IMPACT ECONOMICS

Economic Assessment of Grays Bay Road and Port Project

Technical Report for Nunavut Resources Corporation

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Summary

The Grays Bay Road and Port Project (GBRP) is a transportation system that will connect the Slave Geological Province to arctic tidewater. It consists of a 227 km all-season road from the Tibbitt-Contwoyto Winter Road to a deep-water port at Grays Bay on the Northwest Passage.

Key project details and the results from an assessment of the project's economic effects include:

- The total cost of construction has been estimated at $527 million dollars and will require an estimated 2 ½ years to build.
- It is estimated that the Project will create 2,250 full-time equivalent[1] (FTE) jobs in Nunavut when factoring all direct, indirect, and induced effects, equal to an average of 900 FTE jobs annually during construction.
- The project will contribute $189.5 million to Nunavut's GDP.
- Governments could generate as much as $85 million in tax revenues from the construction activities.

The Project's purpose is to open up the Kitikmeot region to mineral exploration and development. The largest known mineral deposits in the region are at Izok Lake and High Lake. These zinc-copper properties contain an indicated resource worth more than US$10 billion at today's prices. If developed, these properties would have a significant effect on the region's economy.

Assuming a feasible mine plan can be developed and using prudent assumptions for construction and operating costs, commodity prices, and exchange rates, the effects of the $2 billion mining project could include:

- Creation of 1,260 FTE jobs in Nunavut annually for three years during construction and 1,400 FTE jobs each year for 11 years during operations.
- Mine construction would raise GDP in Canada by $1.5 billion while the mineral production would add $7.5 billion to GDP.
- Mining operations could contribute as much as $665 million to government revenues through resource royalties, corporate tax, and personal income tax, and substantially more if the estimates were to include revenues from indirect taxes on goods and services and fuel, land taxes, import duties, and licensing, as well as Nunavut's 2% payroll tax.

Additionally, the road and port could become an important transportation route for mines operating in the NWT, while the port is expected to attract the interest of other users for such things as community resupply, marine safety, security, and tourism. While more difficult to quantify in terms of economic growth and job growth, these other uses would improve the quality of life and industrial opportunities through reduced costs and improved transportation efficiencies.

[1] One full-time equivalent job is equal to one person working full time for an entire year. This one FTE job can be comprised of several people working part-time, where their collective effort equals one job. Furthermore, should an employee work overtime, their contribution would be greater than one FTE job. All results for employment in this report are given in FTEs.

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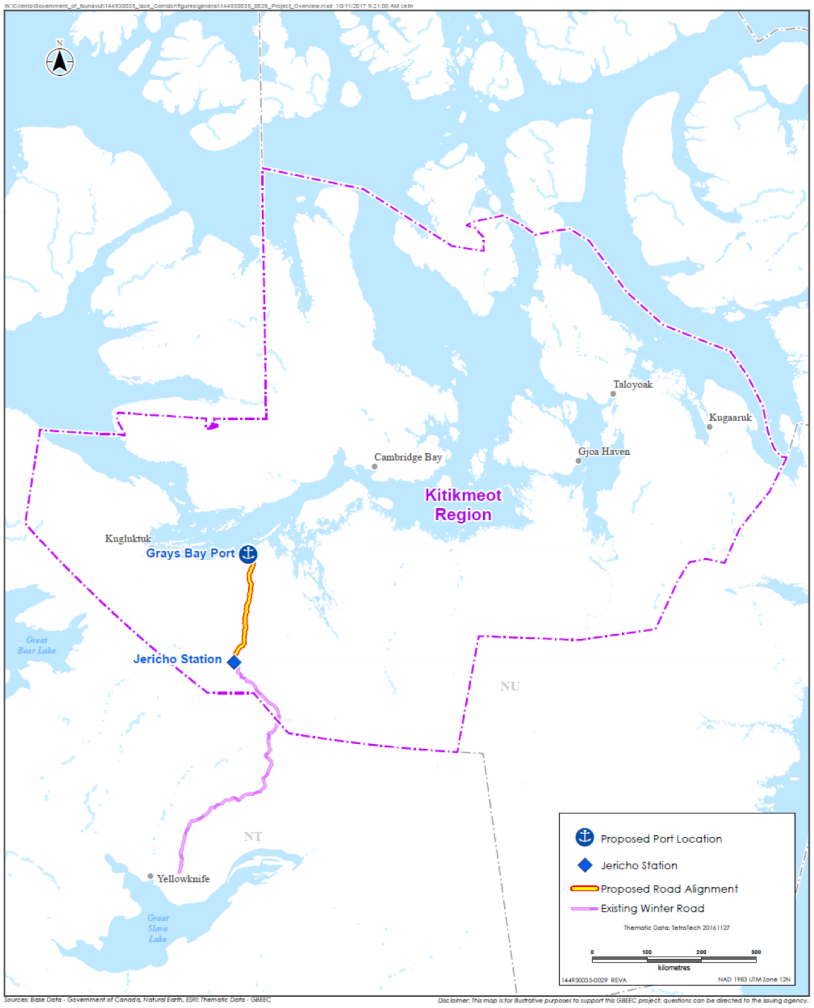
Introduction

The Grays Bay Road and Port Project (GBRP) is a transportation system that will connect the Slave Geological Province to arctic tidewater. It consists of a 227 km all-season road from the Tibbitt-Contwoyto Winter Road to a deep-water port at Grays Bay on the Northwest Passage.

The Government of Nunavut and the Kitikmeot Inuit Association believe that the GBPR is a "transformational project of national significance that will help to define northern economic development throughout the 21st century."

Mineral interests in the Slave Geologic Province have studied the feasibility of the road and port for several decades in connection with potential mineral developments. The conclusion has always been the same; that the cost of this infrastructure is too high without public support to be included in the capital cost of the mining development. As a result, several known mineral deposits have been effectively stranded. This has had a number of implications, the most damaging being an absence of private sector growth in the Kitikmeot economy that has left the region with high rates of unemployment, food insecurity, and poverty, with the only project to advance in recent years being one that is situated adjacent to the arctic coast.

The GN and KIA believe there is a national interest in building this infrastructure. It would be the first overland transportation route to link southern Canada with a deep-water port in the Arctic. Its construction would rejuvenate interest in exploration and mineral development in the Slave Geologic Province. The port would facilitate efficiencies in community resupply and marine transportation more generally. And, its strategic location would offer opportunities for Canada to exercise its sovereignty claim to the High Arctic and provide a measure of safety and security to the region and to the Northwest Passage.



There are three parts to this report. The first includes a description of the methodology used in completing the work, including the benefits and limitations of the modelling work completed. Part one also includes a detailed description of the data that were provided by the project proponent.

The second provides an assessment of the economic effects of the infrastructure investment. The GBRP Project would be an important economic activity for Nunavut. It would create thousands of FTE jobs in a region of Canada plagued by high unemployment rates, it would contribute to a significant rise in Nunavut's GDP, and because the majority of goods and services required in building the road and port will be sourced from southern Canada, it will also make an important contribution to the national economy. Most important of all, the investment will put in place a needed piece of infrastructure that will open up the Kitikmeot region for future industrial activity.

The third part to this report provides the results of an investigation into the economic effects of potential industrial users of the road and port; namely, mineral exploration and mining. The primary purpose for mineral exploration is to discover new mineral deposits and assess whether known deposits are valuable enough to attract investments for mine development. The industry is often overlooked for its contribution to the local economy and to employment. Exploration typically offers seasonal work that can be labour intensive for short periods of time. Many Nunavummiut rely on seasonal exploration jobs to supplement other sources of income. This report provides insight into the economic contribution of mineral exploration.

The real prize for the GBRP Project will be mine development. As part of the quantitative investigation, two known deposits at Izok Lake and High Lake were analyzed. These are substantial zinc-copper deposits. Their development would represent a significant change in the Kitikmeot region's economy. And, while the road and port construction does not guarantee this development, by studying it, we can assess the potential return on investment from building the GBRP, and how future industrial development can transform Nunavut's economy and contribute to the nation's Gross Domestic Product.

Methodology and Data Sources

This assessment utilises a methodology based largely on Input-Output modelling, relying on Statistics Canada's *Interprovincial Input-Output Model* as the principal modelling tool. Results were generated from unique simulations of the Input-Output model, calculations based on Supply and Use tables, and economic multipliers—all sourced from Statistics Canada. Other survey data from Statistics Canada is incorporated into the report to help contextualise the modelling results. The Project proponent's engineering team is the primary source for project-specific data, including the road and port construction costs and labour force needs. The economic assessment of Izok Lake and High Lake makes use of publicly available resource data and prudent assumptions on commodity prices, construction and operating costs, exchange rates, and production rates.

Overview of Input-Output Modelling

Input-Output modelling is one of many tools used in economic analysis. These models are best suited when investigating the economic impacts of a change in production, and especially in cases where that change can be thought to occur without significantly altering the structural make-up of an economy.

An input-output model utilises the expenditure patterns from an existing or potential producer to depict the impact those expenditures will have on an economy. This is often described as a "shock minus control" analysis, where the control is defined as the current economy and the shock is the same economy having added or removed the production of a firm or an industry. A shock can be understood as a change in the economy. Adopting this approach allows us to assess the economic value of the GBRP Project; that is, the effects of expenditures associated with the construction of the road and port. We can think of this as an exercise if tracing the movement of money.

Determining the value and location of the thousands of transactions that occur as a result this construction project would be virtually impossible to do manually. Input-Output models perform these calculations through a complex system of resource allocation. The model tracks the value-added component of every round of transactions that occur along the supply chain when a shock or change is introduced to the economy.

In Canada, Statistics Canada builds and maintains the *Inter-provincial Input-Output Model*. In addition to calculating the impacts of a change in Canada's gross domestic product, this model has the added complexity of tracing trade flows between Canada's provinces and territories as well as international imports and exports. In 2003, Statistics Canada built separate models for Nunavut and the Northwest Territories, enabling a better understanding of the economies of these two jurisdictions. It should be noted however that the small size of Nunavut's economy means that there can be a lot of variation year over year in the historical data.

Input-Output models can calculate direct, indirect, and induced effects. Separating one effect from another can be confusing—especially between direct and the first round of indirect effects for major construction projects. It should be noted that the manner in which economists label these effects has no bearing on effected labour or business. Whether a new job is labelled a direct effect because the employee is paid directly by the Project proponent or is labelled an indirect effect because the employee is working for a contractor does not alter the total number of jobs created as a result of the initial investment. This will be important to remember when looking at the results of this assessment.

What is important to understand is that effects are generated from expenditures on goods and services (in this case, the initial expenditures are for the goods and services required to build the GBRP). Direct effects are the value-added components of the production process, and are largely associated with the proponent's cost of labour and capital (depreciation), indirect taxes, and profits (sometimes referred to as "other operating surplus"). The purchase of goods and services by the Project proponent to be used as inputs into the construction process is technically an indirect effect (fuel is a good example), though sometimes these are referred to as direct endogenous effects or the first round of indirect effects because the expenditures are paying for goods and service providers that operate on site and contribute directly to the road and port construction.

Indirect effects are those generated by any expenditures made by the business sector as a result of its need to deliver goods or services to the Project. The majority of indirect effects flow to and then from the manufacturing sector. Once producers of inputs are affected, additional expenditures are triggered as manufacturers purchase goods and services needed for their manufacturing process. This is often referred to as the trickle-down effect and the sum of the value added from all of the additional expenditures is what is referred to as the multiplier effect. Indirect effects are low in Nunavut regardless of the industry being studied because of its limited manufacturing base.

To better understand economic effects and how and where they are recorded, it is helpful to think of an example. The GBRP will require a large volume of fuel. Fuel represents an input cost to the project, sometimes referred to as an intermediate good. It is not capital or labour, and therefore is considered a part of the first round of indirect effects. Fuel is not manufactured in Nunavut. Fuel will be imported from a southern jurisdiction with the transaction traced by the model as interprovincial trade. The only effect recorded in Nunavut will be a small portion of the transportation cost and any wholesale margin if the supplier were based in Nunavut. The remainder of this effect will be recorded in the jurisdiction from which the fuel was manufactured (for simplicity, we can assume the purchase is made directly from a refinery). Buying this fuel depletes the reserves of the supplier. The refiner must then purchase more oil to replace what was just sold. This purchase causes oil producers to increase production, leading to additional economic production in its oil fields. One could imagine that at some point, the additional demand for oil causes a need for new wells and new exploration, which has its own set of expenditures. At some point, the marginal effect of the distant expenditures is so small that the model can no longer measure it. The sum of all of the many rounds of economic activity caused by the original purchase of fuel is referred to as the indirect effect.

The labour income gained or lost from the change in production has an effect on consumer activity, which causes changes in employment, labour income, and profits within consumer-based industries. These economic effects from a change in consumption are called induced effects.

Adding induced effects to an economic assessment brings additional challenges. While accounting for the response of households to a shock, Input-Output models do not do the same for government. Depending on the size and nature of the shock, one can imagine government might respond through different spending or taxation changes. Input-Output models assume such things remain unchanged.

Other complexities arise when someone is working in one jurisdiction, but resides, consumes, and pays taxes in another. This issue is addressed by imposing an assumption on the model regarding the residency of employees. This assumption should not be interpreted politically; that is, it is not necessarily a reflection of agreements signed between the producer and representatives of resident labour regarding any employment targets. Instead, it is an estimate based on historical evidence and/or an assessment of a region's labour market.

Input-Output models are useful for studying impacts of changes in production, but one must be cautious when interpreting the results. Like all models, Input-Output models are predicated on numerous assumptions that alter or influence the results. Therefore, any results should be viewed as approximations and be combined with other knowledge of the firm or industry being studied. Some of the more influential assumptions associated with Input-Output models include:

- Input-Output models are linear, meaning they do not make adjustments for the size, scale, or direction of any change to an economy.
- Input-Output models do not reflect limitations of capital and labour; that is, there are no capacity constraints.
- Input-Output models are static, meaning they are based on an economy as it exists at a single point in time.
- The data used to develop the relationships between industrial sectors are the result of surveys. They must be treated as approximations of actual relationships because an unknown variability is embedded in the mathematics.

With the areas of caution noted, Input-Output models provide a useful starting point for understanding economic effects. They provide reasonable estimates of gross production, gross domestic product, employment and labour income, and indirect taxes.

Summary of Assessment Data

GBRP Construction Project

The Project's engineers provided the data used in this assessment that was based on their own internal work in combination with previous engineering studies. The data consisted of a detailed list of expenditures on goods and services, including direct labour. The goods and services data were further separated by the location of the seller in order to facilitate an assessment of interprovincial trade and the Project's effects on the economies of all regions of Canada. The labour data was separated by the expected residency of the workforce based on the experience of Nunavut Resource Corporation and Nuna Logistics working in the Kitikmeot region. This allowed for a more accurate depiction of the indirect and induced effects because the model was able to trace the multiplier effects specific to industry production functions and consumer spending patterns by province.

A summary of the expenditure data by major category is included in the table on the following page. It shows the total project cost is estimated at $527 million. Direct labour costs are the single largest category of expenditure at $96 million. Capital equipment will cost $58 million. General construction goods and services that include fuel, machinery parts, repair services, construction tools and equipment, and various professional services will cost a combined $137 million. Other major input costs include drilling and blasting goods and services, transportation, buildings and equipment, camp services, and specialised construction services dealing with the port facility and bridges.

The estimated cost of goods and services were divided by province and territory. The distribution of expenditures and the assumed residency of the Project's direct labour force are depicted in the figures on the following two pages. A word of caution is warranted. While the Project proponent and their engineers provided this detailed breakdown of expenditures, they remain estimates. This is particularly important for the assumptions involving the residency of labour. It is assumed that Nunavummiut will provide 25% of the direct labour requirements when measured by value. A participation rate higher or lower would change the total size of economic benefits flowing to different jurisdictions. Similarly, should the Project proponent choose a supplier from a different jurisdiction that what used in this

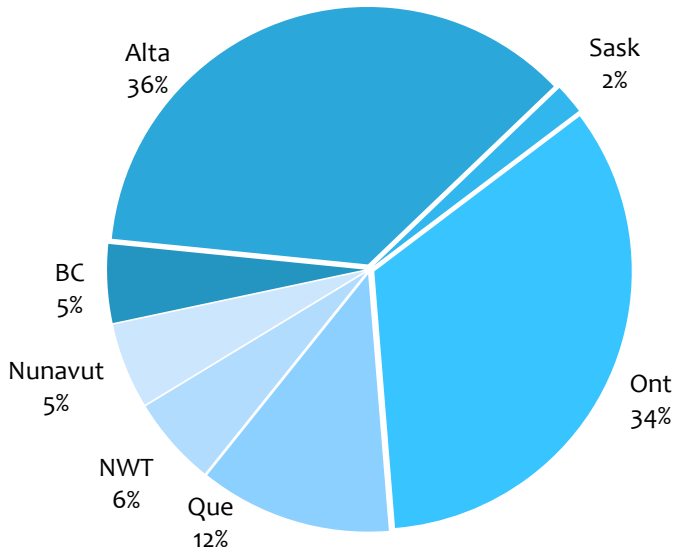
assessment, the distribution of economic effects will shift from one jurisdiction to another. Note that these kinds of changes would not alter the economic impact of the Project from a Canadian perspective, notwithstanding the possibility of different production functions across jurisdictions.

Summary of Construction Cost Estimates

	Expenditure Vector ($)
Direct Labour Cost	96,000,000
Direct Capital Equipment	58,000,000
Construction Goods and Services*	137,000,000
Drilling and Blasting Goods and Services	79,000,000
Transportation Services	37,000,000
Prefabricated Buildings and Equipment	29,000,000
Specialised Bridge Construction	27,000,000
Specialised Marine Construction	18,000,000
Work Camp Services	19,000,000
Other miscellaneous goods and services	26,000,000
Total	527,000,000

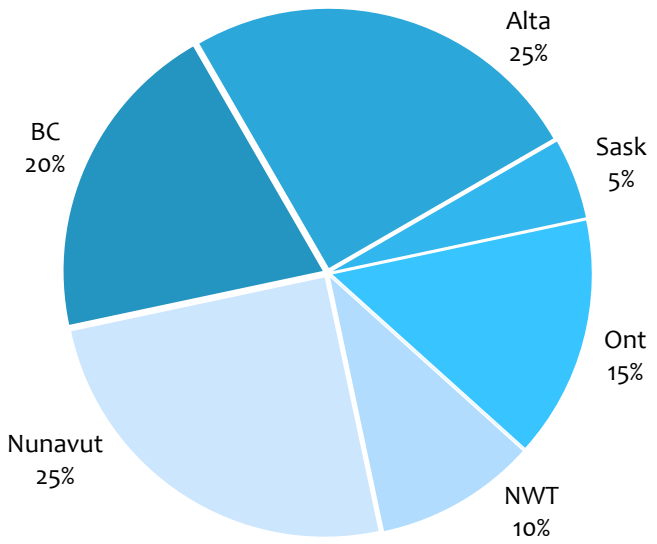
Source: Nuna Logistics
Note: *includes Machinery parts and repair services, fuel and lubricants, fuel storage, construction materials and equipment, other professional services.
Numbers may not add up due to rounding error.

Distribution of Expenditures across Canada, % of dollars spent on goods and services



Source: Nuna Logistics

Distribution of Labour by Residency, % of direct labour by value



Source: Nuna Logistics

Izok Lake and High Lake Mine Development Data

The data used to estimate the economic effects of a mining development were obtained from publicly available sources. The proposed road would connect several known mineral deposits to the port. The largest amongst these is Izok Lake, which is a potential zinc-copper mine with an indicated resource of 13.5 million tonnes at 13.3% zinc and 2.4% copper. Also adjacent to the road is High Lake, which is another zinc-copper deposit with an indicated resource of 7.9 million tonnes at 3.5% zinc and 3% copper. For the purpose of this study, the assessment does not include inferred resources at either property. At today's prices[2]— US$1.50 per pound for zinc and US$3.10 per pound for copper—this resource would be worth more than US$10 billion.

There is no feasible mine plan for these properties at this time. Therefore, key elements of a potential mine plan were assumed based on previously published materials. Below is a list of these assumed numbers:

- A feasible mine plan can be developed resulting in a successful environmental assessment that attracts the required capital investment and that leads to mine development;
- The total capital cost would be $2.0 billion with a 3-year construction phase;
- 20% of capital expenditures and 7% of operational expenditures are directed to imports
- Production would span 11 years and would amount to 95% of the indicated resource assuming commodity prices 20% below current levels and an exchange rate of CDN$1.25 to US$1.00; and,
- Nunavummiut will supply 15% of the construction labour (direct and indirect), 25% of the operations labour (direct and indirect), and 100% of the induced labour within the territory.

[2] As of January 2018.

Description of Economic Modelling and Assumptions

GBRP Construction Project

The assessment of economic effects of the GBRP Project is based on a special simulation of Statistics Canada's commodity-based *Interprovincial Input-Output Model* using expenditure data and labour force estimates supplied by the Project's engineers.

The detailed vector of expenditures on good and services was entered into the model, separating them by commodity and by the province or territory where the purchase would be made. This methodology meant that the first round of indirect effects (the direct endogenous effects) was being constrained based on the input data rather than determined by the model—this causes the purchase of intermediate goods and services to be treated as a direct effect. Had the model been left alone to perform these calculations; that is, if the Project proponent had not known where it would purchase the required inputs, the model would have made those determinations itself. In such cases, the model looks at the jurisdictions within Canada where the commodity is sold. For example, in the case of diesel fuel, the model would find that it is produced in Quebec and Alberta and would choose one or both jurisdictions based on historical trade flows with Nunavut. With the methodology adopted for this study, the proponent is able to tell the model how much diesel they estimate will be purchased from each jurisdiction.[3]

Designating the location of each major purchase clearly affects the jurisdiction in question, but also has a small positive effect on the accuracy of the net economic effect for Canada because the production function in each jurisdiction will be slightly different.

The list of required goods and services also includes items that are not produced in Canada, but these purchases still occur in Canada; that is, the purchases originate in Nunavut but typically flow to a supplier in southern Canada. For example, the Project requires $58 million worth of heavy equipment. By in large, this equipment is not manufactured in Canada. The model knows this because the supply chain associated with heavy equipment suppliers is embedded in the input-output tables. The $58 million purchase from an Ontario supplier (in this case) triggers the importation of equipment. Ontario benefits from any mark-up applied to the wholesale price it pays to cover its own labour, capital, and profits as well as any intermediate goods and services it purchases as a part of its heavy equipment supply business. Ontario's economy benefits further when the labour income earned as a result of the transaction is used to purchase consumer goods and services in the province. For the most part, though, the majority of the $58 million price is transferred to the international manufacturer. This is often referred to as leakage.

The benefit of this methodology is twofold. First, it means the exercise of tracing the flow of money through the economy will more accurately reflect reality. Not only does the money go into the right jurisdiction, but all of the indirect effects that flow from the initial purchase will be calculated based on the production function specific to that region. Second, this methodology greatly improves the accuracy of the induced effects by ensuring the consumer expenditures resulting from the labour income earned reflect the consumer habits of the jurisdiction in which the labour resides.[4]

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[3] Remember that, at this stage of the planning process, designating specific jurisdictions for the purchase of goods and services is an assumption.
[4] In discussing the improved accuracy of results, remember that they are based on estimated expenditure data. The improved accuracy of the adopted methodology is entirely dependent on the accuracy of these input data.

There is one drawback to this approach. As already mentioned, the purchase of intermediate goods and services are essentially being treated as a direct effect; that is, it lumps together the direct effects with some of the activities performed by contractors. This does not undermine the overall results, but it does interfere with the model's ability to determine the trade flows that would otherwise occur. For example, if the Project requires professional services not produced in the Nunavut economy, the model will import that service from another jurisdiction within Canada. The methodology used in this report designates the jurisdiction where those services are purchased, but to do so, the purchase is entered as a direct effect occurring in that jurisdiction rather than in Nunavut, where the service is actually performed. The model results are therefore showing a measure of gross national product, not gross domestic product. To fix that problem, the model results were manipulated by moving activities into the jurisdiction in which they actually occur. Unfortunately, with this methodology, an employee working for a contractor is indistinguishable from one that works for the Project proponent. This hardly matters for the employee, but it can cause some confusion when viewing the results of the model. For instance, the Project proponent estimates it will create approximately 1,000 jobs, but the results show twice that many because they include all the workers employed by contractors.

With this drawback, it is important to note that the composition of economic activities and labour required to build the road and port does not change if the Project proponent chooses to outsource aspects of the work or perform that work itself. For example, if the proponent hires a contractor to complete all of the bridge work needed along the road rather than using its own labour and capital, this does not change the tasks associated with the work. The only difference is the work becomes classified as an indirect effect. Outsourcing can improve efficiencies though. If, in this example, the contractor is a specialist in building bridges, it might do the job faster and/or with less labour—something that would be reflected in the production function of that service provider.

Mineral Exploration in the Kitikmeot Region

A simple approach was adopted for the modelling work associated with the assessment of mineral exploration's contribution to the economies of Nunavut and Canada. The money spent on exploration can provide important jobs and contract opportunities for resident labour and businesses, but there is tremendous variation within this industry depending on the size, scope, and duration of exploration work taking place. As a result, it is not reasonable to adopt an approach similar to that used to assess the GBRP Project. One exploration project is not representative of all others.

Instead, we rely on the collective activities of the industry and assume that the expenditure profile of any future mineral exploration work that occurs as a result of the GBRP infrastructure investment will follow the industry average. This is a prudent assumption because it eliminates the possibility of over- or underestimating the effects—all future activities are assumed to be average. Furthermore, because the assessment is not specific to one known or planned activity, the approach was to describe the effects of a $1 million shock (increase) to the mineral exploration industry. This approach is reliant on the fact that Input-Output models are linear, and therefore, the results of a $1 million shock can be scaled up according to any actual investment in exploration in the future.

The challenge with this approach is selecting the industry that best reflects the typical activities of mineral exploration companies operating in Nunavut. Statistics Canada's *Industry Accounts Division* includes these activities in the industry labelled "Support Activities to Mining". In some jurisdictions in certain years, this industry is heavily influenced by exploration activities, in other cases, mine development work that is not considered a part of mine construction (stripping is one example) can influence the industry's expenditure profile.

In Nunavut's case, both activities are present in the economy. Exploration and deposit appraisal expenditures have averaged close to $200 million per year over the past five years—the fourth highest amount of all jurisdictions in Canada.[5] So we can have some confidence that Support Activities to Mining is representative of exploration expenditures, but must be mindful that there are other influences on the results.

Mining in the Kitikmeot Region

The economic effects of a potential mining industry operating in the Kitikmeot region were calculated from Statistics Canada's input-output multipliers calculated from the Industry Accounts Division *Supply and Use Tables*. These multipliers are used to assess the effects of a change in the output of a given industry. They show the direct, indirect, and induced effects on gross output, GDP, jobs, and imports.

For the purpose of this study, the change in output is defined as the gross output from the zinc-copper production at Izok Lake and High Lake. The industry is Copper, Nickel, Lead, and Zinc Mining.

The challenge with this approach is that Nunavut has not been engaged in mining of this type since the lead-zinc mine at Nanisivik closed in 2002, prior to the separation Nunavut's input-output data from that of the NWT. Without recent historical evidence, intensity ratios for the direct effects were estimated based on published data for the Izok Lake and High Lake mine resources and from assumptions regarding capital costs, depreciation, labour force requirements, and other operating surplus. These estimates were then compared to published intensity ratios for copper, nickel, lead, and zinc mining found in other Canadian jurisdictions. The estimates proved to be reasonable in comparison, with a GDP to gross output ratio of 50% and import's share of output equal to 7%.

Estimating multipliers that capture indirect effects is less complicated because Nunavut's economy does not produce many intermediate goods or services purchased by mine operators. The extent to which Nunavut participates in the mining industry's supply chain can be seen in other mining industries already established, including gold mining in the Kivalliq region and iron mining in the Qikiqtaaluk region. This participation centres on the supply of services including such things as wholesaling, warehousing, logistics, transportation, and accommodation. The supply of capital and consumable goods such as fuel, machinery, parts, and building materials as well as most professional and engineering services are imported from southern Canada or from international markets.

Induced multipliers were based on Nunavut's input-output tables. The multiplier data for the mining sector in general was the starting point, but we could have assumed that the consumer habits of Nunavummiut working in the mining industry are similar to Nunavummiut in general. And, in fact, the historical difference between these two multipliers is negligible.

Establishing reasonable resident labour force participation is far more important in the calculation of induced effects. It is assumed that Nunavummiut will not be in a position to supply 100% of the labour force needs of the mine construction or its operations. In the absence of such an assumption, the model would calculate the induced effects as if 100% of the labour income generated in Nunavut is spent in Nunavut. When a mine is using imported labour, this assumption does not hold. For the purpose of the potential mines at Izok Lake and High Lake being studied, a resident participation rate of 15% during construction and 25% during operations was adopted.

[5] Natural Resources Canada, *Table 27 Exploration and deposit appraisal expenditures, by Province and Territory*. http://sead.nrcan.gc.ca/expl-expl/ExploTable.aspx?FileT=27&Lang=en. Accessed January 28, 2018.

Results from the Economic Assessment

Grays Bay Road and Port Construction Project

It is estimated that the $527 million GBRP project will raise Canada's gross output by $1.15 billion over the planned 2½-year construction period, equal to approximately $416 million annually (at annual rates). Gross output is an important variable to investigate because it shows the effects on business demand in addition to the value-added. Ontario and Alberta will be affected more than any other jurisdiction because the majority of intermediate goods and services will be purchased from these provinces and because of the extensive supply chain that exists in these two economies.

GBRP Project's Effect on Gross Output, $ thousands

	Direct Output	Indirect Output	Induced Output	Total Output	Annual Average*
Nunavut	527,200	3,000	6,700	536,900	214,800
Newfoundland and Labrador	0	3,500	700	4,200	1,700
Prince Edward Island	0	100	200	300	100
Nova Scotia	0	3,900	1,300	5,300	2,100
New Brunswick	0	11,800	1,200	13,000	5,200
Quebec	0	67,200	19,300	86,500	34,600
Ontario	0	140,000	81,000	221,000	88,400
Manitoba	0	5,400	3,600	9,100	3,600
Saskatchewan	0	11,300	7,100	18,400	7,400
Alberta	0	141,000	62,300	203,400	81,300
British Columbia	0	16,800	24,000	40,900	16,400
Yukon	0	100	200	300	100
Northwest Territories	0	9,600	4,400	14,100	5,600
Canada	527,200	413,900	212,000	1,153,100	461,200

Source: Statistics Canada, Industry Accounts Division, Interprovincial Input-Output Model, Project-specific simulation.
Note: *assumes a construction period of 2 ½ years. Totals may not add up due to rounding errors.

The GBRP Project's effect on GDP was estimated at $188 million for Nunavut and $486 million for Canada. These results combine all direct, indirect, and induced effects of the Project's spending. The direct effect will occur in Nunavut and is estimated to equal $182 million.

The indirect effect is much larger in the rest of Canada than in Nunavut because the majority of goods and services used in the Project will be imported from other Canadian jurisdictions. This indirect effect on GDP is estimated at $180 million across Canada. Following from the location of the business demand revealed in the gross output results, we can expect that the majority of value-added will originate in Ontario and Alberta.

When the labour income generated by the new direct and indirect employment is spent on consumer goods and services, the spending will have an induced effect on GDP. Recall the assumption that Nunavummiut will fill 25% of the jobs created by the project. This assumption effectively lowers the induced effect in Nunavut and raises it in the rest of Canada. It is estimated that Nunavut's GDP will rise by $4.6 million as a result of the induced effects, while GDP in all of Canada will rise by $123 million.

GBRP Project's Effect on Gross Domestic Product, $ thousands					
	Direct GDP	Indirect GDP	Induced GDP	Total GDP	Annual Average
Nunavut	182,400	1,200	4,600	188,300	75,300
Newfoundland and Labrador	0	2,200	400	2,600	1,000
Prince Edward Island	0	100	100	200	100
Nova Scotia	0	1,600	700	2,300	900
New Brunswick	0	1,500	600	2,000	800
Quebec	0	24,800	10,100	34,800	13,900
Ontario	0	64,000	45,800	109,800	43,900
Manitoba	0	2,500	1,900	4,400	1,800
Saskatchewan	0	5,300	4,000	9,300	3,700
Alberta	0	65,300	37,700	103,000	41,200
British Columbia	0	8,000	14,600	22,600	9,000
Yukon	0	100	100	100	100
Northwest Territories	0	3,900	2,800	6,800	2,700
Canada	182,400	180,500	123,300	486,200	194,500

Source: Statistics Canada, Industry Accounts Division, Interprovincial Input-Output Model, Project-specific simulation.
Note: *assumes a construction period of 2 ½ years. Totals may not add up due to rounding errors.

The Proponent's engineers estimated the Project would require a direct workforce of 1,000 over the 2½ years of construction activities. The table below shows the model results that include a direct job effect much higher than this (2,220 FTE jobs) because it includes jobs associated with the first round of indirect effects. Across the country, the $527 million construction project will create 4,440 FTE jobs in total when combining all direct, indirect, and induced labour demand. On an annual basis, the average FTE job creation is just under 1,800.

GBRP Project's Effect on Full-Time Equivalent Jobs						
	Direct FTE Jobs* (by location)	Direct FTE Jobs (by residency)	Indirect FTE Jobs	Induced FTE Jobs	Total FTE Jobs	Average Annual FTE Jobs**
Nunavut	2,220	330	10	20	370	146
Newfoundland and Lbdr	0	0	0	0	10	3
Prince Edward Island	0	0	0	0	0	1
Nova Scotia	0	0	10	10	20	8
New Brunswick	0	0	10	10	20	7
Quebec	0	0	240	90	330	133
Ontario	0	630	550	360	1,540	615
Manitoba	0	0	20	20	40	15
Saskatchewan	0	80	30	30	140	55
Alberta	0	820	340	230	1,390	557
British Columbia	0	230	70	110	410	166
Yukon	0	0	0	0	0	1
Northwest Territories	0	120	40	20	170	70
Canada	2,220	2,220	1,330	900	4,440	1,776

Source: Statistics Canada, Industry Accounts Division, Interprovincial Input-Output Model, Project-specific simulation.
Notes: *includes jobs created by contractors. **assumes a construction period of 2 ½ years. Totals may not add up due to rounding errors. The Direct FTE Jobs (by residency) shows the assumed residency of the direct and contracted labour force.

The job effect for Nunavummiut is estimated to equal 370 FTE jobs, where the annual average will be close to 150 FTE jobs for the duration of the construction activities. It cannot be overstated that determining the residency of labour working in Nunavut is an assumption imposed on the model. If left alone, the model would assume that Nunavummiut fill all jobs located in Nunavut, which is not realistic. The approach taken here was one of great caution in order to ensure the economic benefits of the project are not overstated. However, it is worth noting that Nunavut's labour market is not static and the availability and qualifications of its labour force is improving. Should this project proceed to construction, a more detailed investigation of the labour force at that time would be advisable in order to determine a more accurate assumption regarding its participation in the Project.

Economic Benefits from Potential Users of GBRP

While the economic benefits of the road and port construction are considerable, the Project's real purpose is to open the Kitikmeot region to mineral exploration and development. The road will pass through rich geological regions that are currently difficult and expensive to access and where known deposits are left stranded. The presence of a road and port will lower the future cost of mine construction and operations.

Despite good evidence that the GBRP will improve the feasibility of mineral development in the region, one should be cautious in reporting benefits of these induced opportunities. However, it is equally incorrect to ignore the possibilities altogether.

Two industrial activities that could grow as a result of the GBRP are examined in some detail in the report: mineral exploration and mining. As noted, other users would bring further benefits to the region through improved community resupply, marine safety and security, enhanced sovereignty, opportunities for tourism, and as an economical supply route for diamond mines operating in the Northwest Territories.

Mineral Exploration

The money spent on exploration can provide important jobs and contract opportunities for resident labour and businesses. It is estimated that for every million dollars spent in Nunavut on exploration, GDP is given a $518,000 boost and 5.2 direct FTE jobs are created in the territory.[6] The high GDP to Output ratio is the result of the high percentage of labour and capital used in the activity, with the primary inputs (intermediate goods) being fuel, steel, and professional services and equipment. The cost of labour alone (including benefits and employer contributions) represents as much as 70% of the value added (and between 35% to 40% of the gross output).

Like most economic activities in Nunavut, there is a benefit to other Canadian jurisdictions from exploration in the territory through indirect business demand and induced consumer spending. A million dollar investment in activities that support mining in Nunavut (including mineral exploration) can create as many as 8.7 FTE jobs across the country when considering all direct, indirect, and induced effects.

[6] These estimates are derived from Statistics Canada's *Interprovincial Input-Output Model*. The figure includes several industrial activities that support mining, including exploration.

Economic Benefits from Support Activities to Mining (effect from $1 million investment in mineral exploration)				
	Direct	**Indirect**	**Induced**	**Total**
		Gross Domestic Product		
Nunavut	518,000	41,500	74,000	633,500
Rest of Canada	0	195,300	104,300	299,500
All of Canada	518,000	236,800	178,300	933,000
		Employment (# of FTE jobs)		
Nunavut	5.2	0.4	0.4	6.0
Rest of Canada	0	1.6	1.1	2.7
All of Canada	5.2	2.0	1.5	8.7
Source: Statistics Canada *Industry Accounts Division*. Input-Output multipliers of the industry: Support activities for mining.				

MINING

The real prize for investing in the GBRP will be mine development. The mining sector is a critical piece in the future success of Nunavut. Mining attracts much needed capital inflow to the region. It creates jobs at a scale that no other industry in the territory can match. And, when managed well, can be transformative in the socio-economic development of Nunavut communities.

The proposed road would connect several known mineral deposits to the port. The largest amongst these is the zinc-copper deposit at Izok Lake. Also adjacent to the road is High Lake, which is another zinc-copper deposit. It was stated earlier in this report that these resources would be worth more than US$10 billion based on today's commodity prices.

These deposits are owned by the same company improving the possibility that a feasible mine plan can be developed. At the moment, this company is the most likely to become the first major industrial user of the road. The economic effects of the potential mine were estimated based on the assumptions provided earlier in the report. They are presented again for convenience. It was assumed that:

- A feasible mine plan can be developed resulting in a successful environmental assessment that attracts the required capital investment and that leads to mine development;
- The total capital cost of developing the two deposits is $2.0 billion with a 3-year construction phase;
- 20% of capital expenditures and 7% of operational expenditures are directed to imports
- Production will span 11 years and will produce 95% of the indicated resource
- Commodity prices will be 20% below today's values[7]
- The exchange rate is CDN$1.25 to US$1.00;
- Economic multipliers were estimated based on historical mining data for Nunavut and Canada and using Statistics Canada's *Interprovincial Input-Output Model*; and,
- Nunavummiut will supply 15% of the construction labour (direct and indirect), 25% of the operations labour (direct and indirect), and 100% of the induced labour within the territory.

[7] Today's prices refer to those stated earlier in the report, US$3.10/lb copper and US$1.50/lb zinc, which were taken in January 2018.

A $2 billion mine development is estimated to raise Nunavut's GDP by $739 million spread over three years and create 3,770 FTE jobs, equal to 1,260 per year for the three years. Similar to the GBRP project construction, the majority of indirect and induced effects would flow to goods and service providers (including labour) located in southern Canada The mine development would provide a $1.5 billion boost to Canada's GDP and create more than 10,000 FTE jobs.

An operating mine of this size would cause GDP in Nunavut to rise by almost $500 million annually while creating 1,400 FTE jobs when all direct, indirect, and induced effects are considered. Should Nunavut labour participation in the project grow to 25% of all direct and indirect jobs and 100% of all induced jobs, this project would bring about an increase in employment equal to 365 full-time equivalent jobs annually for 11 years.

The economies in other parts of the country would also benefit from the operating mine. It was estimated that the GDP throughout the rest of Canada would expand by $2.1 billion over the Project's lifetime, equivalent to $193 million annually. The labour markets in these jurisdictions would also benefit, with the estimated job growth equal to 2,100 FTE jobs annually (23,300 FTE jobs over the life of the Project).

The results of this exercise are presented in the table below: [8]

Potential Economic Effects from the Development of Izok and High Lake mineral deposits, $,thousands and full-time equivalent jobs

			MINE CONSTRUCTION (3 YEARS)		
	Direct	**Indirect**	**Induced**	**Total**	**Annual Average**
			Gross Domestic Product		
Within Nunavut	556,000	175,000	9,000	739,000	246,000
Rest of Canada	0	487,000	276,000	764,000	255,000
Canada	556,000	662,000	285,000	1,503,000	501,000
			Employment (# of FTE jobs)		
Within Nunavut	2,090	1,640	40	3,770	1,260
Rest of Canada	0	4,260	2,550	6,810	2,270
Canada	2,090	5,900	2,590	10,580	3,530
			MINE OPERATIONS (11 YEARS)		
	Direct	**Indirect**	**Induced**	**Total**	**Annual Average**
			Gross Domestic Product		
Within Nunavut	5,000,000	400,000	38,000	5,438,000	494,000
Rest of Canada	0	1,070,000	1,042,000	2,112,000	193,000
Canada	5,000,000	1,470,000	1,080,000	7,550,000	687,000
			Employment (# of FTE jobs)		
Within Nunavut	11,200	3,300	400	14,900	1,400
Rest of Canada	0	14,300	9,100	23,300	2,100
Canada	11,200	17,600	9,500	38,200	3,500

Source: Statistics Canada *National and Provincial Input-Output Multipliers.* Impact Economics. Published data from MMG Inc.

[8] The purpose of this exercise is to demonstrate how a mining project in the Kitikmeot region would affect Nunavut's economy. Without a defined mine plan, the estimates were based on known mineral data and reasonable assumptions on what a feasible project would look like. The results should be viewed as such.

Government Revenue Potential

Any economic activity generated either directly or indirectly from the GBRP project affords government the opportunity to generate revenue. In this section of the report, estimates of government revenues generated from the GBRP construction project and the potential Izok Lake and High Lake mine development are presented.

GBRP Project Construction

The modelling work completed for the project construction provides estimates of some tax revenues, including taxes on products such as GST and HST, federal and provincial gas tax, import duties, and municipal taxes. Combined, these taxes will bring in close to $18 million when considering all levels of government and combining the direct and indirect effects. Adding in the induced effects, which represents the economic effect generated from consumers spending their $287 million labour income earned from working directly or indirectly for the Project, generates a further $25 million in government tax revenues.

Potential Tax Revenues from GBRP Project, $	
Indirect Tax (GST, gas tax, duties, licences, etc.)	18,000,000
Personal Income Tax	43,000,000
Corporate Income Tax	23,500,000
Tax from direct and indirect economic activity	85,000,000
Indirect Tax from induced economic activity	25,000,000
Total	110,000,000
Note: combines federal, provincial, and territorial taxes	

Personal income taxes and corporate taxes should also be considered. These revenues are challenging to estimate because they are influenced by numerous assumptions including the difference between total and taxable income, differing taxation rates across each jurisdiction, as well as different tax exemptions and non-taxable credits, and, in the case of corporations, factors that affect their profitability. These complexities were addressed through the use of simple methodologies that made use of prudent assumptions so as to not grossly over- or under-estimate the revenue possibilities.

The modelling work provided an estimate of $287 million in labour income from all direct and indirect employment. The average federal personal income tax rate was assumed to equal 10% of gross income, while provincial and territorial personal tax rates were set at 5% of gross income. Applying these assumptions to the estimated labour income generated from the GBRP project construction results in $43 million in personal income tax revenue for all levels of government.

Estimating corporate tax revenues required an assumption on corporate profits. The model results included an estimate of direct and indirect gross output equal to $941 million. It was assumed that profits represent 10% of grow output; that is, corporate earnings before tax but after all tax adjustments is 10% and that the average corporate tax rate was 25% when combining federal, territorial, and provincial corporate tax regimes. These assumptions contribute to a direct corporate tax estimate equal to $23.5 million.

Taken together, the GBRP project construction could generate an estimated $85 million in direct and indirect tax revenues across Canada.

Mine Development and Operations at Izok Lake and High Lake

A large-scale profitable mining project will all but pay for the GBRP project's construction costs through the government tax revenues generated. The example used in this study was the development of zinc-copper deposits at Izok Lake and High Lake. Several assumptions were introduced in order to calculate potential tax revenues from this example, including a feasible mine plan, the gross value of production, capital depreciation, and profitability.

Only the mine's direct effects were used in calculating the tax estimates to ensure tax revenues were not overestimated. It should be noted that the indirect and induced effects from a mining project of this size would be substantial. The estimated gross output from indirect and induced effects occurring outside Nunavut exceeded $2 billion. The tax implications from that economic activity should not be forgotten. Furthermore, only three taxes were assessed—mining tax, corporate tax, and personal income tax. This excludes important indirect taxes on goods and services at the federal and provincial levels (GST and HST) and fuel (gas tax), land taxes, import duties, and licensing, as well as Nunavut's 2% payroll tax. If the tax potential from all indirect and induced effects as well as all indirect and payroll taxes were accounted for, it is reasonable to assume the tax revenue from this project would more than double the estimates being reported.

Resource royalties and corporate income taxes depend on profitability after accounting for the capital costs of the project. Therefore, it must be assumed that these mine operations will be profitable. Several additional assumptions were needed to generate the tax results for the Izok Lake and High Lake mine example:

- Operating surplus was assumed to represent 37.5% of gross output
- Capital depreciation was calculated as the cost of construction plus 20% for sustaining capital
- The average mining tax rate (resource royalties) was calculated to equal 10.4% of calculated taxable profits
- Federal corporate tax rate was assumed to be 15% of calculated taxable profits
- Provincial/territorial corporate tax rate was 10% of calculated taxable profits
- Federal personal income tax rate was 10% of estimated direct gross labour income
- Provincial/territorial personal income tax rate was 5% of estimated direct gross labour income

The results are presented in the table below. The tax potential includes $140.4 million for resource royalties, $337.5 million in federal, provincial, and territorial corporate taxes, and $187.5 million in personal income taxes for a combined total of $665 million.

Estimated Tax Revenues from the Direct Effect of Mining at Izok Lake and High Lake ($)	
Mining Tax (Resource Revenues)	$140,400,000
Federal Corporate Income Tax	$202,500,000
Provincial/Territorial Corporate Income Tax	$135,000,000
Federal Personal Income Tax	$125,000,000
Provincial/Territorial Personal Income Tax	$62,500,000
Total Estimated Tax Revenue	$665,400,000

Summary of the Economic Effects from the GBRP Project Construction

The Grays Bay Road and Port represents a potential watershed for the Nunavut economy. The $527 million investment would open up the mineral-rich Slave Geologic Province in the Kitikmeot region and provide a supply route to operating mines in the Northwest Territories. The Grays Bay port would attract interest from other users including community resupply shipping companies and the Canadian coast guard, and could improve marine safety in the region as well as tourism opportunities.

This assessment demonstrates the potential economic effects of the construction project and how the new infrastructure might attract industrial activity, including mineral exploration and mining activities. Of particular interest is the possibility of a major zinc-copper mine that would become an important user of the road and port. An operation of this size would bring substantial positive change to the region's economy, while the tax revenues, from the direct effects alone, would cover the cost of construction.

From the perspective of public finance, the risks associated with the investment must be weighed against the potential return that includes all financial, economic, and social benefits that would be realized from a realistic long-term development scenario for the region with the road and port infrastructure in place.