The Mackenzie Valley Highway: Should it be Completed?
If so, How Should it be Funded?

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Abstract

The GDP of the Northwest Territories (NWT) has grown by more than 50% since 2000. Contributing most to this growth are resource-based industries, such as diamond mining and oil and natural gas extraction. High resource prices are making it profitable for large companies to start up or expand their production in the NWT. Improvement of the territory's transportation infrastructure is vital to supporting this anticipated growth. Improvements would also benefit many small, often desolate communities, by providing them with ready access to basic needs and helping to raise their living standards. Presently winter roads are the only surface transportation available to these communities, and the season for winter roads is shrinking as average temperatures rise in the North.

The Government of the NWT has a short-term plan to improve strategic permanent and winter roads. Of greater interest is the Territories' longer-term proposal to complete an all-weather highway through the Mackenzie Valley that will connect with the Arctic Coast. An attempt to construct an all-weather highway of this sort began in the 1970s, but construction stopped after a small portion of the planned road was completed. Amongst the various reasons for the stoppage was uncertainty about the region's economic prospects. Completing the Mackenzie Valley Highway will involve extending the existing permanent portion of road to the Dempster Highway, and constructing another section further north from Inuvik to the coastal community of Tuktoyaktuk. Completing the highway would eliminate the need to build several hundreds of kilometres of winter roads every year. Given the magnitude of this project, and the NWT's small population, it is clear that external sources of financing will be necessary.

The first part of this paper will examine whether the Mackenzie Valley Highway project is economically justified. Estimates of construction and annual maintenance costs are available. In assessing the benefits from quicker and cheaper transport, account will be taken of an alternative highway route, the Dempster Highway. Consideration will also be given to an emerging technology, airships, which in the near-to-medium future may become a viable

alternative for the transport of consumer goods and commercial freight to Northern communities and development sites.

This second part of the paper will examine alternative methods of financing the Highway project. Financing could come from a federal government grant or from a royalty tax on resource extraction. As far as direct user charges, it has been proposed that a toll could be imposed on commercial vehicles. Construction of the highway could be accomplished through a public-private partnership. A public-private partnership has recently been undertaken in the NWT that will result in completion of the Deh Cho Bridge along the Yellowknife Highway. A private group is to design, finance and construct the bridge, and in return receive payments from the NWT, consisting of tolls collected from commercial vehicles using the bridge, as well as a contribution of the territory's cost savings. The Deh Cho Bridge contract could serve as a template for the much larger Mackenzie Valley Highway project.

I. Introduction and Background

The Northwest Territories (NWT) covers 1.2 million square kilometers in northern Canada. Its permanent population is approximately 43,000. Although it comprises more than 10% of Canada's total area, it accounts for only 0.14% of Canada's population of over 31 million people. The NWT has many known reserves of non-renewable resources. For example, in early 2005, a large oil and gas deposit was discovered near the town of Tulita, situated in the heart of the Mackenzie Valley (NWT, 2005b, p.6).

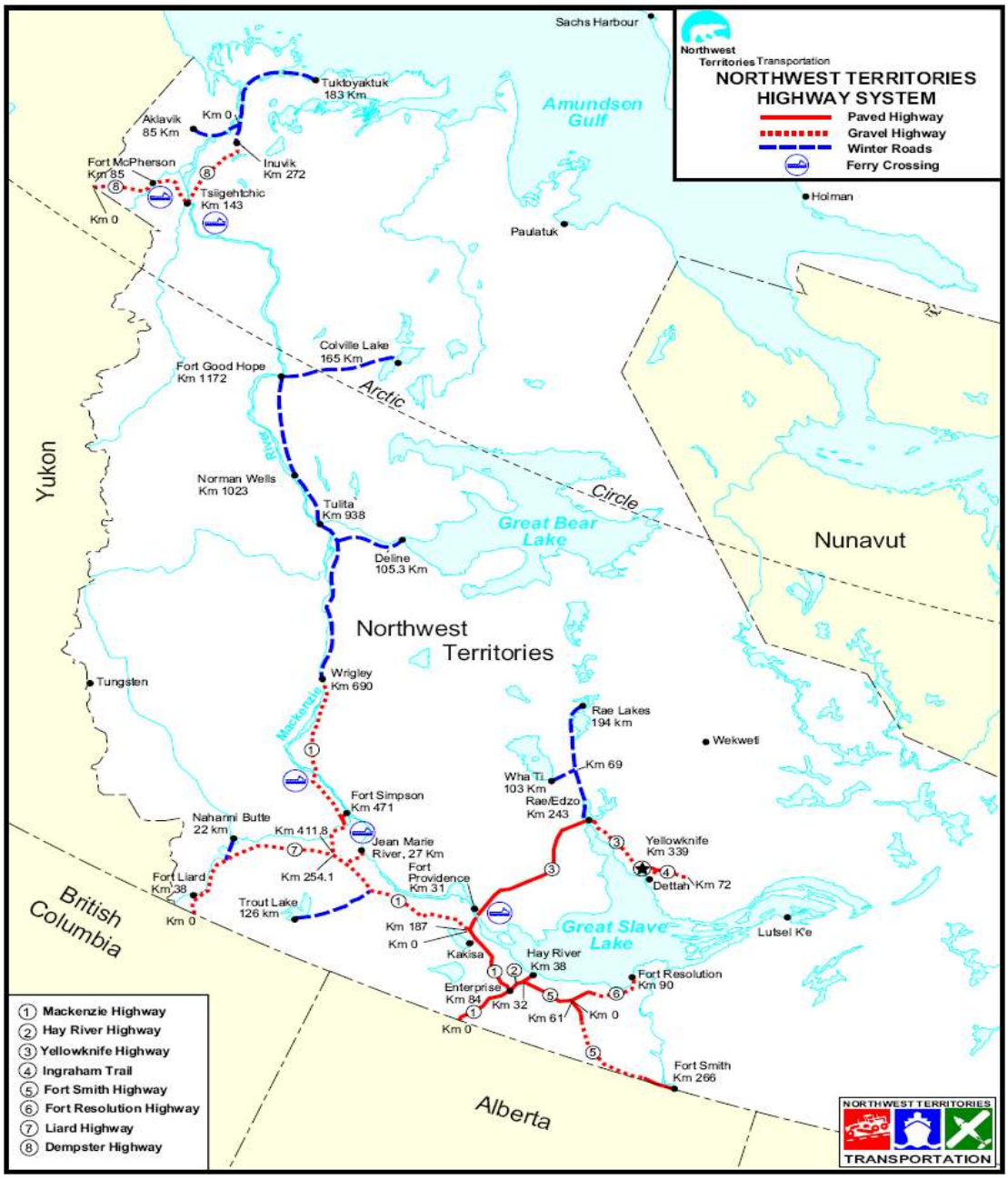
In recent years the NWT has experienced very rapid economic growth, thanks in large part to its resource-based industries. From 2000 to 2005 the gross domestic product of the NWT grew by more than 50% (NWT, 2005b, p.5). The emergence of activities associated with drilling for oil wells and the opening of diamond mines have been major components in this growth. Despite these successes, reserves in the territory have remained untapped largely because of the high costs attributable to the region's great distance from most of Canada's population and the adverse climatic conditions. The remoteness is also responsible for the NWT's lack of development and infrastructure relative to the Canadian provinces, but efforts have been made to improve its transportation infrastructure as of late. The recent installation of bridges along the Mackenzie Valley winter road are intended to extend the operation of the road by about four weeks in some areas (NWT, 2005a, p.59). The potential for further development in the NWT

makes it worthwhile to look at completing a permanent highway through the territory that would ultimately connect with the Arctic Coast.

The Mackenzie Gas Project is currently in the early planning stages. Traffic in the Mackenzie Valley resulting from the Mackenzie Gas Project is anticipated to peak between 2007-2009, meaning that at the present, there is virtually no way that any substantial portion of a permanent highway extension would be completed to support this project. The goal of this project is to exploit the reserves of natural gas that reside in and around the Beaufort Delta. It also involves construction of a pipeline down the Mackenzie River Valley and into Alberta, where it will connect with existing pipeline systems to bring the gas into North American markets. The Government of the Northwest Territories (GNWT) believes that the extension of the Mackenzie Valley Highway (MVH) and completion of a permanent highway to the Arctic Coast will further encourage development of the resources in the Mackenzie Valley. With a permanent highway link in the region, the easier access provided would cut costs for firms attempting to explore and develop resource deposits. This infrastructure would also benefit inhabitants along the proposed route, including many aboriginal groups. These benefits range from increased employment from activity in the region to a reduction in the cost of living from having year round access to necessities that are shipped in from the south. At the same time, environmental damage to the pristine environment and adverse exposure to other cultures are possible.

In the early 1970s, the Canadian federal government attempted to construct a permanent highway through the Mackenzie River Valley, but in fact only a small link was completed from Fort Simpson to Wrigley (see Figure 1). Presently the MVH, or Highway 1, north of Yellowknife consists of the completed segment of permanent road and a system of winter roads serving community re-supply and exploration during its period of operation. Warmer temperatures in recent years have reduced the period of winter road operations. Winter roads are constructed annually over frozen ice on lakes and rivers and over terrain cleared of obstructions. Snow is packed down and becomes ice, and the roads open once the level of ice is thick enough to support vehicles. With the present level of exploration and development in the region, now is a propitious time to construct an all-weather highway corridor in the region. Figure 2 provides the areas of resource potential within the NWT.

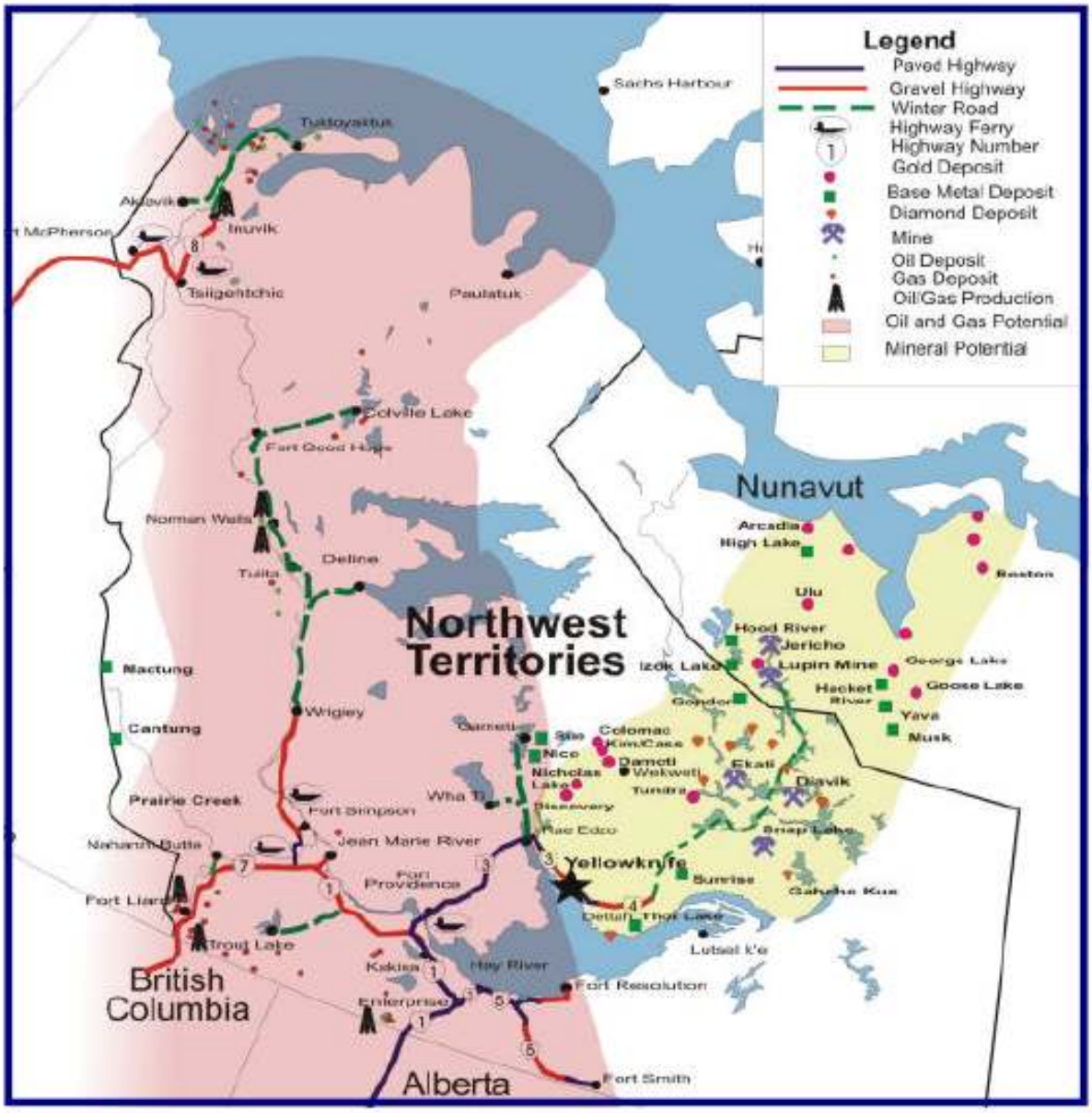
Figure 1.



The Northwest Territories Highway System[1]

[1] Figure 1 is taken from page 13 of the "NWT Department of Transportation Submission to the Canada Transportation Act Review Panel" (2001).

Figure 2.



The Resource Potential of the Northwest Territories[2]

The GNWT desires to have the MVH with all-weather travel capability connect to the Dempster Highway, which would then connect with the Arctic Coast and provide a permanent link between Inuvik and Tuktoyaktuk. For simplification, this entire plan will henceforth be referred as the MVH extension. The MVH extension would not be paved, but would be composed of a gravel surface. Comparing benefits to the estimated cost of the project, an idea

[2] Figure 2 is taken from page 24 of the NWT's publication "Corridors for Canada II: Building on Our Success," (2005).

can be given to the practicality of completing construction. Financing the proposed venture is another issue that must be looked at. The GNWT has proposed (Connecting Canada, 2005) to cover some of the costs by charging commercial vehicles a toll to use the highway. Other modes of transport are currently used to transport commercial supplies and goods for community re-supply. These include barges along the Mackenzie River and airplanes. An emerging mode of transport – the airship – has also been promoted (Airships to the Arctic Symposium, 2002) as a means of transporting freight in the Arctic.

II. Benefits and costs of the Mackenzie Valley Highway extension

Currently the proposed MVH extension remains at the conceptual planning stage. It is not yet possible to develop an accurate estimate of all the costs and benefits of the project. The GNWT (Connecting Canada, 2005, p.6) estimates the costs to be $700 million. This figure includes $600 million for construction, $60 million for engineering and $40 million for financing. It does not include an estimate of environmental costs, and is therefore likely to be a liberal estimate of the project's total social costs.[3] The benefits of the project are even more uncertain. Using the information available, this paper will attempt to identify whether the benefits are likely to outweigh the costs.

An important consideration in any cost-benefit study is how the proposed project compares to existing or available substitutes. Relating this to the proposed MVH extension, barges currently provide freight transport up the Mackenzie Valley from the southern part of the territory. The NWT's only railroad track, 134 kilometres in length, extends north from Alberta and ceases at the community of Hay River. The transfer of supplies north often involves inter-modal transport, using either a combination of rail and barge, or a combination of truck and barge. At Hay River, freight is transferred from trucks or rail to barges docked on the Mackenzie River. This allows shipment north through the Mackenzie Valley to stops at docking stations for local communities, and shipment beyond the river to stops along the Arctic Coast. Under some circumstances, freight is off-loaded onto trucks once again at docking stations along the

[3] For-hire trucking vehicles emit approximately 10 times the grams of carbon dioxide per tonne-kilometre compared to domestic marine transport (Lawson, 2003, p.38). Providing a comparison with air transport, light trucks for urban city travel emit approximately 25% less the grams of carbon dioxide per passenger-kilometre than domestic airplane travel (Lawson, p.39).

Mackenzie River in order to access off-river sites. Inter-modal transport necessitates costs for storage and for the transfer of freight from one mode to the next.

The possibility exists that the completed MVH extension could divert freight demand away from barging companies. Barging companies would only likely be hit hard if there were an unexpected decrease in demand. With the expected growth in exploration and development in the region, demand for barging services may increase for freight delivery that is exclusive to transport by barge due to size constraints. Completion of the highway is a long-term process that will take many years to complete and barging companies would have plenty of time to adjust their supply of vehicles. As well, some barge companies do not serve only the Mackenzie Valley region, but also have customers at ports in the Beaufort Sea area and off the northern coast of Alaska. Any losses over a longer time frame would result from the inability to exercise economies of scale, as trip-chaining opportunities on the Mackenzie River would be reduced.

Option value exists with the potential to complete the MVH extension in the future rather than today. Continued exploration in the region may not meet the projections of resources that are thought to exist, reducing the necessity for a permanent highway. Unforeseen circumstances can arise in the future, which could jeopardize the project. These include a recession that postpones development, or excessive costs. Downside to the MVH extension could also result from the inability to reach land-use agreements with aboriginal parties who maintain land rights on the proposed route.

This time period of construction is important to the project. If construction takes a long time to complete, for example 15-20 years, it may be decided that some projects cannot wait for the highway, resulting in lost traffic opportunities. The extended highway would still serve local communities, tourism and additional traffic induced by continuous exploration and processing in the region. But the bulk of traffic associated with a project such as the Mackenzie Gas Project would be long gone.

The perspective of three groups that have the potential to benefit from the MVH extension will be viewed. These three groups include the citizens of the NWT, the Canadian federal government, and private groups. Each group will perceive advantages and disadvantages from completing the MVH extension.

(i) Citizens of the NWT

Completion of the MVH extension will provide many sources of benefits to citizens of the NWT. Benefits to locals could derive from increased employment in the region. Construction of the highway has the capability to attract local residents who are presently unemployed, as well as teach these people abilities that can be used later on in community development. With the construction of a permanent link, the region would no longer have to worry about constructing winter roads each season. From the 2006/2007 estimate on winter road programs, assuming all winter roads experience equal costs, the total annual cost saving for the 482 km winter road between Wrigley and Fort Good Hope would amount to $0.9 million.[4] It is uncertain whether there would be any substantial differences in the maintenance of an all-weather road versus a winter road. This value would almost certainly be reduced by the fact that the all-weather road would require maintenance year-round, and not only during the winter months.

Another category that benefits would spring from would be cheaper consumer goods, especially food. From recent statistics provided by the GNWT, the areas that would be served by the MVH extension presently experience an extreme disparity with the territory's capital city, Yellowknife, in prices of food. In 2004, some towns situated along the current winter road network, Tulita, Norman Wells and Fort Good Hope, had food price indices of 190, 187 and 191 when compared with Yellowknife, whose base index was 100.[5] These values are slightly higher than they were in 2001. An all-weather link passing through these communities would lead to lower prices by enabling trucks to deliver goods to these communities year round, and avoiding the costs of storage or more expensive transportation methods such as airplanes. Additional benefits in the region would stem from access to medical facilities outside of the remote communities along the route. Finally, increased community access will likely spur an increase in tourism to Canada's north.

It is unlikely that NWT citizens will be able to cover the entire costs of the project. No reason exists to believe that citizens of the territory would accrue enough benefits as a group to outweigh the costs. For this to happen, benefits would have to exceed $16,000 per each resident

[4] As listed on page 10-24 of the GNWT's "2006-2007 Main Estimates" on transportation, the total cost on all 1425 km of winter roads in the territory is to approach $2.7 million.
[5] Listed on page 28 of "Statistics Quarterly" (2005) by the Northwest Territories. This publication also includes price indices for other communities in the NWT.

of the NWT. Considering that many individuals residing outside the Mackenzie Valley region stand to gain nothing from the project, this value must be even greater for those who do stand to benefit.

(ii) The Government of Canada

According to Connecting Canada (2005), the federal government will receive upwards of $13.3 billion in tax and royalty revenue from oil and gas exploration and development in the NWT when "facilitated by all-weather access" (page 5). What the document does not indicate is how much revenue would be acquired without construction of an all-weather link. If the federal government anticipates an increase in the present value of its revenues of more than the $700 million expected project cost, then perhaps it would be willing to fund the entire project. Construction of a permanent highway linking the rest of Canada to the Arctic Coast will also help to preserve Canadian sovereignty in the Arctic. It will strengthen the Canadian presence in the Northwest Passage, which has the potential to become a major shipping route in the near future if Arctic ice continues to recede.

The opportunity cost of using federal funds for the MVH extension versus other projects in Canada must be considered along with the benefits. The federal government has other responsibilities in Canada to fulfill. If there is another project in Canada that would provide more benefits than the MVH extension, then essentially the government is sacrificing additional benefits. As the NWT is still a developing region, the Government of Canada may place a greater weight on providing infrastructure to the NWT than to other provinces. This could also be considered as a strategy to reduce the omnipresence of the Alberta economy in Canada. The Government of Canada is not a corporation, and is justified in its attempt to raise living standards in regions where they lag.

(iii) Private Firms

Private firms operating in the NWT would benefit greatly from enhanced mobility. For them the best-case scenario would be for a public agency to construct the link. If this does not happen the private sector may be enticed to construct all-weather roads themselves. Versus the estimated $700 million cost of the MVH extension, firms could enjoy some scale economies in completing the project, thus alleviating costs slightly. With inflation raising labour and transportation costs for the Mackenzie Gas Project by millions of dollars monthly, shipping

construction materials into the Mackenzie Delta from overseas has been considered, rather than shipping capital from North America.

Even if a net benefit from completing the highway was available to firms, it is unlikely a private company or group of companies would ever complete the link. The time-frame for construction is too long and this would divert these companies from using all their manpower to complete their primary task of harvesting natural resources or continue with further exploration. This could be overcome if, for example, resource companies outsource road construction and concentrate on their core business. Second, a private firm would want to charge others for using its road, but may face pressure from the local governing authority. It may be also be difficult to control others who are free-riding. In addition, even though there may be net benefits to completing construction, private firms will require a greater rate of return than a public authority. Publicly-held companies have shareholders to satisfy. And other projects may be available that would provide a greater return than completion of the MVH extension.

III. Alternatives to the MVH Extension

The Dempster Highway is a possible alternative in establishing a permanent connection to the Beaufort Delta, the setting of the Mackenzie Gas Project. Completing a permanent section of road from Inuvik to Tuktoyaktuk, including a bridge over the Mackenzie River, would give Canada its permanent, all-weather road to the Arctic Coast. Unfortunately, the Dempster Highway only serves the most northern region of the NWT, and does not serve the majority of the Mackenzie Valley, which includes many communities and much of the resource exploration and drilling in the territory. Other than upgrading the Mackenzie winter road, no alternatives exist for completion of an all-weather road in the Mackenzie Valley.

A re-emerging mode of transportation that does have potential to provide all-weather travel throughout the NWT is the airship. It has been almost seventy years since the explosion of the Hindenburg, and thus the subsequent stop of airships as a prominent mode for air transport, including freight. Recently, airships with the capacity to carry large volumes of freight have reappeared as transport options. Transportation of fuel and other freight to northern regions is very costly. As an example, Prentice (2005, p.482) notes that truck shipments are 65-70% more expensive over winter roads compared with all-weather roads. Furthermore, compared with southern geographical regions, Prentice and Thomson (2003, p.592) note that ground-based

transportation in northern regions can be upwards of ten to twenty times the cost! Rather than investing in the construction of all-weather roads, consideration can be given to investing instead in airships. With transportation in the north carrying extremely high costs, the possibility for improved and safe airships to compete is now worth deliberating, especially considering their ability to operate throughout the year.

Prentice and Thomson (2003) provide an economic model for a single airship with the capacity to carry 84 tonnes of freight. It is calculated that as long as the airship is active for at least 245 days per year at three flights per day from the given origin-destination points of Hay River to the Ekati mine, savings will take place compared to the current situation of winter road transport in the region (p.599). Some benefits to airships stem from reduced storage costs of fuel and other supplies. Since airships have fewer infrastructure limitations, the need for multi-mode transport could be reduced or perhaps eliminated. This would obviously reduce costs.

One problem faced by many industries in the NWT in the construction of infrastructure, such as roads and pipelines, is that infrastructure must be placed on land where aboriginal land claims are entrenched. Thus, agreements must be formed with these groups in order to proceed with projects. Airships would be able to bypass the lands that are controlled by these groups or at least minimize intrusions into those lands.

The greater payload capacity for airships provides environmental benefits in reducing the number of trips made versus truck transport. Hauling fuel on roads is not the best method environmentally, especially during winter. Besides trucks' own pollution, the potential exists for accidents in bad weather, which would be expensive to clean up and detrimental to the habitat that many residents of the NWT enjoy and rely on for fishing, hunting and ultimately living. Compared to the situation at present with winter roads, the ability for airships to supply fuel year round will reduce both safety and environmental risks associated with fuel storage (Prentice and Thomson, 2003). Furthermore, Prentice (2005, p.484) classifies greenhouse gas emissions by airships as 'low' and trucks as 'medium.'

The ability for airships to supply arctic communities and contribute to resource development through heavy lifting capacity and the before-mentioned minimal infrastructure requirements are two main important benefits for the consideration of airship operation in the Arctic. Other benefits that can be realized from the presence of airships are the assertion of Canada's sovereignty in the Arctic, the provision of emergency services such as search and

rescue, and the transport of critical supplies in the case of an accident. Industries such as tourism and communications also have the potential to make use from an airship presence. The main barrier to the emergence of airships in the Arctic lies in finding investors to finance this new frontier of northern transport (Prentice and Thomson, 2003). As an example of costs, Prentice and Thomson estimate the capital cost of an airship as $60.4 million in their model (p.597). Symposiums such as the Airships to the Arctic series have shown that airships would be seriously considered by many industries if they were available for operation. Without any demonstration of airships, profit-driven companies cannot justify the financing of airships to investors when other less risky projects are available. The promotion of airships over an all-weather highway route in the NWT could lay the foundation for airships in the north.

IV. Possible Financing Mechanisms and other project considerations

The decision of whether to complete the MVH extension or not is further complicated by other issues and facts. The NWT's small population clearly places restrictions on its ability to raise funds by itself. Nix (2001, p.15) noted that in regards to financing projects such as the MVH extension, the GNWT felt that this responsibility lay with the federal government. That the GNWT maintains this feeling is not surprising, as only the federal government has the authority to collect royalties on locally extracted resources. Although the GNWT does not come close in having the ability to completely finance the MVH extension, it would be able to partially contribute. Its solution in Connecting Canada (2005) is a partnership with the federal government to borrow the $700 million cost, with the GNWT contributing $10 million annually for 35 years as repayment. The federal government would be responsible for contributing $30 million annually, fulfilling the estimated $40 million annual requirement on the loan.

Continuing from this proposed solution, three prominent paths for financing are present that could help in the completion of the MVH extension. These include involvement of the federal government, the ability to collect charges from users of infrastructure, and public-private partnerships.

(i) Federal Government Involvement

As the federal government has jurisdiction on the collection of royalties from the resources extracted in the NWT, part of these royalties could be utilized to provide infrastructure in the NWT. In a report prepared for the Canadian Arctic Resource Committee, Cizek (2005) is

of the opinion that the royalties collected from non-renewable resource extraction are not nearly enough. From 1998-2004, it is estimated that the average royalty rate collected by the federal government from NWT resources approximated 5.4%, a small sum compared to the 30% rate of Alberta (p.24). The royalties collected from resource production in the NWT have the potential to provide enhanced infrastructure to the territory and to the rest of Canada. Allowing authorization for the GNWT to collect a percentage of revenue itself could be more beneficial to infrastructure projects in the NWT, as the territory itself would collect this revenue. If the federal government were to increase its royalty rates, there would be some benefit to the NWT, but the magnitude of this is debatable, as any increase in revenue would be shared by all of Canada.

As well, the federal government also has the ability to alter taxes in order to raise funds, such as gasoline taxes, which are a portion of road-user fees. In raising taxes, distortionary effects present themselves and result in reactions by taxpayers that reduce the tax revenue collected, as well as the revenue available for public projects. The marginal cost of public funds tries to measure the economic costs of raising additional tax revenue. Dahlby (1994) attempts to measure the marginal cost of public funds from the taxation of labour income, and finds in many Canadian provinces that additional funds from taxation sum to a total that is less than the economic costs. Distortions on taxes are reduced under conditions where a lump-sum tax is imposed. Thus, the degree to which additional taxation is to benefit infrastructure is questionable.

The report on Canada's National Highway Policy (Infrastructure Canada, 2004) notes that investing in highways can lead to improvement in productivity by reducing costs, securing inputs and reaching markets. The MVH extension would perform all three of these. Furthermore, all routes in the National Highway System are to meet the standard of providing service in all weather conditions. Although it is not yet completed, the MVH extension would connect with Yellowknife, a capital city, as well as ascertain Canada's sovereignty in the Arctic. These facts alone justify consideration for the addition of the Mackenzie Valley Highway into system, with the minimum requirements of providing it with an all-weather service. Although the main responsibilities for roads lie with municipalities, provinces and territories, where it is not feasible, the federal government should maintain a greater role in the supporting routes critical to national productivity.

(ii) User Charges

In completing the construction of transportation infrastructure, it is suggested that efficiency in the use of roads revolves around users paying for the roads they use (Canada Transportation Act Review Panel, p.181). Examples in Canada of road-related charges to users are vehicle registration fees, taxes on gasoline, and where applicable, toll charges. It is not only in the NWT where highway infrastructure is lacking at the present. Upgrading Canada's National Highway System alone up to standards, including four-lanes, was estimated in 1998 to cost upwards of $15 billion (Council of Ministers, 1998). Governments can achieve some improvement to road infrastructure if revenue resulting from road-related taxes, such as gasoline taxes, is spent directly on roads. Nix (2001) notes that this is not the case, as road expenditures are outweighed by the sum of fuel taxes and other road-related user fees. It is further mentioned that since roads in the majority of municipalities are funded out of property taxes, there is a wide gap between the revenues and expenditures, one greater than $2 billion (p.5). Allowing the excess user revenue to go directly to the upkeep and construction of new roads would certainly help overcome the costs required for improving transportation. Those who use infrastructure are an important consideration as to who shall pay for it, and vice versa.

Toll roads are not nearly as popular in Canada as in other countries. The United States has many turnpikes that were funded by toll revenue. A reason why tolled routes in Canada remain uncommon is that there exist few high-volume routes. Roads are not items that are universal to all constituents in a region, such as water treatment facilities. By charging tolls on vehicles and using this revenue specifically for roads, drivers are paying for the service the roads have provided. This furthers the ability to complete more projects from separate general revenue streams that are more universal to all residents of a region. Tolls have often been considered on routes where the majority of traffic originates from outside the local area. The purpose of this is to fund infrastructure for locals by collecting tolls from a large portion of individuals who lie outside the region. This provides an external revenue source besides locals who already contribute to infrastructure in the form of taxes.

Designating set funds as road funds is a method of separating revenue set aside for expenditure on roads from general tax revenue. In 1993, British Columbia established a

"transport capital fund" (Canada Transportation Act Review Panel, 2001, p.185). Neither the GNWT nor Government of Canada maintains a road fund. The World Bank is proponent of road funds and, with funds set aside for roads, believes that users will have greater awareness in ensuring the funds are used for their set purpose. This is intended to promote great efficiency (Canada Transportation Act Review Panel, 2001, p.187). The United States provides the Highway Trust Fund, established in 1956, to finance part of the Interstate network. Some taxes contributing to the fund include taxes on fuel, new trucks and trailers, as well as taxes on tires that are based on weight (Nix, 2001, p.45). New Zealand's Transfund is a very successful road fund partly in due because it approves projects on a cost-benefit basis, carries no debt, and has resulted in reduced accidents and travel time (Nix, 2001, p.50). Nix further states that two important elements to the Transfund are that it clearly identifies road user charges that contribute to the fund and that the road tariff is adjusted appropriately (p.48).

Regarding the financing plan proposed in Connecting Canada (2005), the GNWT suggests implementing a toll on commercial vehicles which would help it pay a portion of the required annual payment. Based on an estimated volume of 10,000 commercial vehicles using the MVH extension per year and a toll rate of $500 per vehicle, the estimated revenue that could be recovered annually is $5 million. The portion of this toll revenue received by the GNWT would help to alleviate its annual commitment of $10 million, but depending on the administration costs, which could total 20-25% of toll revenue, how much this would help the territory is questionable. Vehicles subject to the toll would be those with a weight of 4,500 kg or more that are used for commercial purposes. Empty commercial vehicles, pick-up trucks and buses would likely be exempt from a toll. How this increase in cost would affect the demand for commercial freight on the highway is debatable and dependent on the value of what is shipped and the generalized cost added by the toll to each unit of good.

With the low traffic levels anticipated on the route, implementing high-tech electronic tolling devices or booths at each entrance and exit point would be uneconomical. In order to simplify the process and reduce administration costs, a lump sum payment for using the MVH extension is the most probable option. Vehicles responsible for the toll would be subject to paying the toll only on the inbound route. An efficient method of charging commercial vehicles for the wear and tear they cause would be through a charge per tonne-mile. This is a usual method of assigning an "amount-of-use measure" to roads, as noted by Bryan (1972, p.9). With

a scale at the entrance point of the MVH extension and basing the distance traveled by commercial vehicles on an honour system, charging a tonne-mile charge is a possibility.

(iii) Public-Private Partnerships

In the case that a private developer, or a group of developers, decide to use their own means to complete a road, there must be stipulations in place that allow these developers privileges on the road which are not available to others. Although developers may have sufficient incentive to pursue the road regardless of whom else uses it, restrictions may be imposed to prevent free riders from taking advantage of the road's existence. Designating the road as private and forcing external users to pay an appropriate charge for the road's services would accomplish this.

Svein Sigfusson of the Sigfusson Transportation Company pioneered a system of private winter roads, charging competing shippers for the use of his company's roads (Sigfusson, 1992). Sigfusson contributed to the development of a network of private winter roads throughout Manitoba and Northern Ontario. At first, roads were built for swings pulled by tractors, but by the 1960s, these roads were capable of handling semi-truck traffic. In maintaining autonomy over his company's road network and preventing free-riders, shippers using the Sigfusson roads were charged tolls. With a small fee paid to the Government of Ontario, Sigfusson had gained the approval to finance, build and operate these winter roads. Although the transfer of these roads to the provincial governments was involuntary, Sigfusson's agreements and ventures were at first in essence a public-private partnership.

Dahlby (1994, p.45) notes that deficits run by governments have required a reduction in spending or a potential raise in taxes. This crunch on available funds led to the development of new ideas on how to finance many infrastructure-based projects that were desperately needed. This led to the formation of public-private partnerships. A true public-private partnership would consist of a private group that finances, designs, builds, maintains and operates a project, with a possible transfer of the project to the public sector in the future. From the perspective of the public sector, having the private group finance the project itself eliminates the need for excess public borrowing. Being specialized in a certain industry, private groups also gain the ability to reap scale economies.

Although it is not considered a true public-private partnership, the planning and materialization of Highway 407 in Ontario fulfilled many of the characteristics associated with

one. As opposed to waiting about twenty years for construction by using designated funds for the project, it was decided to contract out the completion of the highway to a private consortium. In addition to not having the funds to complete the highway right away, another purpose of the project was to stimulate employment, as Ontario was emerging from a recession. In 1993 bidding on the project took place and Highway 407 opened to traffic in 1997.

One issue that has come to the forefront in the public-private partnership agreements, such as the Highway 407, is who is best to finance the project. Often it has been the case that since public agencies have better credit, they would receive a better interest rate than a private group. This is the reason that a government agency, the Ontario Transportation Capital Corporation, financed Highway 407 (Mylvaganam and Borins, 2004). It is because of this that some feel a public-private partnership was not created (Nix, 2001, p.30).

With regards to the NWT, a public-private partnership has been agreed to between the GNWT and the Fort Providence Combined Council Alliance. According to the Deh Cho Bridge Memorandum of Intent (2002), this partnership will result in the construction of the Deh Cho Bridge, which will cross the Mackenzie River at Fort Providence. The bridge is to be built to the standards of the GNWT, with one condition being that the Alliance receives sufficient financing. In order to recoup revenue, the GNWT will collect a toll on commercial vehicles of $5-$6 per tonne of freight. Each year in return for the financing and construction of the bridge by the Alliance, the GNWT is to pay a base amount to the Alliance. This amount will have to cover the annual operating cost, debt service as well as an annual return of 4.5% of the Alliance's equity of $2 million. After the 35th year of full operation, ownership of the bridge will revert to the GNWT. At the publication of the Deh Cho Bridge Memorandum of Intent, construction was anticipated to last from 2003-2005. As of the present, construction has not yet begun, with environmental concerns being one reason for the bridge's postponement.

There exists potential for the MVH extension to be completed as a public-private partnership, but only if the federal government is involved. The anticipated low volume of commercial vehicles that would use the highway limits the user charge revenue that can be collected. If a private consortium is to build the MVH extension, this consortium will require annual payments from the GNWT each year. Over a term of 35-40 years, these payments would run in the tens of millions of dollars annually based on the $700 million cost of the project. Anticipated toll revenue would not meet the expected annual repayment, and with limitations on

its budget, the GNWT would require federal assistance. With federal government involvement, rather than having a private consortium finance the project, the federal government could finance the project at a lower interest rate. At this point, similar to the Highway 407 project, how to best approach construction of the highway could be studied, and whether or not the scope of the project is too large for local firms to overcome.

V. Conclusion

Construction of the MVH extension has been proposed in order to provide all-weather transport along the Mackenzie River to support local community re-supply and resource exploration and development. How a cost-benefit analysis is manipulated can help in determining whether net benefits are present for the project. It is unlikely that the MVH extension can go ahead without involvement by the Canadian federal government. The enormous per-capita benefits required to overcome the $700 million cost for NWT citizens supports this. Expected commercial traffic tolls will not completely support the highway's costs. With limitations on the funds devoted to transportation by the GNWT, a public-private partnership would certainly need federal repayments to any private consortium that were to complete the road. Private involvement would require sufficient returns on the private investments. With future investment, airships provide a viable, all-weather transport mode in the NWT and the Arctic that could substitute for the MVH extension.

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