criteria, the CIB also requires that infrastructure projects undergo a rigorous due diligence process to assess their feasibility, financial viability, and potential impact. This includes conducting market assessments, financial analysis, and risk assessments, as well as engaging with stakeholders and conducting public consultations.

Overall, the CIB's role is to provide funding and support to infrastructure projects that have the potential to generate revenue, provide economic and social benefits, and improve the quality of life for Canadians, while also attracting private sector investment and expertise to these projects.

13. RISK ANALYSIS

The final step in the estimation process involves evaluating the risk and uncertainty associated with a project and incorporating the potential cost of this risk and uncertainty into the total cost estimate.

This document was prepared in the context of the Grande Alliance Phase 1 Feasibility study, and it outlines the results of the risk analysis completed at this stage of the project. This report is part of the deliverable Volume 5 – Economic, Risk and Financial, in which the project scope and context are presented as well as the financial assumptions and analysis associated with the risk analysis.

The risk analysis was conducted between mid-January 2023 and the end of February 2023, to comply with the schedule of the project agreed with the client. Therefore, the risk analysis methodology was customized to meet the targeted schedule and the number of workshops were adjusted, as describe in section 3. It is important to note that it is usually recommended to take more time to conduct a complete risk analysis and make sure the team experts are able to spend time defining the risk, assessing and quantifying them as well as establishing the response strategy with the appropriate mitigation measures. In the case of this risk analysis, the timing did not allow the team to conduct the entire risk analysis methodology and the mitigation measures could not be entirely identified.

13.1.1 Principles

Risk and Opportunity : Project risk is defined as any uncertain activity or event that, if it occurs, might cause the Project KPI's to deviate, increase (threats) or decrease (opportunities) from the project baseline, whether caused by quality, contractual, technical or schedule issues.

Contingency Allowances : An allowance to cover undefined items of work which will have to be performed or elements of cost that will be incurred within the defined scope of work of the estimate that cannot be explicitly foreseen or described at the time the assessment is being made because of lack of complete accurate and detailed information. Basically, contingencies are provided for known unknowns.

Risk reserve: Risk reserve is added to an estimate to account for events that are not included in the base estimate but may occur during the project's life. It may be event-driven, which reflect the economics of the times, or the specificity of the technology, site, country, or client involved in the project.

Table 13-1: Risk Definitions

Tag	Definition
Risk Management Plan	This plan which is part of the Project Execution Plan.
Risk Breakdown Structure	Categories which provide a basis for classifying risks by type.
Qualitative Risk Analysis	The process used to identify risk events including a description of the causes, consequences & treatments of each event.
Quantitative Risk Analysis	The process used to understand the risks in terms of the likelihood of the risk event occurring and the potential consequences of the event, according to the risk analysis criteria provided in the project risk matrix. Quantitative Risk Analysis may include further analysis and evaluation of risks which fall in the "unacceptable" zone of the risk matrix requiring more rigorous treatments to quantify risk implications further. Quantitative risk analysis also includes capital probabilistic risk analysis using Monte Carlo simulations.
Risk Register	A central record of identified Project risks which is updated monthly. Key elements include workshop history, context, categories, the risk log, risk profile, risk severity and history of retired risks.
Risk Owner	An assigned member from the project team or stakeholder group who is accountable for ensuring that a specific identified risk is managed and does not prevent the attainment of the Project objectives.
The Project	Work required at the Feasibility Study

13.1.2 Risk Analysis objectives

Risk analysis is an essential exercise in the planning and development process of a major public infrastructure project. The objectives of the risk analysis conducted under this mandate are the following:

- Identify, analyze and quantify the risks associated with the project, based on current knowledge at this stage;
- Prepare the risk register : this register will be used as a basis for the preparation of a risk mitigation plan;
- Assess the financial implications and provisions required for the Project (risk reserve);
- Strengthen the ability to meet the project cost and schedule for the next steps.

The risk register prepared at the feasibility study stage can be updated throughout the life cycle of the project, including

- During the project planning phase, the risk register is updated with the most recent information and development.
- The register can then be periodically updated throughout the construction progress as well as during the commissioning of the infrastructure, and throughout the operation phase (including rehabilitation).

13.1.3 Risk management

The risk analysis is an important step of the risk management process which must be implemented in the project management activities. As per good project management practices, it is recommended to complete the following activities:

- Development of risk management strategy at the beginning of the study.
- Generation and maintenance of the risk management plan.
- Scheduling and facilitation of specific risk management activities including technical risk review workshops.
- Development and maintenance of the risk register.
- Identification and tracking of risk mitigation measures to support the acceptable level of risk as defined by the project team.
- Risk management of project change.

13.2 RISK ANALYSIS APPROACH

13.2.1 Methodology

The approach used for the project risk analysis is shown in the figure below. Considering the timeline to complete the risk analysis (from mid January 2023 until the end of February 2023), it was decided to proceed with the quantification of the risks after the risk identification activities (without completing the qualitative risk assessment). To ensure the success of the process, the contribution of the project team experts was also solicited before each workshop to help prepare the content and discussions of each workshop.

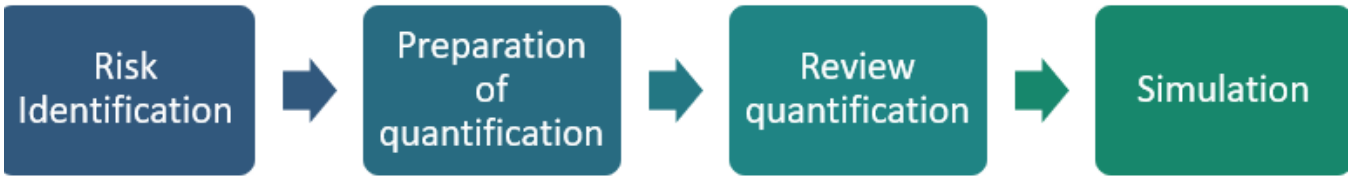

Figure 13-1 : Risk Analysis Approach

13.2.2 Risk Identification

To start the risk identification, a preliminary risk register was developed, and a list of risk categories was proposed to allow a risk categorization. Prior to the first workshop, two informal work sessions were organized on January 16th and January 23rd 2023, with the project team to conduct a preliminary brainstorm on the risk list and confirm the risk families previously identified.

To finalize the risk identification, a formal workshop was held on January 26th and 27th 2023 to confirm and formalize the risk list with the entire project team and representatives from the client.

The retained risk categories are listed below:

- Planning
- Social
- Site
- Environment
- Design
- Construction
- Operations, maintenance, and rehabilitation during the entire operation period
- Operations and maintenance during commissioning
- Finance
- Legal
- Other risks.

The operation, maintenance and rehabilitation risk category were divided into two different categories to make a distinction between the operation and maintenance risk occurring during the commissioning and beginning of the operation phases from the risks occurring during the 50-year period of operation. It is later considered in this report that the operations and maintenance risks during commissioning are included in the project risks, whereas the operations, maintenance, and rehabilitation risks during the entire operation period are covered by a distinct risk reserve.

13.2.2.1 Quantification Preparation

Following the first workshop, the risk register was finalized with the help of the core project team. It was then asked to the disciplines leads to conduct a first assessment of the risk quantification for the categories that were assigned to them. The team members were also asked to identify the mitigation measure suggested for each risk.

This exercise was conducted between the end of the first workshop and the second workshop and aimed to start the quantification process within each technical team. It was asked to the team to assess the likelihood of the risk as well as the minimum, most likely and maximum impact.

13.2.2.2 Qualitative Risk Analysis

The second workshop was held on February 9th and 10th 2023. The purpose of this workshop was to confirm the baseline project cost estimates, monetary impacts, and risk occurrence probabilities that will be used to quantify project risks:

- The basic costs used to calculate:
- Monetary impacts related to the occurrence of risks : these cost bases include, for example, design and construction costs, the cost of relocating public utilities, land acquisition costs and other costs.
- Time impacts related to the occurrence of risks : these cost bases include, for example, the monthly costs of a delay in the planning and design phase or the monthly costs of a delay in the construction phase.
- The probability of occurrence of risks, between 0% and 100%;
- Monetary impacts related to the occurrence of risks, i.e., the additional costs that could be incurred beyond the contingencies (% of the basic costs) : minimum impact, most likely impact and maximum impact. These monetary impacts are assessed after risk mitigation measures are taken into account.

In summary, the project risks are quantified using the following formula:

Cost of risk = Base cost * Likelihood of occurrence of risk * Impact of risk

13.2.2.3 Finalization or the quantification

As the quantification couldn't be completed during the second workshop, additional meetings were held with the core project team to finalize the quantification (between the 10th and the 24th of February). The objective of these work sessions was to ensure the uniformity of the quantification of all the risks and make sure the risk reserve amount is in phase with the development stage of the project.

To ensure the risk reserve is calculated in nominal dollars to comply with the financial model developed by the project team, all the cost bases were converted in nominal dollars using the inflation assumptions from the project financial model.

Finally, the quantification of delays was finalized. The project team members identified some delay impacts for several risks during the workshops. In order to quantify the delay and avoid double counting of delays that could occur simultaneously, it was decided to only quantify in an additional risk, the impact of inflation on the CAPEX if the most important delay associated with the risks were to occur. The cost basis was then established based on the CAPEX and the inflation assumptions from the financial model developed by the project team

13.2.3 Simulation

The final step of the risk quantification process involves a risk modelling using Monte Carlo analysis. Once the risk quantification inputs are completed for each risk in the risk register, a Monte Carlo simulation was modelled with the probability of occurrence and a cost impact distribution (e.g., a triangular distribution of low, most likely, and high values).

A Monte Carlo simulation was performed for all risks using multiple iterations (e.g., 10,000 iterations) with each iteration producing a different total risk value. The values from all iterations were summarized in the form of a distribution pattern.

In order to produce a conservative outcome, the Monte Carlo simulation was run indicating the risk outputs at the 80th percentile. This means that there is an approximate 20% probability of exceeding this project risk reserve and an approximate 80% probability that the project risk reserve will be sufficient to cover the risks, if they were to materialize.

It was decided to retain this level of confidence (80^{e} percentile) as it would allow for a sufficient risk reserve in case some of the risks identified in the register would materialize. The use of conservative approach in estimating the risk reserve is common among large complex infrastructure development projects. In addition, the 80% figure was determined based on the progress of the project. As the project is in very early planning stage, this confident level also takes into account the uncertainties and unknown project elements that have not been considered at this stage.

In addition, a correlation coefficient of 0.4 was applied to the Monte Carlo simulation to reflect the fact that risks are not independent from each other (for example, the quality of project management may limit or increase the occurrence of several risks). The correlation coefficient does not impact the expected value of risks, it rather affects the potential total cost variability due to risks (upper and lower range of costs associated to risks).

The risk register compiling all the information gathered during the different workshops and meetings, as well as the risk quantification is provided in Appendix A of this report.

13.3 MAIN ASSUMPTIONS

This section outlines the main assumptions made to perform the risk analysis.

13.3.1 Timeline Used for Risk Quantification

The project schedule key assumptions on which are based on the risk quantification are the same as those presented in the financial analysis in Table 11-2.

13.3.2 Procurement Model

It is considered for the purpose of the risk analysis that the project is being delivered under a **design-bid-build** (DBB) procurement mode.

DBB is a traditional method of project delivery in the construction industry that involves three main phases:

1. First, the client hires professionals (architect and engineers) to design the project and develop the tech and specifications.
2. Once the design is complete, the owner invites bids from different contractors to build the project. The owner selects the bidder based on predetermined criteria such as the price, experiences, and qualifications.
3. Once the contract is awarded, the construction begins. The contractor is responsible for building the project according to the design and specifications and the contract's terms and conditions.

It is important to note that the delivery mode will be chosen following the delivery mode analysis to be completed during the upcoming phases of the project. The risk analysis will have to be updated for this analysis taking into consideration the different procurement model being assessed.

13.4 SUMMARY OF RESULTS OF THE RISK ANALYSIS

13.4.1 Risk Reserve

The table below presents the two risk reserves, after the Monte Carlo simulation, in nominal dollars. As mentioned in section 13.3.1, the long-term operation and maintenance risk reserve is presented separately from the project risk reserve as it covers a 50-year operation period.

Table 13-2: Project risk reserve

Type of risk	Risk Reserve (Nominal $M)
Project capital risks	942
Long-term operation and maintenance risks	5.4

Risk reserve with a correlation factor of 0.4 and a confidence level of 80% (in millions of nominal dollars)

The project risk reserve includes the risks associated with the planning, design, and construction (including commissioning) phases of the project. Therefore, the Project capital risk reserve includes the risk of all the risk categories, except the category for long-term operation and maintenance.

13.4.2 Project Capital Risks

This section presents the details of the project capital risks presented in the Table 13-2.

13.4.2.1 Risk Allocations Between Categories

The table below presents the risk allocation per category, which gives an idea of how the risk reserve is distributed between the different risk categories.

Table 13-3: Risk allocation per category

Risk Category	% of the risk reserve
Planning	5%
Social	4%
Site	4%
Environment	7%
Design	11%
Construction	39%
Operation and maintenance – commissioning	7%
Financial	3%
Legal	5%
Other (Pre-construction delay risks)	15%
Total	100%

The construction category represents a significant portion of the risk reserve as it includes the risk for the lack of competition in the procurement process for the construction, resulting in higher bids and increase in the project. costs.

13.4.2.2 CAPEX, contingencies and risk reserve

The table below provides a summary of the capital costs, contingencies, and project risk reserve for the project.

Table 13-4: Project capital costs, contingencies, and risk reserve

SUMMARY OF COSTS (in millions of nominal dollars)	
Capital costs of the project	4,891
Contingency (20% of Capital costs of the project)	978.2
Project capital risks reserve	942
Total project costs	
% of contingency / Project capital costs	20%
% of project risks reserve / capital costs	19%
% of Contingency and Project Risks Reserve / Capital Costs	39%

The risk reserve obtained following the analysis represents 19% of the estimated CAPEX. This proportion is considered consistent with the level of progress of the project (pre-feasibility study stage).

13.4.2.3 Major Project Capital Risks

The Table 13-5 presents the five most important capital risks of the project.

Table 13-5: Major project risks

Risk ID	Description	Quantification (in millions of nominal dollars)
CON-12	Lack of competition from suppliers / Lack of bidding	311
AUT-01	Pre-construction delay risks	153
CEP-01	Significant changes to project specifications by the client and stakeholders	107
CON-01	Unavailability of construction raw materials (steel, aggregates, concrete, glass, gasoline, etc.)	38
ENV-04	Identification of new environmental constraints (including contaminated lands).	35

Based on the discussions during the workshops, it appears consistent that these risks come out as the most important for the project, based on its nature, the associated constraints as well as the context in which it is being developed (social and economical).

13.4.3 Long-term Operation & Maintenance Risks

13.4.3.1 OPEX, Contingency and Risk Reserve

The Table 13-6 provides a summary of the operation and maintenance costs, contingency, and long-term O&M risk reserve.

Table 13-6: Project operating costs, contingencies, and risk reserve

SUMMARY OF COSTS (in millions of nominal dollars)	Annual average in nominal $M
Operation and maintenance costs (OPEX)	55.8
Contingency (20% of OPEX)	11.2
Long-term operation and maintenance risks reserve	5.4
% of contingency / OPEX	20%
% of project risks reserve / OPEX	10%
% of Contingency and Project Risks Reserve / OPEX	30%

Considering the project stage and the fact that the operation and maintenance risk reserve were calculated over the 50-year operation period, the proportion of the risk reserve appears consistent with the annual operating costs.

13.4.3.2 Long-term Operation and Maintenance risks

The table below presents the two risks for long-term operation and maintenance.

Table 13-7: Long-term Operation and maintenance risks

Risk ID	Description	Quantification (in millions of nominal dollars)
EER-01	Change in users' requirements during the operating period	32%
EER-02	Change in the attractiveness of the infrastructure for freight and passenger users compared to the existing need	68%

13.5 NEXT STEPS

As mentioned previously in the report, the risk management activities must be defined and carried out by the project team. Following this risk analysis, here are suggestions of next steps to be completed by the project team:

- The risk reserve estimated must be added to the project's budget and taken into consideration in the project's financial analysis.
- Considering that the identification of the mitigation measures could not be completed, it would be required to finalize the exercise of identification of the mitigation measure, determine the budget associated as well as the people responsible for those actions.
- Once the mitigation measures are identified, the people responsible within the project team will have to implement the associated actions. Those actions should be included in the project activities to ensure a proper follow-up on them.
- Finally, it will be important for the project team to plan for the next risk management activities, including maintenance and update of the risk register and next risk analysis workshops at key project milestones.

14. CONCLUSION

This volume deals with economic, financial and risk aspects of LGA infrastructure program. On the one hand, the study presents efficiency evaluation including the benefit cost analysis, the financing structure and results, and the risk quantification. On the other hand, aspects dealing with economic development include the economic impact assessment, the employment opportunities and training requirements and wider economic benefits.

The ***benefit cost analysis*** measures the desirability of a project, intervention, or policy from the society's efficient perspective. With the basic parameters (project duration of 30 years, real social discount rate of 2.37%, benefit unit values indexed from MTMD, constant 2023$), the base case generates a negative net present value of -$1.8 billion and a benefit/cost ratio of 0.58 for Phase I railways. Thus, the collective present value of benefits accumulated over the 30-year period does not outweigh the present value of costs. Consequently, the railway infrastructure does not appear to be recommendable under the social efficiency criteria. The present value of $3.4 billion in capital expenditure for both railway lines represents 83% of the present value of all quantified costs since the discounted value of OPEX over the period sums up to $0.7 billion. As the present value of the initial CAPEX takes a share of 94% of the present value of capital expenditure group (initial CAPEX, sustaining capital, pollution during works), the initial CAPEX is a key element affecting the economic efficiency of the infrastructure program.

The total benefit amounts to a present value of $1.5 billion on both railway lines. Globally, the reduction in transportation costs (fuel, vehicle, shipping, time) explains for the largest share of the benefits ($1.2 billion or 80%) while the present value of the improvement in transport safety is more than $0.2 billion, and that of the reduction in pollutants and GHG $0.1 billion. All these benefits are directly related to the freight forecast. The present value of the residual values of infrastructure at the end of the period is equal at 22% of the present value of initial CAPEX.

The sensitivity analysis showed that no variation in a single factor allows for positive results. The best results correspond to a negative net present value of -$0.9 billion when the initial CAPEX is less by 30%, $-1.3 billion using a low real social discount rate of 1% instead of 2.37%, -$1.3 billion with the optimistic freight volume forecast (43% more than for the realistic traffic assumption or base case). In those cases, the benefit/cost ratio lies in a bracket of 0.60-0.66 for the BDHR and 0.82-0.85 for the GCR. Under the basic parameters, the freight traffic needs to be more than the double (+136%) of the realistic traffic and revenue forecast. This means that unless the demand is quite more substantial than the near future vision tends to show, the railway component of LGA infrastructure program cannot be considered as economic or socially efficient.

The present economic value of road costs amounts to $1.3 billion, from which $0.8 billion to the Route du Nord and $0.5 billion for the access roads. This cost comes almost entirely from construction since net operation costs appear marginal.

The ***financial analysis*** aims at assessing the profitability of the commercial operation of rail infrastructure and service as well as the financing mechanisms including public funding or other conditions that would support the financial viability of the activity. The analysis is based on an entity that is responsible to build, manage, and operate the infrastructure and the train service. This entity would build the new railway asset and then is assumed to manage maintenance, life cycle investments, and operation of the railway infrastructure, charge fares to passengers and tariffs to freight shippers, give access to railway operators or provide the train services and consequently maintain and sustain the rolling stock.

The financial model is based on a 30-year appraisal period, a discount rate of 6.15% in nominal terms and an inflation rate of 2%. The project net present value of the railways is -$4.3 billion (-$2.8 billion for the BDHR and -$1.5 billion for the GCR). Both railway lines are thus not profitable. Total revenues compensate only 10% of total

costs, with 12% of costs associated with operational costs and 88% are construction costs. Traffic revenue does not even compensate for all operating costs, only at 86%. In the case of passengers, the revenue only compensates for 9% of operating costs, not accounting for access charges. This ratio is similar to that of VIA Rail in remote locations.

Different scenarios were analyzed to determine the funding targets to obtain the reimbursement of equity for a given equity internal rate of return of 12%. To reach self-financing of the operating costs, the combined optimization of operations and higher rates that can offset the 14% gap, given that the demand can absorb this increase of rates, needs to be studied. Otherwise, if the rates and the OPEX structure remain the same, the additional annual revenue would need to be $9.4 million (nominal average) from traffic or subsidy. The investment grant required for a 90% debt financing at 6.15% and an IRR of 12%, still with an additional annual revenue of $107.6 million is estimated at $2.7 billion. With no debt financing, the grant required is higher at $3.9 billion.

Sensitivity tests concluded that there were no significant impacts when varying the revenues and operational costs, given the small proportion of the total NPV these represent. Further to this, the results suggested that for both projects, to reach a project NPV of zero, the revenues would be required to be around 10 times the value estimated by market forecasts, under base conditions, which could be re-evaluated. A decrease in capital costs has larger impacts to the profitability of the project.

Different ***institutional and funding structures*** may be chosen for the railway project. The infrastructure/service may be completely public or completely private. The structure may take different forms of vertical integration (infrastructure owner may operate service or be different from the operator) and of horizontal integration (infrastructure and/or service by the CN for example). The BOOT model involves a private entity designing, building, and operating the railway infrastructure for a set period, after which ownership is transferred to the government or other public entity. The PPP model involves a partnership between the government or public entity and a private entity, with both parties sharing the risks and rewards of the project. The Concession model involves a private entity being granted a concession to operate the railway infrastructure for a set period. The Joint Venture model involves two or more entities collaborating to design, build, and operate the railway infrastructure. A public funding model for a railway infrastructure company involves the government or a public entity providing financial support for the development, maintenance, and expansion of the railway infrastructure.

The Canadian Infrastructure Bank (CIB) could serve as an example for a public funding strategy. The CIB is a federal government-owned financial institution investing in infrastructure projects that involve private sector partners, are financially viable (with sufficient revenue to cover operating costs and repay loans or investments made by the CIB and its private sector partners) and provide economic and social benefits (including job creation, environmental benefits, and improved quality of life).

Given the forecasted demand, it may be difficult to finance the railway project in Eeyou Istchee Baie-James. Additional mining sites are needed to secure sufficient transportation demand to generate enough revenues to make the project financially viable. Under those conditions, the public funding model could be the most suitable for a railway in Eeyou Istchee Baie-James. This model would allow the government or a public entity to provide financial support for the development, maintenance, and expansion of the railway infrastructure. The Cree Nation could also be involved in the ownership and operation of the rail, as this would align with the public interest criteria of the Canadian Infrastructure Bank. Additionally, the mining sector could provide equity in the railway, which would help to attract private sector investment and potentially increase the viability of the project. However, it is important to conduct a rigorous due diligence process to assess in more details and in view of optimization, the specific market, the financial viability, the socio-economic impacts, and the feasibility of the project before moving forward with any funding strategy.

The ***risks*** were analyzed for the entire Phase I, including road and railway infrastructure. Their qualification and quantification were determined during workshops, compiled in a risk register, and introduced into a Monte Carlo simulation to estimate the mean global risk from multiple mix of various values for each specific risk. The risk reserve was estimated at $948 million (19% of CAPEX before contingency), mostly during design and construction (11% and 39% respectively) or because of delays (15%). The three major risks (lack of competition, delay before works, changes in specifications) generate a mean value of $571 million, or 11.7% in extra of the reference CAPEX. The operation and maintenance risk reserve were estimated at 8%. These proportions are considered consistent with the level of progress of the project (pre-feasibility study stage).

In terms of ***economic impact***, the construction of road and rail components of LGA Phase I, for a CAPEX of $4.5 billion, shall create, or support the employment of 28,300 years-persons in Québec, for a value of wages before taxes of $1.6 billion (equal to 35% of CAPEX) over the five-year period. The value added at basic prices amounts to $2.9 billion (66% of CAPEX), by adding to the wages the other income, mainly corporate profits ($1.4 billion). The imports are important with a value of $2.1 billion (47% of CAPEX). Government revenue totals to $690 million (15% of CAPEX), mainly from tax on wages and incidental revenue from the workforce. Direct effects account for half of the economic impact, indirect effects for a third, and induced effects for 16%.

The annual operating expenses for the two railway lines of approximately $44.6 million shall generate impacts every year on the Québec economy. The total employment created or supported is estimated at 375 person-years every year. The value-added amounts to $38.4 million and imports to $17.0 million. Wages before taxes are equivalent to $30.4 million and the additional revenue for governments to $12.3 million every year.

The regional impact of the construction and operation of railways and roads considered in Phase I should be important in view of the large share of possible local works, the intensity of the workforce required during both construction and operation periods, the provisions of the JBNQA and of CCQ regulation, the experience of Cree companies and communities in major construction projects and, the commitment of the CNG and the CDC towards the Grande Alliance infrastructure program as a tool for economic development of the Cree communities. The size of these railway and road projects shall require a lot of humans, physical, and organizational resources during construction, beyond regional capability. The construction schedule would enhance the likelihood of maximizing the Cree participation in terms of employment and procurement. The railway management and operation by the Cree, as well as their participation to road maintenance, are objectives to aim at. The Innu-Naskapi operation of Transport ferroviaire Tshituetin (TFT) is an experience that would be useful to the Cree.

The construction and the operation of the railways and roads included in Phase I of LGA will provide important ***employment opportunities*** for the Cree youth and adults. The construction will require hundreds of workers while the rail operation requires more than 200 employees.

Training should commence as soon as possible to accelerate the integration of Cree individuals into railway construction and operation. Some of the training will require long-term education and hands-on experience, which should continue even after operations begin. Succession plans, which are typically part of regional organizations, can be incorporated into the project setup. Normal operations with training new personnel after rotation. The long-term training would take place in the years leading up to the beginning of the project to ensure that there is enough qualified Cree labour to cover the workforce requirements for both the construction and operating phases. The OMOT will take place in the months leading up to the beginning of railway operations and it will prepare staff for their duties on the railways.

Partnerships are required to ensure a proper training and mobilization of human resources among the Cree communities. The experience involving educational institutions in partnership with Cree communities, notably with

the Cree School Board, Apatissiiwin Skills Development, the Cégep de Saint-Félicien, UQAT and others, as well as Transport Ferroviaire Tshiuetin's experience in First nations' railway operating over the last 20 years, should serve as a model to plan and provide training and support to Cree workers.

The proposed next steps as relating to the project opportunities and training include: Meetings and presentations with the GACIOs to obtain their views and recommendations; formation of a committee which will oversee LGA training initiative; specification of job requirements in development of a training plan; establishment of collaborative relationships with educational institutions and other partners; adaptation of the training plan based on recommendations from Cree community representatives and key educational partners; adaptation of the project delivery to maximize Cree involvement; Initiate discussions, between LGA program and the Cree communities, on the various agreements which should be put in place.

The ***wider economic benefits*** that can be brought LGA new railways and roads in Eeyou Istchee Baie-James to Cree communities include: more efficient and safer infrastructure; increased access to workplaces and services, as well as to resources and markets; reduced transportation costs; increased social and economic activity allowed by improved accessibility and better efficiency; job creation during the construction and operation of the railway lines and roads and in related industries, and in overall increase economic activity; increase in income resulting from the enhanced regional economy; reduced trucking movements and improvement in quality of life for residents, making communities more attractive places; improvement in community infrastructure and engagement.

Business and employment opportunities may be made possible or more likely with improved access and regional roads or with the train service. These wider benefits could include: new tourism attractions or services, notably along with COTA/TBJ tourism development planning, as tourist circuits declining many themes, or tourist/service nodes for example at the Waskaganish Junction or Waswanipi station; the development of Cree forestry activity and territorial knowledge in a comprehensive approach considering the preservation of the environment, the transmittal of the Cree culture, more responsive to local population needs, and the development of outside markets; the consolidation of mining projects and their likelihood to get realized, in a proper way and to maximize the adaptation and participation of the Cree workforce in these activities; the training and transmittal of knowledge and know-how for wildlife protection officers and assistants, park rangers and guardians, research field assistants, guides, tourism, craft persons, salespeople, machinery operators, drivers, mining, engineering.

The extension of the road up north to Whapmagoostui and of the R167 to the Trans-taiga Road, as well as the improvement road access and of the Route du Nord, shall facilitate the access to the traplines for those who hunt and fish, especially those who benefit from the Economic Social Program. The beneficiaries of this program are mostly among the group of youths and elderly people. These infrastructure elements shall thus enhance the inclusion of these age groups and less rich people.

In addition to contribute to improve the access to employment locations, the improvement of the road network, especially the access road and the RDN would allow for easier exchanges with other Cree communities. More especially, the new hospital centre and a possibly collegial studies centre in Chisasibi would be regional service centres more accessible to the members of other Cree communities and consequently contribute to a higher use of these installations and more education opportunities to the Cree.

The economic analysis of LGA transportation infrastructure program showed that the capital costs are major and make difficult the financial viability and the economic justification of realizing the projects. Meanwhile, the socio-economic benefits may be important.

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APPENDICES

APPENDIX A – WORKFORCE CHARACTERISTICS, CREE AND JAMESIAN COMMUNITIES, 2021

Cree Communities

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Reference population (age 15+)	325	525	2,675	1,670	570	630	1,110	3,430	690	**11,625**
Employed	175	290	1,510	805	370	385	645	1,900	430	**6,510**
Unemployed	15	15	100	100	30	45	55	165	35	**560**
Inactive	140	225	1,060	760	170	205	405	1,360	230	**4,555**
Participation rate	57%	56%	60%	55%	70%	68%	62.6%	60%	67%	**61%**
Employment rate	54%	55%	56%	48%	65%	61%	58.1%	55%	62%	**56%**
Unemployment rate	8%	5%	6%	11%	8%	11%	7.9%	8%	8%	**8%**
Status										
Reference population (age 15+)	325	525	2,675	1,670	565	630	1,110	3,430	690	**11,620**
Did not work	145	210	1,035	660	160	190	425	1,470	210	**4,505**
Worked full year full time	140	235	1,055	565	255	285	385	1,260	315	**4,495**
Worked part year and/or part time	40	75	585	450	150	160	295	700	165	**2,620**
(%)										
Did not work	45%	40%	39%	40%	28%	30%	38%	43%	30%	**39%**
Worked full year full time	43%	45%	39%	34%	45%	45%	35%	37%	46%	**39%**
Worked part year and/or part time	12%	14%	22%	27%	27%	25%	27%	20%	24%	**23%**

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Education										
Reference population (age 25-64)	210	340	1,780	1,110	395	430	760	2,210	480	**7,715**
No high school diploma	75	110	765	410	135	105	235	1,010	180	**3,025**
With high school diploma	55	60	215	180	60	75	150	260	100	**1,155**
Trade school diploma or trade apprentice	90	170	800	525	195	245	375	940	205	**3,545**
University undergraduate	10	25	160	65	20	30	65	120	45	**540**
University graduate (including medicine)		10	30				10	40		**90**
PhD			10					10		**20**
(%)										
No high school diploma	36%	32%	43%	37%	34%	24%	31%	46%	38%	**39%**
With high school diploma	26%	18%	12%	16%	15%	17%	20%	12%	21%	**15%**
Trade school diploma or trade apprentice	43%	50%	45%	47%	49%	57%	49%	43%	43%	**46%**
University undergraduate	5%	7%	9%	6%	5%	7%	9%	5%	9%	**7%**
University graduate (including medicine)	0%	3%	2%				1%	2%		**1%**
PhD			1%					1%		

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Major field of study										
Reference population (age 15+)	325	525	2,675	1,670	565	630	1,110	3,430	690	**11,620**
Education	10	20	100	75	25	35	50	115	20	**450**
Visual and performing arts, and communications technologies			10					15		**25**
Humanities	10	15	45	35		15	20	75	10	**225**
Social and behavioural sciences and law	15	25	150	70	15	40	70	150	45	**580**
Business, management and public administration	15	50	190	105	50	40	60	240	70	**820**
Physical and life sciences and technologies			25	10				10		**45**
Mathematics, computer and information sciences			25				10	20	10	**65**
Architecture, engineering, and related trades	15	40	125	120	35	55	100	220	30	**740**
Engineering			10					10		**20**
Engineering/engineering-related technologies/technicians		10	30	20	10	10	10	40		**130**
Mechanic and repair technologies/technicians		10	25	20	10		20	45	10	**140**
Precision production		10	10	10			10	15		**55**
Construction trades	10	15	60	65	20	40	60	110	25	**405**
Architecture and related services										
Historic preservation and conservation										
Agriculture, natural resources and conservation	10	10	20	10	10	10		15		**85**
Health and related fields	15	15	95	45	20	30	35	120	10	**385**
Personal, protective and transportation services	10	35	110	105	50	65	60	160	35	**630**
Other										
(%)										
Education	3%	4%	4%	5%	4%	6%	5%	3%	3%	**4%**
Visual and performing arts, and communications technologies										
Humanities	3%	3%	2%	2%		2%	2%	2%	1%	**2%**
Social and behavioural sciences and law	5%	5%	6%	4%	3%	6%	6%	4%	7%	**5%**
Business, management and public administration	5%	2.37%	7%	6%	9%	6%	5%	7%	2.37%	**7%**

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Physical and life sciences and technologies			1%	1%						
Mathematics, computer and information sciences			1%				1%	1%	1%	**1%**
Architecture, engineering, and related trades	5%	8%	5%	7%	6%	9%	9%	6%	4%	**6%**
Engineering										**0%**
Engineering/engineering-related technologies/technicians			1%	1%	2%	2%	1%	1%		**1%**
Mechanic and repair technologies/technicians		2%	1%	1%	2%		2%	1%	1%	**1%**
Precision production		2%		1%			1%			
Construction trades	3%	3%	2%	4%	4%	6%	5%	3%	4%	**3%**
Architecture and related services										
Historic preservation and conservation										
Agriculture, natural resources and conservation	3%	2%	1%	1%	2%	2%				**1%**
Health and related fields	5%	3%	4%	3%	4%	5%	3%	4%	1%	**3%**
Personal, protective and transportation services	3%	7%	4%	6%	9%	5%	5%	5%	5%	**5%**
Other										

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Profession										
Reference population (age 15+)	185	300	1,610	910	395	425	695	2,065	465	**7,050**
Legislative and senior management occupations		10	10	15	10	10	10	15	10	**90**
Business, finance and administration occupations	25	65	290	135	90	75	125	365	35	**1,205**
Natural and applied sciences and related occupations		10	35	15	10	10	15	35	10	**140**
Health occupations		10	95	25	10	15	15	120	20	**310**
Education, law and social, community and government services	50	80	425	235	115	120	160	405	155	**1,745**
Art, culture, recreation and sport	10	30	65	25	10	20	20	50	20	**250**
Sales and service occupations	35	45	360	240	85	90	170	515	115	**1,655**
Trades, transport and equipment operators and related occupations	35	40	245	135	60	65	135	355	80	**1,150**
Natural resources, agriculture and related production occupations	15	10	50	45	10		15	140		**285**
Manufacturing and utilities			20	15	10	10	15	15		**85**
(%)										
Legislative and senior management occupations		3%	1%	2%	3%	2%	1%	1%	2%	**1%**
Business, finance and administration occupations	14%	22%	18%	15%	23%	18%	18%	18%	8%	**17%**
Natural and applied sciences and related occupations		3%	2%	2%	3%	2%	2%	2%	2%	**2%**
Health occupations		3%	6%	3%	3%	4%	2%	6%	4%	**4%**
Education, law and social, community and government services	27%	27%	26%	26%	29%	28%	23%	20%	33%	**25%**
Art, culture, recreation and sport	5%	10%	4%	3%	3%	5%	3%	2%	4%	**4%**
Sales and service occupations	19%	15%	22%	26%	22%	21%	25%	25%	25%	**23%**
Trades, transport and equipment operators and related occupations	19%	13%	15%	15%	15%	15%	19%	17%	17%	**16%**
Natural resources, agriculture and related production occupations	8%	3%	3%	5%	3%		2%	7%		**4%**
Manufacturing and utilities			1%	2%	3%	2%	2%	1%		**1%**

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Sector										
Reference population (age 15+)	185	300	1,610	910	395	425	695	2,065	465	**7,050**
Agriculture, forestry, fishing and hunting			30	35			15	140		**220**
Mining, quarrying, and oil and gas extraction	10	15	55	10	10		15	25		**140**
Utilities			20	10		10	10	20		**70**
Construction	15	10	90	55	15	20	45	190	20	**460**
Manufacturing			15					10		**25**
Wholesale trade								15		**15**
Retail trade	10	10	105	60	15	20	40	175	40	**475**
Transportation and warehousing			25	10	10	10	10	30	15	**110**
Information and cultural industries			20	10		10	10	25	10	**85**
Finance and insurance				10	10					**20**
Real estate and rental and leasing	10		30	10			10	10	10	**80**
Professional, scientific and technical services	10		25	10	10		20	25	10	**110**
Management of companies and enterprises			10							**10**
Administrative and support, waste management and remediation services	10		35	15		30	45	50	15	**200**
Educational services	20	35	240	155	50	70	105	270	40	**985**
Health care and social assistance	45	70	440	190	85	95	150	565	125	**1,765**
Arts, entertainment and recreation	10	20	25		10	20	25	30	15	**155**
Accommodation and food services		10	65	45	15	15	40	90	20	**300**
Other services (except public administration)		10	35	15	15	10	15	25	15	**140**
Public administration	45	100	325	250	155	100	145	315	125	**1,560**
(%)										
Agriculture, forestry, fishing and hunting			2%	4%			2%	7%		**3%**
Mining, quarrying, and oil and gas extraction	5%	5%	3%	1%	3%		2%	1%		**2%**

	Waswanipi	Oujé-Bougoumou	Mistissini	Waska-ganish	Nemaska	Eastmain	Wemindji	Chisasibi	Whapma-goostui	Cree
Utilities			1%	1%		2%	1%	1%		**1%**
Construction	8%	3%	6%	6%	4%	5%	7%	9%	4%	**7%**
Manufacturing			1%					1%		
Wholesale trade								1%		
Retail trade	5%	3%	7%	7%	4%	5%	6%	9%	9%	**7%**
Transportation and warehousing			2%	1%	3%	2%	1%	2%	3%	**2%**
Information and cultural industries			1%	1%		2%	1%	1%	2%	**1%**
Finance and insurance				1%	3%					
Real estate and rental and leasing	5%		2%	1%			1%	1%	2%	**1%**
Professional, scientific and technical services	5%		2%	1%	3%		3%	1%	2%	**2%**
Management of companies and enterprises			1%							
Administrative and support, waste management and remediation services	5%		2%	2%		7%	7%	2%	3%	**3%**
Educational services	11%	12%	15%	17%	13%	17%	15%	13%	9%	**14%**
Health care and social assistance	24%	23%	27%	21%	22%	22%	22%	27%	27%	**25%**
Arts, entertainment and recreation	5%	7%	2%		3%	5%	4%	2%	3%	**2%**
Accommodation and food services		3%	4%	5%	4%	4%	6%	4%	4%	**4%**
Other services (except public administration)		3%	2%	2%	4%	2%	2%	1%	3%	**2%**
Public administration	24%	33%	20%	28%	39%	24%	21%	15%	27%	**22%**

Jamesian Communities

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Reference population (age 15+)	1,740	1,150	1,130	5,805	2,005	**11,830**
Employed	1,075	680	685	3,870	1,060	**7,370**
Unemployed	40	35	40	150	85	**350**
Inactive	630	430	410	1,790	855	**4,115**
Participation rate	64%	63%	64%	69%	57%	**65%**
Employment rate	62%	59%	61%	67%	53%	**62%**
Unemployment rate	4%	5%	6%	4%	7%	**5%**
Status						
Reference population (age 15+)	1,740	1,150	1,130	5,805	2,005	**11,830**
Did not work	540	385	390	1,580	805	**3,700**
Worked full year full time	700	390	395	2,355	745	**4,585**
Worked part year and/or part time	500	380	350	1,870	455	**3,555**
(%)						
Did not work	31%	34%	35%	27%	40%	**31%**
Worked full year full time	40%	34%	35%	41%	37%	**39%**
Worked part year and/or part time	29%	33%	31%	32%	23%	**30%**

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Education						
Reference population (age 25-64)	1,215	695	775	3,920	1,300	**7,905**
No high school diploma	185	105	220	535	410	**1,455**
With high school diploma	170	125	125	605	270	**1,295**
Trade school diploma or trade apprentice	860	470	425	2,780	620	**5,155**
University undergraduate	100	75	25	465	55	**720**
University graduate (including medicine)	40	30		175		**245**
PhD					10	**10**
(%)						
No high school diploma	15%	15%	28%	14%	32%	**18%**
With high school diploma	14%	18%	16%	15%	21%	**16%**
Trade school diploma or trade apprentice	71%	68%	55%	71%	48%	**65%**
University undergraduate	8%	11%	3%	12%	4%	**9%**
University graduate (including medicine)	3%	4%	0%	5%	0%	**3%**
PhD	0%	0%	0%	0%	1%	**0%**

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Major field of study						
Reference population (age 15+)	1,740	1,150	1,130	5,805	2,005	**11,830**
Education	50	45	25	235	80	**435**
Visual and performing arts, and communications technologies	10	10		70	10	**100**
Humanities	30	10		75	40	**155**
Social and behavioural sciences and law	40	50	35	200	65	**390**
Business, management and public administration	135	115	70	615	115	**1,050**
Physical and life sciences and technologies	35	10		115	10	**170**
Mathematics, computer and information sciences	15			70	15	**100**
Architecture, engineering, and related trades	435	195	215	1,000	260	**2,105**
Engineering	25	10		75		**110**
Engineering/engineering-related technologies/technicians	125	95	70	320	70	**680**
Mechanic and repair technologies/technicians	175	50	65	270	90	**650**
Precision production	45	15	50	140	40	**290**
Construction trades	60	25	25	190	45	**345**
Architecture and related services					10	**10**
Historic preservation and conservation						
Agriculture, natural resources and conservation	65	10	15	150	25	**265**
Health and related fields	110	80	90	525	60	**865**
Personal, protective and transportation services	135	60	70	345	105	**715**
Other						
(%)						
Education	3%	4%	2%	4%	4%	**4%**
Visual and performing arts, and communications technologies	1%	1%		1%	1%	**1%**
Humanities	2%	1%		1%	2%	**1%**
Social and behavioural sciences and law	2%	4%	3%	3%	3%	**3%**
Business, management and public administration	8%	10%	6%	11%	6%	**9%**
Physical and life sciences and technologies	2%	1%		2%	1%	**1%**

Mathematics, computer and information sciences	1%			1%	1%	**1%**
Architecture, engineering, and related trades	25%	17%	19%	17%	13%	**18%**
Engineering	1%	1%		1%		**1%**
Engineering/engineering-related technologies/technicians	7%	8%	6%	6%	4%	**6%**
Mechanic and repair technologies/technicians	10%	4%	6%	5%	5%	**5%**
Precision production	3%	1%	4%	2%	2%	**2%**
Construction trades	3%	2%	2%	3%	2%	**3%**
Architecture and related services					1%	
Historic preservation and conservation						
Agriculture, natural resources and conservation	4%	1%	1%	3%	1%	**2%**
Health and related fields	6%	7%	8%	9%	3%	**7%**
Personal, protective and transportation services	8%	5%	6%	6%	5%	**6%**
Other						

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Profession						
Reference population (age 15+)	1,110	720	720	4,015	1,150	**7,715**
Legislative and senior management occupations		15		30	30	**75**
Business, finance and administration occupations	100	100	100	580	145	**1,025**
Natural and applied sciences and related occupations	100	30	15	265	25	**435**
Health occupations	55	50	30	410	55	**600**
Education, law and social, community and government services	155	105	60	515	240	**1,075**
Art, culture, recreation and sport	30	10		95	15	**150**
Sales and service occupations	210	165	195	875	265	**1,710**
Trades, transport and equipment operators and related occupations	295	140	145	825	240	**1,645**
Natural resources, agriculture and related production occupations	45	70	30	145	110	**400**
Manufacturing and utilities	110	40	125	250	20	**545**
(%)						
Legislative and senior management occupations		2%		1%	3%	**1%**
Business, finance and administration occupations	9%	14%	14%	14%	13%	**13%**
Natural and applied sciences and related occupations	9%	4%	2%	7%	2%	**6%**
Health occupations	5%	7%	4%	10%	5%	**8%**
Education, law and social, community and government services	14%	15%	8%	13%	21%	**14%**
Art, culture, recreation and sport	3%	1%		2%	1%	**2%**
Sales and service occupations	19%	23%	27%	22%	23%	**22%**
Trades, transport and equipment operators and related occupations	27%	19%	20%	21%	21%	**21%**
Natural resources, agriculture and related production occupations	4%	10%	4%	4%	10%	**5%**
Manufacturing and utilities	10%	6%	17%	6%	2%	**7%**

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Sector						
Reference population (age 15+)	1,110	720	720	4,015	1,150	**7,715**
Agriculture, forestry, fishing and hunting	40	15	25	65	40	**185**
Mining, quarrying, and oil and gas extraction	70	170	60	245	150	**695**
Utilities	20		30	100	10	**160**
Construction	55	25	30	185	55	**350**
Manufacturing	215	45	165	615	15	**1,055**
Wholesale trade	25			50		**75**
Retail trade	95	115	90	470	75	**845**
Transportation and warehousing	50		40	105	45	**240**
Information and cultural industries	10			30	10	**50**
Finance and insurance	15	10		80	10	**115**
Real estate and rental and leasing	10			30	10	**50**
Professional, scientific and technical services	35	10	15	145	30	**235**
Management of companies and enterprises						
Administrative and support, waste management and remediation services	30	15	15	100	35	**195**
Educational services	65	45	20	255	130	**515**
Health care and social assistance	155	105	90	755	185	**1,290**
Arts, entertainment and recreation				80	10	**90**
Accommodation and food services	30	25	60	225	40	**380**
Other services (except public administration)	65	35	20	160	55	**335**
Public administration	125	75	40	275	235	**750**
(%)						
Agriculture, forestry, fishing and hunting	4%	2%	4%	2%	4%	**2%**
Mining, quarrying, and oil and gas extraction	6%	24%	8%	6%	13%	**9%**
Utilities	2%		4%	3%	1%	**2%**
Construction	5%	4%	4%	5%	5%	**5%**
Manufacturing	19%	6%	23%	15%	1%	**14%**
Wholesale trade	2%			1%		**1%**
Retail trade	9%	16%	13%	12%	7%	**11%**
Transportation and warehousing	5%		6%	3%	4%	**3%**
Information and cultural industries	1%			1%	1%	**1%**
Finance and insurance	1%	1%		2%	1%	**1%**

	Lebel-sur-Quévillon	Matagami	Chapais	Chibougamau	Eeyou Istchee Baie-James	Jamesians
Real estate and rental and leasing	1%			1%	1%	**1%**
Professional, scientific and technical services	3%	1%	2%	4%	3%	**3%**
Management of companies and enterprises						
Administrative and support, waste management and remediation services	3%	2%	2%	3%	3%	**3%**
Educational services	6%	6%	3%	6%	11%	**7%**
Health care and social assistance	14%	15%	13%	19%	16%	**17%**
Arts, entertainment and recreation				2%	1%	**1%**
Accommodation and food services	3%	4%	8%	6%	4%	**5%**
Other services (except public administration)	6%	5%	3%	4%	5%	**4%**
Public administration	11%	10%	6%	7%	20%	**10%**

APPENDIX B – RISK REGISTER

Identification		Description		Quantitative analysis									
						Monetary impact				Temporal impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Monetary impact Min	Monetary impact Most likely	Monetary impact Max	Cost Base (nominal $ / month)	Temporal Impact Min	Temporal Impact Most likely	Temporal Impact Max	Monte Carlo Output
I. Planning													
PLA-01	Project approvals delayed due to budget constraints	_ Delays in project approval by certain levels of government _ Delay in drafting of the bill (involvement of several departments required; not all legislative aspects allow work to begin in 2030) _ Need for multiple business cases	_ Project completion will be delayed (months, years) _ Delay in issuing the various deliverables for the project (Future agreement between parties) _ Risk estimate: Evaluation of costs per month of delay (e. g., variable costs of agents, professional fees, etc.)	50%	$22,080,000	75.0%	100.0%	125.0%					$12,523,568
PLA-02	Agreement on project scope and prioritization of phases	_ Large scale project _ Large number of project stakeholders with sometimes divergent interests. _ Funding from multiple sources _ Long term project (political leadership could change)	_ Choosing between diff obj of the project. _ Abandonment/Consolidation of certain phases of the project (prioritization) _Framework reshuffled	30%	$22,080,000	75.0%	100.0%	125.0%					$7,514,141
PLA-03	CN may abandon Matagami and Chapais subdivisions	_ The closure of the Matagami mine has reduced traffic on CN's Matagami and Chapais subdivisions, making it very loss-making. Lithium shipments to the Matagami Transshipment Centre could ensure the continuation of this subdivision. _ Segment no longer maintained by CN	_ In the event of the closure of the Matagami Subdivision, it will have to be re-commissioned in order for the BDH rail line project to be completed. _ Additional costs _ Addition to the scope _ Additional time to complete	10.0%	$110,400,000	50.0%	100.0%	150.0%					$14,007,136
PLA-04	Unavailability to get the agreement signed with the different stakeholders and communities	_ Multitude of communities affected/involved in the project _ Sometimes divergent views on the scope of the project. _ Divergent priorities between Quebec and the Crees regarding the access road versus the regional corridors. _Local corridors seen as external by QC. _ Divergent interest between QC and the communities from the region (Crees and Jamesians)	_ Difficulty in establishing the definition of the project. _ Revision of the scope of the project _ Delay in approval phases. _ Additional costs	30%	$22,080,000	75.0%	150.0%	300.0%					$16,001,464

Identification		Description		Quantitative analysis									Monte Carlo Output
				Monetary impact					Temporal impact				
						Monetary impact				Temporal Impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Min	Most likely	Max	Cost Base (nominal $ / month)	Min	Most likely	Max	
PLA-05	Agreement with stakeholders to be authorized to build on public lands: (forestry companies, CN, Ministry)	_ The agreements must me negotiated with multiple Cree communities. and include the compensation mechanism for uses that could be lost _Specially for the Grevet-Chapais line. Busiest part of the territory (lack of available space). _ The agreement will include the groomers (cottage owners) which are sometimes difficult to deal with.	_ Delay in approval phases. _ Additional costs	10%	$552,000	80.0%	100.0%	120.0%					$61,134
II. Social													
SOC-01	Compensations (impacts)	_ The Cree are expecting a lot when it comes to land compensation or compensation for camps and land use features (vision «Like for Like plus»). _ Complexity of drawing the line for compensation _ Difficulty of dealing with Cottage owners for compensations. Since they have chosen their cottage site for the natural setting, calm and peace, nuisances from a train (noise, dust, vibration, visual aesthetics, safety issues) will be perceived as significant impacts. _ Depends on who is the promoter of the project (promoter from outside would be less willing to compensate)	_ Loss of trust toward the project from the local communities. _ Potential contestation _ Delay for approval _ Additional costs for compensation	50%	$33,120,000	50.0%	100.0%	150.0%					$21,010,705
SOC-02	Ownership structure (operations)	_ Very sensitive and complex issue	_ Loss of trust toward the project from the local communities. _ Potential contestation _ Delay for approval	50%	$1,104,000	50.0%	100.0%	150.0%					$700,357

Identification		Description		Quantitative analysis									
				Monetary impact					Temporal impact				
						Monetary impact				Temporal Impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Min	Most likely	Max	Cost Base (nominal $ / month)	Min	Most likely	Max	Monte Carlo Output
SOC-03	General social acceptability of the project	_The Cree Nation will need some time to analyze the infrastructure program and its potential impacts. 1- there is a possibility that there is no consensus around some infrastructure. 2- there is a possibility that the model of development will be questioned: opening the territory with new infrastructures will be facilitating the extractivist industry _The Jamesians will need some time to analyze the infrastructure program and its potential impacts. There is a possibility that there is no consensus around some infrastructure. _ Civil society from outside the region try to impose their vision on the development of the project _ Environmental NGO slowing down the project considering the environmental sensitivity of certain areas crossed by the project. _ No enough economic spinoffs during construction for the local communities	_ Opposition to the different infrastructure projects _ Delays caused by additional work to justify the project and activities to build consensus. _ Potential additional costs.	50%	$7,728,000	100.0%	200.0%	500.0%					$15,116,624
III. Site													
SIT-01	CN Easements (Grevet-Chapais corridor)	_ Land owned by CN _ Lack of information about the land-owner creating uncertainty about the true owner of the corridor.	_ Delay in obtaining agreements / authorizations for land use and delay in schedule _ Additional costs if additional steps required	60%	$3,312,000	25.0%	100.0%	150.0%					$2,456,045
SIT-02	Relocation of infrastructure for the Grevet-Chapais corridor and coordination of the stakeholders involved in the road portion of the project.	_Interface between the alignment and existing roads (including the snowmobile trail on Grevet-Chapais) - former rail line now used by snowmobiles and forestry road. _ Land Use Conflict _ Multiple stakeholders regarding existing roads (owner, manager, etc .): MTQ, Hydro Québec, SDBJ, MRNF _ Many entities involved and interested in maintaining these roads. _ Expectations with regards to contracts. _Strong leadership within the Crees needed.	_ Scope of the relocation of the route could change. _ Additional costs _ Additional delays.	60%	$55,200,000	50.0%	100.0%	125.0%					$36,521,913
SIT-03	Slowness of the land tenure approval process (Billy-Diamond corridor)	_ Complexity of process and slowness of negotiations _ Experiences on other similar projects	_ Delays in completing the project. _ Additional costs	25%	$110,400	400.0%	800.0%	1200.0%					$280,143

Identification		Description		Quantitative analysis									Monte Carlo Output
				Monetary impact					Temporal impact				
						Monetary impact				Temporal Impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Min	Most likely	Max	Cost Base (nominal $ / month)	Min	Most likely	Max	
IV. Environment													
ENV-01	Project approvals delayed due to environmental constraints	_ Delays in project approval by certain levels of government due to negotiation of project conditions _ Conditions of authorizations resulting in additional costs	_ Risk that project completion will be delayed (months, years) _ Increase in project costs	40%	$22,080,000	75.0%	100.0%	150.0%					$11,527,762
ENV-02	Compensation for wetland losses	_ Financial compensation or compensation work for wetland and water losses _ Experience in mining projects where compensation has been requested.	_ Increase in project costs _ Increase in deadlines if clearing projects must be submitted and approved	75%	$26,496,000	50.0%	100.0%	150.0%					$25,212,845
ENV-03	Identification of new environmental constraints (including contaminated lands).	_ Changes required to the project following the identification of new environmental constraints (e.g. species with status, currently confidential protected area) during the subsequent planning stages (impact study) or during construction. _ Possibility that the project crosses a protected area (lands reserved by the Taliman for protection against development, wildlife refuges, protected areas under negotiation between the Cree Nation and the Quebec government) _ Discovery of elements / sites related to archaeology _ Discovery of contaminated land (including Grevet-Chapais)	_ Change project costs (re-route, adapt project to what is discovered). _ Stop work in the area of the discovery and discuss with government authorities if discovered during construction	50%	$55,200,000	50.0%	100.0%	150.0%					$35,017,841
ENV-04	Archelogy: Level of precision of the assessment	_Level of precision of the predictive model will keep evolving. (not yet fully tested) _Limit of the sampling program _Inability to reach 100% knowledge	Mitigation _Protocols are clear and established in collaboration with the communities. _ Assessment to be done Impacts _Delays during the construction phase										$0
ENV-05	Archeology: Timing of the impact assessment	_Impact assessment stage has to be done in advance in case archeological sites are discovered. _Has to be done during the summer _Permitting with the ministry and approval can be long	Mitigation _Collaboration with the communities to develop the impact assessment _Adapted contract with the contractor Impacts _ Additional costs and delays										$0
V. Design / Technical													

Identification		Description		Quantitative analysis									
						Monetary impact				Temporal impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Monetary impact Min	Monetary impact Most likely	Monetary impact Max	Cost Base (nominal $ / month)	Temporal Impact Min	Temporal Impact Most likely	Temporal Impact Max	Monte Carlo Output
CEP-01	Significant changes to project specifications by client and stakeholder	_Significant changes in the technical characteristics, definition or performance expected by the client during the design phase that significantly impact project costs (excluding uncertainties related to geotechnical and bathymetric data) _ Changes desired by the Tallyman in relation to noise pollution, _ Existing infrastructure reused to limit the project's impact on the environment and on the territory	_Modification of the route: additional costs and delays _ Reduced activities, revised costs, timelines, approval times and new professional studies _ Depending on the timing, could impact the approvals _ trust toward the project from the SH _ Risk estimate: Assessment of costs to revise work already done, additional professional fees, consultations to be carried out and impact on the schedule (e. g.: variable costs of professional fees, slowing down costs that could affect the project and cause a delay, etc.)	20%	$331,200,000	50.0%	100.0%	200.0%					$106,676,426
CEP-02	Geotechnical risks for structures and track	_ Non-exhaustiveness of geotechnical investigations carried out to date (peat, soils and others) _ Limited information available. _ Limited level of precision of investigations to date	_ Change in the choice of technical solutions; _ Additional costs and delays	40%	$11,040,000	50.0%	100.0%	200.0%					$7,111,762
VI. Construction													
CON-01	Unavailability of construction raw materials (steel, aggregates, concrete, glass, gasoline, etc .)	_ Local and international economic context for raw materials _ Experience with projects in progress disrupted by raw material supply issues. _ Significant volume of aggregate required for road refection and culverts rehabilitation	_ Risk of delays or cost overruns that could affect project commissioning _ Risk estimate: Expediting and deadline impact fees to be paid by the Supplier (s) to compensate for delays, customer claims for delay, claims by certain agents and subcontractors, etc.	20%	$147,000,000	75.0%	100.0%	150.0%					$38,373,663
CON-02	Railway construction materials not available	_ Existence of quarries in operation and threat of closure of some of them _ Project in remote locations _ Limited availability of this type of material in Quebec.	_ Lack of borrowed material (compactable material) lack of aggregate (MG56, Ballast ...) _ Additional costs and delays	40%	$28,909,333	75.0%	100.0%	150.0%					$15,093,293
CON-03	Unavailability of track equipment, rolling stock and maintenance equipment (O&M equipment)	_ Global Economic Environment and Supply Chain Disruption _ Dependence on international markets for certain elements _ Experienced delays on other rail projects.	_ Failure to put lines into service; _ Lack of operating revenue; _ Cost and time	30%	$1,294,000	300.0%	600.0%	1200.0%					$3,751,068

Identification		Description		Quantitative analysis									
						Monetary impact				Temporal impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Monetary impact			Cost Base (nominal $ / month)	Temporal Impact			Monte Carlo Output
						Min	Most likely	Max		Min	Most likely	Max	
CON-04	Buried cables breakage (telecom, fibre optics)	_ Lack of information on existing cable systems for the Grevet-Chapais corridor _ Lack of information for community access roads	_ Unscheduled emergency response _ Delays and additional costs	10%	$1,294,000	50.0%	100.0%	200.0%					$208,393
CON-05	Training and availability of manpower for the project.	_ Project in remote areas _ Generalized scarcity of qualified local labour in Quebec _ Overheated construction market _ Competition with the mining industry attracting manpower (versus a temporary project).	_ Delay in project completion. _ Additional costs to mobilize labour from other regions.	20%					$1,294,000.00	4 months	8 months	12 months	$2,626,846
CON-06	Unavailability of trucks and construction equipment	_ Large scale project _ Limited capacity for local businesses and suppliers	_ Delays in completing the project _ Additional costs to procure equipment from other regions of Quebec.	20%					$6,125,000.00	3 months	6 months	12 months	$11,836,832
CON-07	Poor work execution	_ Limited skilled labour _ Partial monitoring of the work _ Poor interpretation of plans and specifications	_ Additional costs and delays	20%					$6,125,000.00	3 months	6 months	12 months	$11,836,832
CON-08	Upgrade of the CN subdivisions (Matagami and Chapais)	_ Potential increase of 1 MtPA on the CN subdivisions due to the project _ CN might ask for financial compensation if the upgrade is required due to higher use of the corridor	_ Additional scope to the project to upgrade the CN corridor _ Additional costs _ Additional delays.	1%	$15,704,800	50.0%	100.0%	150.0%					$199,257
CON-09	Campsite for workers during the construction period are not appropriatly located.	_ Large scale project _ Limited local housing.	_ Additional costs. _ Social acceptance issues.	10%	$20,416,667	50.0%	100.0%	150.0%					$2,590,390
CON-10	Schedule doesn't take into consideration all constraints from limited access to the land during certain periods.	_ Existing of breaks when the lands can't be accessed (ex: moose and goose breaks). _ Possibility that some of these breaks were not taken into consideration.	_ Work stoppage _ Additional costs	1%					$6,125,000.00	2 months	4 months	12 months	$564,308
CON-11	Lack of competition from suppliers / Lack of bidding	_ High number of projects in Quebec and Canada _ Project in remote areas _ Regional economic impact requirements _ Due to the scope of the work phases, there are potentially few contractors in Quebec capable of bidding on LGA projects. _ Lot of uncertainties with stakeholders.	_ This results in a revision of the terms of the contract and / or a resumption of the process _ Risk estimate: Re-engagement costs, increased client involvement in financing, evaluation of late costs (e. g., variable costs of agents, professional fees, etc.)	50%	$4,900,000,000	5.0%	10.0%	15.0%					$310,846,776
VII. Operation and maintenance													
Operation and maintenance - Long term													

Identification		Description		Quantitative analysis									Monte Carlo Output
				Monetary impact					Temporal impact				
						Monetary impact				Temporal Impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Min	Most likely	Max	Cost Base (nominal $ / month)	Min	Most likely	Max	
EER-01	Change in users requirements during the operating period	_ Changes to performance specifications for maintenance (e.g., frequency), operation (e.g., addition) or rehabilitation (e.g., deficiencies) are requested _ Possibility that the frequency of passenger trains will be increased.	_ Revision of operating, maintenance and rehabilitation costs _ Risk estimate: Maintenance example: claims and additional costs of Suppliers and agents over the period (e.g., housekeeping, sweeping, snow removal) Example in operation: management fees, specialized equipment Rehabilitation example: management fees, plans and specifications, call for tenders, costs of work, subsequent adjustments in operations and maintenance, etc.	20%	$4,000,000,000	5%	10%	20%					$90,185,384
EER-02	Change in the attractiveness of the infrastructure for freight and passenger users compared to the existing need	_ Some project characteristics may favour or discourage users' use of the infrastructure. _ Users can increase or diversify their production / shipping / traveling based on the new possibilities offered by the infrastructure. _ Change in the acceptability thresholds for infrastructure usage rates. _ Economic factors that may affect demand	_ Decrease in traffic if project not adapted to user needs _ Increase in operating costs and revenues if the project is adapted to user needs _ Increased ridership and revenue if potential users take advantage of new development opportunities brought about by the project	50%	$194,000,000	-575%	-100%	452%					$190,849,886
Operation and maintenance - Commissioning													
EER-03	Defective components causing disruption of service, additional maintenance and sustaining capital.	_ Experience on previous projects. _ Possibility of default within the components.	_Short term additional maintenance costs _ Dispute and litigations _ Derailment (potentially leading to environmental and safety issues) _ Additional sustaining capital to replace the equipment. _ Delays _ Loss of revenue	30%	$147,000,000	50.00%	100.00%	200.00%					$71,020,990
EER-04	Inappropriate maintenance causing disruption of service and major accidents	_ Railway not maintained to its track class.	_Short term additional maintenance costs _ Derailment (potentially leading to environmental and safety issues) _ Additional sustaining capital to replace the equipment. _ Delays _ Loss of revenue	1%									$0

Identification		Description		Quantitative analysis									
						Monetary impact				Temporal impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Monetary impact Min	Monetary impact Most likely	Monetary impact Max	Cost Base (nominal $ / month)	Temporal Impact Min	Temporal Impact Most likely	Temporal Impact Max	Monte Carlo Output
EER-05	Training and Availability of Workforce for the Operation Phase	_ Site in remote areas _ Scarcity of qualified local labour / high turnover _ Complexity of scheduling and performing effective training _ Difficult work conditions _ Loss of interest from the new generations for the construction industry	_ Failed operations leading to service interruptions loss of revenue	5%					$1,078,333.33	2 months	3 months	6 months	$264,848
EER-06	Original terms for operation are no longer respected by the operator	_ Ownership structure during the operation phase. _ Parameter changes that were not initially agreed	_ Failed operations leading to service interruptions loss of revenue	5%					$1,078,333.33	2 months	3 months	6 months	$264,848
EER-07	Loss of social acceptability during the operation phase.	_Operator doesn't respect the agreed term for operations _ No economic spinoffs for the Cree communities.	Potential blockage of the tracks and loss of revenue	5%					$1,078,333.33	2 months	3 months	6 months	$264,848
VIII. Finance													
FIN-03	Change in interest rates (higher than what's planed) due to extraordinary increase of CPI	_ Inflationary economic context _ Monetary policy _ Remoteness causing extra premium _ CPI exceeds financial assumptions due to adverse market conditions	_ This results in an increase or decrease in project financial costs for the client _ Risk estimate: Increase or decrease in interest rates in the financial model, whether or not to add a premium for change in interest rates in the reference rates used in the Case File (e.g.: Bankers' acceptance rate (CDOR) increase, long-term rate increase (RQ10, GoC), etc.)	20%	$1,050,000,000	5.00%	10.00%	15.00%					$26,644,009
FIN-04	Change in foreign exchange rates	_ Uncertain economic context _ Financial volatility in the global political environment	_ Increase or decrease in price of imported materials, products and / or services _ Risk estimate: Additional or lower cost to acquire imported goods and services (e.g., equipment from the U.S., etc.)	10%	$313,000,000	10.0%	20.0%	30.0%					$7,942,452
IX. Legal													
LEG-01	Disagreements between parties on the interpretation of contractual clauses leading to claims, disputes during the design / construction phase	In the customer's opinion, the Supplier or Suppliers fail to perform their obligations as agreed in the contract and the customer after several warnings.	_ This situation leads to work stoppages, claims on both sides and even a return to tender _ Risk estimate: Costs of delays, events not covered by bondspersons, claims, legal fees and re-processing (e.g. variable costs of agents, professional fees, etc.)	75%	$12,190,000	50.0%	100.0%	150.0%					$11,599,660

Identification		Description		Quantitative analysis									Monte Carlo Output
				Monetary impact						Temporal impact			
						Monetary impact				Temporal Impact			
Ref.	Name	Causes	Consequences	Probability	Cost (nominal $)	Min	Most likely	Max	Cost Base (nominal $ / month)	Min	Most likely	Max	
LEG-02	Land acquisitions and noise mitigation	_ Construction BD and GC Railways requires purchase of land inside and near the ROW _ Differences in interpretation in regards to Cree rights on cat 3 lands : Government of Quebec and Cree communities have different interpretations (JBNQA)	_ Additional cost to purchase the lands. _ Doesn't take the compensations into consideration	90%	$35,160,000	50.0%	100.0%	150.0%					$40,148,716
LEG-04	Application of chap 28 : Level of preferential for **cree** companies and workers.	_ Contractors need their RBQ License and Bonding requirements. _ Change in the definition of a Cree Company (becoming more restrictive).	_ Delays. _ Additional costs (fees)	5%									$0
LEG-05	Supplier Defaults, Loss of Licenses, Condemnations and Extraordinary Situations	In the construction phase, the customer recognizes that the Supplier(s) can no longer fulfill their obligations due to legal events (bankruptcy, loss of licenses, litigation, convictions, etc.)	_ Despite the use of sureties, this situation leads to a work stoppage and even a return to a call for tenders _ Risk estimation: costs of delays, events not covered by the bondspersons and redoing the process, evaluation of costs of delay (e. g., variable costs of agents, professional fees, etc.)	5%					$121,900.00	4 months	8 months	12 months	$61,865
X. Other risks													
AUT-02	Pre-construction delay risks	_ Any delay event that can be materialized before the construction commencement. For example: - Project approvals delay - Disagreement on project scope and prioritization of phases - Land acquisition - Issues associated with general social acceptability of the project -Disagreement between stakeholders - Environmental constraints	_ Delays of scheduled construction commencement _Escalation of project cost due to delay	40%					$8,166,666.67	12 months	24 months	60 months	$153,357,060
Project Capital Risks Total													$1,021,236,819
Project Long Term Operation and maintenance Risks Total													$281,035,270

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