Wrigley Norman Wells
MACKENZIE VALLEY HIGHWAY

Mackenzie Valley Highway: Wrigley to Norman Wells

Business Case

Submitted to Infrastructure Canada

Government of the Northwest Territories

July 2015

Northwest Territories Transportation

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Executive Summary

The Government of the Northwest Territories (GNWT) Department of Transportation (DOT) has set a priority to construct the Mackenzie Valley Highway (MVH), an all-weather road beginning where the existing all-weather National Highway System ends in Wrigley and extending down the Mackenzie Valley to the Arctic Coast. Construction of the northernmost section of the MVH, the Inuvik to Tuktoyaktuk Highway is already underway through a funding partnership between Canada and the GNWT. In addition both governments have already placed 38 permanent bridges along the existing Mackenzie valley Winter Road which closely follows the proposed all-weather highway alignment.

The following business case presents an opportunity for Canada and the GNWT to further collaborate in the construction of a 321 kilometre section of highway from Wrigley to Norman Wells in the Central Mackenzie Valley. The Project would further assert Canadian sovereignty in the North by providing reliable access into a relatively isolated region of the territory, incentivizing resource exploration and development of the rich petroleum reserves of the region, and promoting social and economic opportunities for residents of the NWT and Canada. It is estimated that 14,082 jobs within the NWT and the rest of Canada will be created during the construction phase of the project, while 161 long-term jobs are expected to be created for the operation and maintenance phase.

The proposed highway section is 321 kilometres in length and will cost of an estimated $700 million to construct. This project costs can be broken down into four components:

1. Wrigley to Sahtu/Deh Cho Boundary – 102km (31% of the MVH,) general cost estimate- $198m
2. Sahtu/Deh Cho Boundary to Tulita – 144km (45% of the MVH), general cost estimate - $281m
3. Bear River Bridge – 1km bridge plus approaches, cost estimate - $72m
4. Tulita to Norman Wells - 74km (24% of the MVH) general cost – $149m

Project Description

Completing an all-weather highway connecting the Mackenzie Valley in the Northwest Territories (NWT) with the National Highway System has been a longstanding priority of the Government of Canada and the Government of the NWT (GNWT). Over the past 20 years, Canada and the GNWT have co-sponsored significant improvements to the existing Mackenzie Valley winter road system, which serves communities and industrial activities in the Sahtu Region of the NWT, through the construction of several permanent bridges and are currently collaborating on the northernmost section of the envisioned Mackenzie Valley Highway between Inuvik and Tuktoyaktuk, scheduled for opening in Fall 2017.

Constructing the 321 kilometer all-weather section from Wrigley to Norman Wells (the Project) is an immediate priority for Canada to maintain its position as a world class oil and gas producer into the future. The Project will cost $700 million to construct, producing much needed employment, training and business opportunities to Northerners, and will return significant resource-related revenues to Public and Aboriginal Governments over its design life. The highway is integral to the development of a transportation, energy, and communications corridor, which will eventually extend down the entire Mackenzie Valley. In addition, this project will improve the quality of life and lower the cost of living in the remote communities of Tulita and Norman Wells, and will substantially extend winter road access to the neighbouring communities of Fort Good Hope, Délı̨nę, and Colville Lake.

The Project fully meets the criteria for consideration under the Highways and Major Roads category, and the Highways Related to Major Natural Resource Development Opportunities sub-category, of the New Building Canada Plan - National Infrastructure Component. Currently, the winter road system is vulnerable to the effects of climate change and must be upgraded to an all-weather highway to effectively support regional oil & gas development activities and communities in the Sahtu Region. Sustainable economic development will increase long-term employment opportunities for Northerners during the construction phase and through expansion of the resource and tourism sectors and the development of other businesses in the region.

Linking Norman Wells to the all-weather transportation system is critical to embracing the opportunity for resource development and associated resource revenues, the majority of which will flow to the Government of Canada. This is particularly true in light of the significant discovery of an increased level of shale oil resources in the Central Mackenzie Valley by major oil companies Husky and ConocoPhillips and the eventual development of the natural gas reserves in the Sahtu Region, the Mackenzie Delta and Beaufort Delta. As discussed in greater detail in the following section ("Minimum Federal Requirements"), resource extraction from the Central Mackenzie Valley will provide significant economic and employment benefits for NWT residents and to all Canadians.

The Project will extend from Wrigley, NWT (63°13′41″N 123°28′12″W) at km 693 of the existing Mackenzie Valley Highway and extend northward to Norman Wells, NWT (65°16′52″N 126°49′53″W), ending at what will become km 1026 of the Mackenzie Valley Highway.

The highway design parameters for the Project are based on published and accepted guidelines and best practices for developing infrastructure in the NWT, including best practices for permafrost management. The highway design would site the road within a 60 metre wide right-of-way, except where large cut and fill sections will be required. The design is for a 321 km Rural Arterial Undivided (RAU-90) road.

Typical activities proposed over the project's 7-year construction period include: embankment construction;

- development of borrow sources
- construction of remaining water course crossings
- access road development
- fuel and material storage
- camp operations
- waste management

The $700 million project consists of four key components:

1. A highway section from Wrigley to Sahtu/Deh Cho Boundary – 102km (31% of the MVH,) general cost estimate - $198m
2. A highway section from the Sahtu/Deh Cho Boundary to Tulita – 144km (45% of the MVH), general cost estimate - $281m
5. Bear River Bridge – 1km bridge plus approaches, cost estimate - $72m
6. A highway section from Tulita to Norman Wells - 74km (24% of the MVH) general cost – $149m

The GNWT does not anticipate that it will have to secure additional land for the Project, although this will be confirmed during the selection of the final highway alignment. The proposed alignment, defined by Public Works Canada in the 1970's, is anticipated to be completed predominantly within the footprint already established for the Mackenzie Valley public winter road and incorporates the existing permanent bridges at the majority of the water crossing locations.

The Project is proposed as a ten-year project, to be conducted in three phases:

- finalizing funding arrangements in 2015/16;
- completing the environmental assessment and design by 2018/19; and
- constructing the Mackenzie Valley Highway between 2019/20 through to 2024/25.

The project timeframe included in the March 2014 Proposal has not been adjusted. However, the final project plan will be adjusted based on the timing of final project approval.

The proposal submitted to Infrastructure Canada in March 2014, the Project Description Report, and Design Criteria are included in respectively in Appendices 1, 2 and 3.

2015/ 16	2016/ 17 — 2018/ 19	2019/ 20 — 2024/ 25
Timing to Extend the Mackenzie Valley Highway - Wrigley to Norman Wells		
Canada-NWT Funding Partnership	Environmental Assessment and Design	Highway Construction

The majority of the funding ($600M, or 86% of the total proposal) would be loaded in the third phase – Highway Construction (2019/20 through to 2024/25) as shown below.

Canada/ NWT Funding Partnership		15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	Total Ineligible Costs	Total Eligible Costs
Proposed Cash Flow ($M)		10	30	30	30	120	100	100	100	90	90	0	700
Estimated Canada portion (75%)		7.5	22.5	22.5	22.5	90	75	75	75	67.5	67.5	0	525
Estimated GNWT portion (25%)		2.5	7.5	7.5	7.5	30	25	25	25	22.5	22.5	0	175

Minimum Federal Requirements

Project Outcomes and Benefits/Strategic Alignment

The nation's strategic vision for transportation identifies a critical link between Canada's economic prosperity and growth potential and its interdependence on transportation infrastructure to move valuable natural resource commodities to national and international markets. In addition to maintaining existing infrastructure to respond successfully to global pressures, bold investments are necessary to construct basic infrastructure in resource-rich areas where little or no infrastructure currently exists.

The abundant petroleum and mineral resources identified in the Sahtu region of the

Central Mackenzie Valley in the Northwest Territories (NWT) is a case in point. At present, overland industrial development activity is limited to the operating season of a publicly constructed winter road. The length of this operating season fluctuates year to year due to challenges stemming from the effects of global climate change which creates uncertainty around the use of this route .The Mackenzie Valley Winter Road is a temporary snow and ice solution for investors, resource exploration, and community residents alike. A permanent solution to gain year-round access can be realized through the construction of an all-weather highway from Wrigley, the highway's current terminus, to Norman Wells in the Sahtu region.

Strong commitments to continue investing in basic infrastructure in the Mackenzie Valley Corridor remain necessary before Canada can fully realize the benefits of the region's economic potential and maintain a competitive edge in the global marketplace. Innovative investment partnerships between government and industry could make this strategic Canadian corridor a reality.

The vision of an all-weather highway through the Mackenzie Valley to the Arctic Coast has been a strategic priority for Canada since 1958, under the "Roads to resources" program. Construction of this nationally significant highway is viewed as another link to connecting Canada from coast-to-coast-to-coast, and opening new hydrocarbon basins to the benefit of Canadians. This vision is restated in several GNWT strategic investment documents, including *Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories*; in the successful funding proposals *Corridors for Canada* and *Corridors for Canada II;* and in *Connecting Us - NWT Transportation Strategy 2015-2040.*

The 16th NWT Legislative Assembly passed a motion unanimously supporting the construction of the Mackenzie Valley Highway. In 2011, the 17th Legislative Assembly confirmed the project as a priority toward strengthening and enhancing the economies of the North and the rest of Canada. Extending the Mackenzie Valley Highway, from Wrigley to Tuktoyaktuk remains a cornerstone of the GNWT's plan to enhance connections and to seize economic development opportunities.

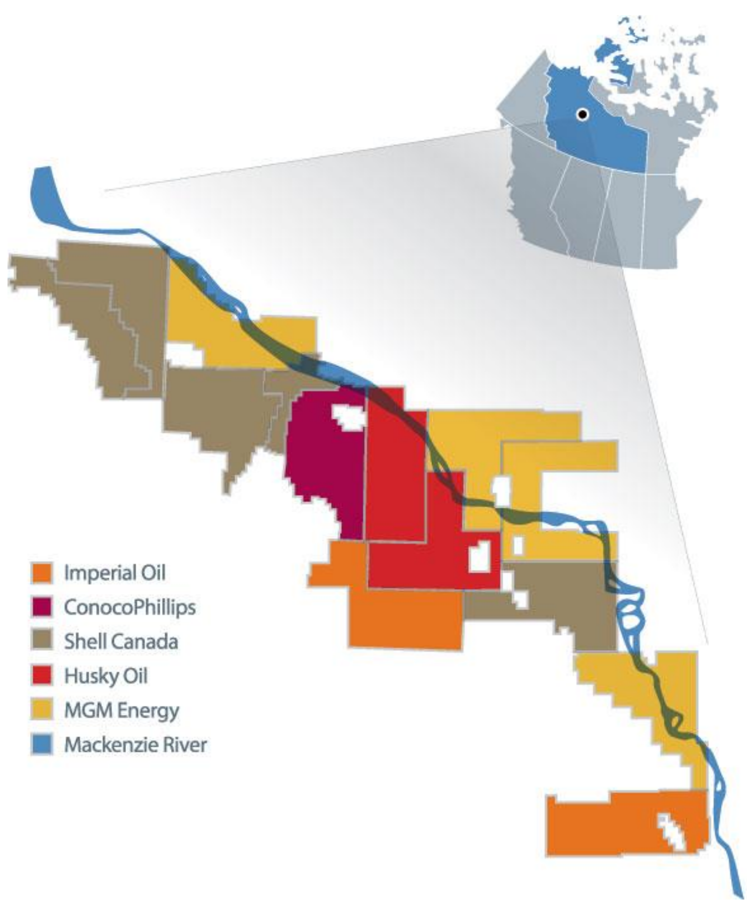
The GNWT has continued developing infrastructure in the Mackenzie Valley since 2000 through funding partnerships with the federal government such as the Building Canada Plan, investing over $120 million. The strength of this partnership resulted in the construction of permanent bridges at 36 water course crossing sites and winter road grade improvements. In addition to extending the window of operation for the winter road system and reducing environmental concerns at stream crossings, the majority of these investments were strategically located along the alignment of the proposed all-weather highway thus reducing the overall cost of achieving the long-held Northern and Canadian vision of year-round access along the Mackenzie Valley Corridor.

Most recently, the Governments of Canada and the Northwest Territories partnered to initiate construction of the northern-most segment of the envisioned all-weather highway to the Arctic coast. This is a 137 kilometre section linking the communities of Inuvik and Tuktoyaktuk on the shore of the Arctic Ocean. The partnership confirms the strategic benefits of building permanent transportation infrastructure to replace expensive to maintain and less reliable winter roads. This 4-year core infrastructure project is promoting economic growth, supporting job creation, increasing productivity, generating income, enhancing the quality of life in the North, and supporting Canada's Arctic Sovereignty.

Extending the all-weather highway into the Central Mackenzie Valley north of Wrigley would alleviate increasing problems associated with the reduction of winter road reliability, uncertainty of opening and closing dates, load limits and reduced periods of operation. Bridge building and construction of an all-weather road would transform the current seasonal road system to a reliable year-round highway.

In 2009, an economic analysis of the influences of building a Mackenzie Valley all-weather highway calculated the direct, indirect, and induced benefits for Canada. The analysis concluded that strategic investments in an all-weather highway are vital to support growth in the hydrocarbon sector over the next five to six decades. Effecting strategic commitments now will contribute to the long-term success of Canada's economy, which requires basic infrastructure such as all-weather highways to access and move resources across territorial, provincial, and international borders.

The Central Mackenzie Valley is an under-explored frontier basin hosting conventional and unconventional oil and gas deposits of substantial proportions. In 2011 and 2012, five different resource companies received 14 license blocks from Aboriginal Affairs and Northern Development Canada to explore the Canol Shale, an area with potential to yield significant

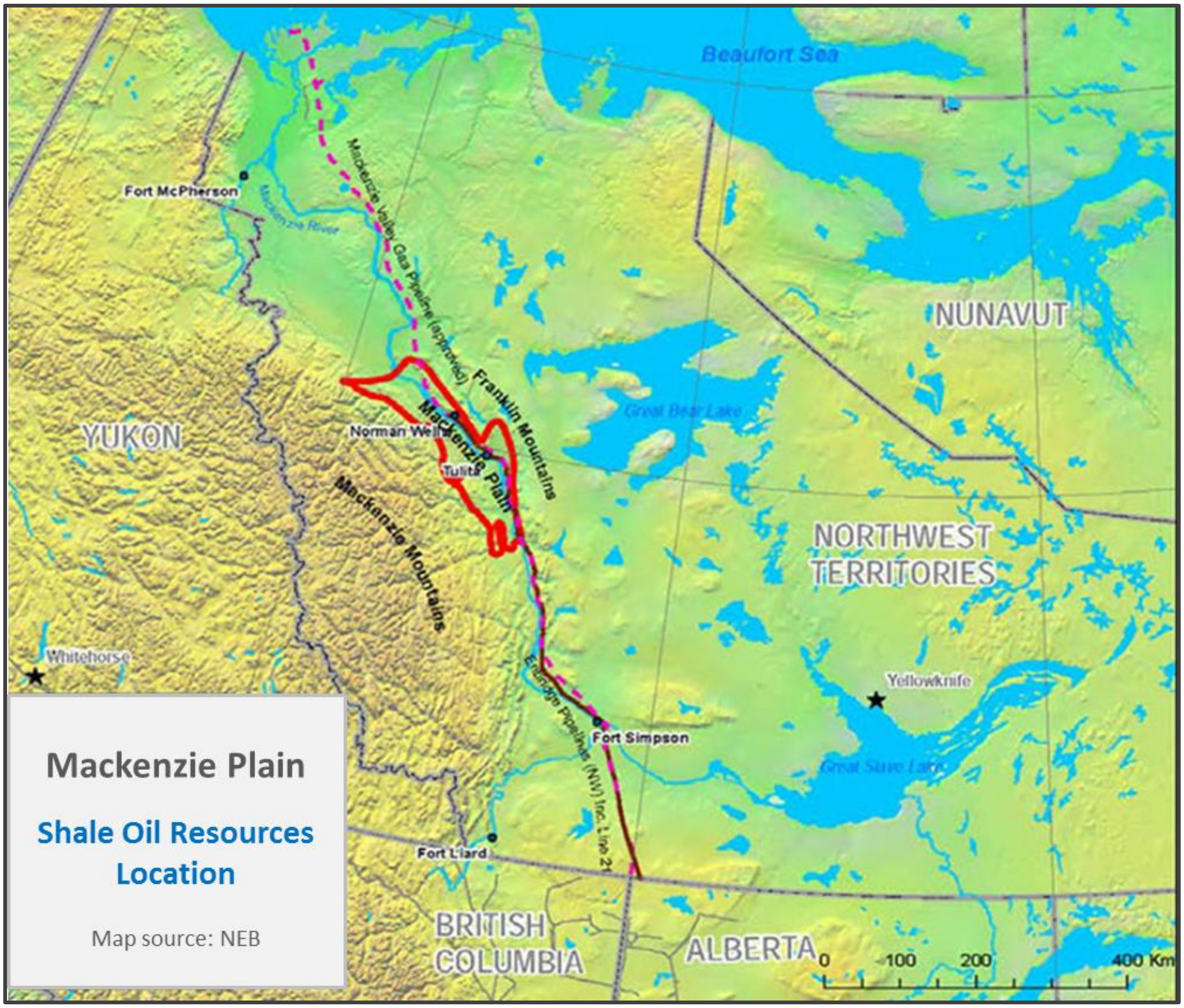


> discoveries of oil and gas in the Central Mackenzie Valley. The Canol Shale is believed to be the source rock of the Norman Wells oil reservoir, which has produced millions of barrels of oil since its discovery in the 1920s. Results of this exploration activity hold the potential to significantly strengthen and diversify the Canadian and NWT economies. In 2011, for example, the petroleum industry committed to investing $534 million to test eleven parcels of land in the Sahtu Region of the NWT and signed access and benefit agreements with local Aboriginal land corporations.

The Canol shale formation, which has already been subject to exploratory drilling by several companies (Husky Energy, Imperial, MGM/Paramount and ConocoPhillips), hosts an estimated 145 billion barrels of oil in place (OIP). The Bluefish shale formation holds an additional estimated 46 billion barrels of OIP, for a combined 191 billion barrels of OIP. The area identified by the red border in the map below shows the location of the Mackenzie Plain Canol and Bluefish shale resources area studied by the National Energy Board (NEB) and the NWT Geological Survey (NTGS).

The shale oil resources in place in the Canol/Bluefish formations in the Sahtu are comparable with other major Canadian shale oil resources, such as the Montney Formation (British Columbia and Alberta - 141 billion barrels) and the Bakken Shale (Saskatchewan and Manitoba - 71 billion barrels). The Bluefish shale could contain between 27 and 70 billion barrels and the Canol shale could contain between 82 to 220 billion barrels of oil. The analysis used a mid-point estimate, meaning that even if only a fraction of the oil from the Canol shale formation was eventually recovered, it would represent a marketable resource of billions of barrels of oil. There is potential that the NWT could become a significantly larger contributor to Canadian energy production and yield associated jobs, business and investment opportunities and government revenues for Canada well into the future.

The May 2015 the Canol and Bluefish shale oil resources estimated by the NEB and NTGS significantly bolstered the need for Canada to consider funding the construction the Mackenzie Valley Highway from Wrigley to Norman Wells. Companies that have been active in petroleum exploration in the Canol shale have stated that their exploration and development costs would decrease by 30-40% if the Mackenzie Valley Highway were in place. Improved access would increase exploration efforts and improving the opportunity to develop marketable oil reserves.



Due to the uncertainties surrounding the recoverability of the oil in these shale formations, the 2015 assessment provided low, expected, and high case estimates of OIP, as shown in the table below. Usually this type of assessment does not include estimates of recoverable volumes, due to limited publicly-available production data. However, even if a small portion of this estimate proves actually recoverable, the recoverable resources will be tens of billions of barrels.

Unconventional Oil-in-place Discovered in the Central Mackenzie

Study Area	Low Case: billion cubic metres (billion barrels)	Expected Case: billion cubic metres (billion barrels)	High Case: billion cubic metres (billion barrels)
Bluefish Shale	4.4 (27.6)	7.4 (46.3)	11.3 (70.8)
Canol Shale	13.1 (82.6)	23.0 (144.8)	35.1 (220.8)
Total	17.5 (110.2)	30.4 (191.1)	46.4 (291.6)

According to a 2009 economic analysis, NWT petroleum developments were expected to generate the following benefits over the next 30 years:

- Contribute up to $58.9 billion to the national gross domestic product
- Create between 86,000 to 181,000 person-years of employment across Canada, 71,118 to 159,719 of which would be created outside the NWT
- Generate up to $15 billion in government revenue, of which the vast majority would flow to the federal government

The above forecasted benefits were calculated years before the recent NEB/NTGS resource estimate was produced, when it was estimated that there were approximately 3 billion barrels of oil in the Sahtu. Clearly, the economic benefits will be substantially greater than those predicted in 2009. The potential development of a 191 billion barrel resource represents a 60-fold increase from earlier expectations.

Due in part to currently low oil prices, two oil and gas giants, Husky Energy and Conoco Phillips, have withdrawn their immediate plans to drill in the Central Mackenzie Valley. Although final numbers are not yet official, activity on the winter road this year reflects a lull in 2014-15 exploration activity compared to previous years. The construction of the Mackenzie Valley Highway from Wrigley to Norman Wells will help send a clear message to industry that the NWT's significant resource reserves are open for development and Canada and the GNWT have set a priority to bring immediate benefits to its residents and to incentivize sustainable resource and other business development activities.

It is presently the opportune time to invest in the Mackenzie Valley Highway, so that essential transportation infrastructure will be in place when oil markets rebound. Given an expected 30-40% reduction in exploration and development costs with the Mackenzie Valley Highway in place, development of the Canol and Bluefish shales may be economic even if oil prices remain at their currently lower levels in the future.

Without improved infrastructure, investors will remain reluctant to invest in the area. The unpredictable factors affecting the length of the winter road's operating season translate into a business concern for mineral, oil, and gas investors involved in exploring the area's resource potential. The existing limited transportation window also increases the cost of development and exploration activities. . Compared to other similar reservoirs elsewhere in North America, the Sahtu shales are seriously disadvantaged by the lack of transportation infrastructure.

The variable nature of the current transportation system also adds uncertainty to other resource development projects while simultaneously posing challenges for community mobility, resupply, industry initiatives, and economic diversification.

Apart from vast petroleum reserves, the Central Mackenzie Valley also holds significant mineral resource potential. However, unlike the successful diamond industries in the NWT's Slave Geologic Province, mineral deposits in the valley require significant transportation infrastructure to export large volumes of ore. The lack of all-season transportation infrastructure to move equipment, goods, and people increases the cost of exploration programs. These costs are the main obstacles to further explore and develop the deposits.

Traffic through the region has demonstrably increased since the major discovery of oil in shale deposits near Norman Wells in 2013. In that year alone, traffic on the winter road, which is limited due to road capacity, increased to an average daily volume of 164, over 200% of the average daily traffic on the winter road over the previous ten years. An all-weather highway is required to keep up with the increased stress and demands upon the region and its limited infrastructure.

Several additional national and territorial outcomes are anticipated from the project as summarized below:

- 14,082 will be created in the construction phase and 161 long-term jobs will be created to maintain the highway afterwards
- Increased employment rates for smaller NWT communitites
- Tourism may increase up to 20%
- increase productivity by improving road access to the region from three months per year to year-round access
- improve access to social programs and lower the cost of living in the five Sahtu communities
- progress towards achieving the four basic priorities of Canada's Northern Strategy: exercising Arctic sovereignty; promoting social and economic development; protecting our environmental heritage, and improving and

devolving Northern governance
- significantly reduce the cost of transporting freight
- stimulate local workforce and business development in the resource sector
- develop hospitality and tourism markets and other businesses
- increase access to health care, education, training resources and employment opportunities
- enable communities and families to interact and share social, cultural, and recreational activities
- incentivize and support resource exploration, development, and production to increase viability and stimulate the economy
- maximize benefits that accrue from resource development
- deliver government commitments for economic development in the NWT
- reduce the cost of delivering government services
- prevent pollution and improve the efficiency of existing facilities that provide emergency response in case of contaminant spillage

Additional details regarding benefits of the Project can be found in Appendices 5, 6, and 7.

A partnership between the Governments of Canada and the Northwest Territories under the National Infrastructure Fund of the New Building Canada Plan to extend the all-weather highway from Wrigley to Norman Wells will contribute to our nation's long-term economic productivity and the future prosperity and well-being of all Canadians.

Eligible Recipient

The eligible recipient for this submission is the Government of the Northwest Territories. Upon completion, the Government of the Northwest Territories will own, operate and maintain the asset as a public highway, unless assessed otherwise by the P3 screening process.

Project Governance

The Government of the Northwest Territories Department of Transportation will be responsible for the environmental assessment and management of contractors through the construction phases of the Project. Governance and oversight will be a vital component of this project. As the project will span the Deh Cho and Sahtu regions, close coordination and consultation with both regional governments has been ongoing for several years and will continue through all phases of the project.

Oversight for this project will be similar to that employed on the Inuvik to Tuktoyaktuk Highway Project. This includes a GNWT Ministerial Oversight Committee, an Infrastructure Deputy Ministers Oversight Committee and a Senior Management Oversight Committee within the Department of Transportation. The Department of Transportation will lead the planning phase, the environmental approval phase, and the design and construction phases. The detailed organizational structure will be developed depending on the type of contract chosen, whether that is a 'design, build, operate and maintain contract' or separate contracts for one or more portions. The planned structure for a traditional procurement approach (design, bid, build) is attached in Appendix 7.

Financial Requirements

All GNWT projects valued at $50 million or greater must be assessed according to the GNWT Public-Private Partnership (P3) Policy and Management Framework to evaluate procurement options. The evaluation will include a detailed feasibility analysis comparing the traditional competitive procurement process against a range of P3 models through the development of an opportunity paper and detailed business case which are currently underway.

Given the benefits to industry, highway tolls may be levied to commercial vehicles to help offset a portion of the projected capital and O&M costs. A detailed business case of the costs and benefits of such tolls is in progress.

This project has been given full endorsement by the GNWT Cabinet, and pending approval by Canada, the GNWT is committed to its $175 million, or 25% cost-share of the project.

Of the total $700 million, Canada's cost share portion will be $525 million, or 75%. The proposed cash-flow is as follows:

Canada/ NWT Funding Partnership	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	Total
Proposed Cash Flow (75% Canada / 25% GNWT)	10	30	30	30	120	100	100	100	90	90	700

The GNWT proposes a funding flow similar to that of the Inuvik to Tuktoyaktuk Highway project, based on milestone completion.

Legal Requirements

The project will adhere to all applicable legislation and all necessary permits and authorizations required for the project will be obtained, including environmental assessment and Aboriginal consultation.

A 2010 funding opportunity with the Canadian Northern Economic Development Agency led to inclusive GNWT partnerships established with Aboriginal organizations to lead, develop, and manage project description reports for sections of the Mackenzie Valley Highway in their land claim areas. These partnerships maximized local involvement, input, and control of the planning process resulting in a common demonstration of support for the proposed all-weather highway. In addition, the collaborative approach resulted in the Department of Transportation receiving the 2012 silver award for innovation from the Institute of Public Administrators of Canada (IPAC).

The completed project description reports formed the basis of a submission initiating an environmental assessment (EA) of the project in 2013. The Mackenzie Valley Environmental Impact Review Board (MVEIRB) issued a Terms of Reference outlining the information and analysis required in a Developer's Assessment Report, a key component of the EA which is anticipated to conclude in 2016/17. The GNWT anticipates finalizing the Developers Assessment Report and completing the environmental assessment process by the close of the 2017 calendar year.

Aboriginal land claim organizations will continue to be involved in related activities such as geotechnical investigations, surveys, consultations, and studies into fisheries, vegetation, wildlife, archaeology, terrain, permafrost, and hydrology.

The contract award process for eligible expenditures is in accordance with the GNWT's well-established and centralized policies and procedures and will be fair, transparent, competitive, and consistent with value for money principles.

Project Risks and Mitigation Measures

Climate change affects the stability of infrastructure in the north, especially through changing permafrost conditions. Highway design parameters are based on published and accepted guidelines and best practices for developing infrastructure in the NWT, including best practices for permafrost management.

No public sensitivities are anticipated by proceeding with the Project. Municipal and Aboriginal governments are supportive of the Project, and have expressed this in community meetings and correspondence. Formal letters of support from the Sahtu Secretariat Incorporated and the Town of Norman Wells are included in this application as Appendix 9.

Through completing a very similar project in the Inuvik to Tuktoyaktuk all-weather highway, the Government of the Northwest Territories is well positioned to anticipate and mitigate possible factors which might impact project delivery timelines or budget targets. The GNWT will further mitigate this through regular reporting and communication with contractors. One possible risk is a scope change pending the results of the environmental assessment. The GNWT considers this to be a low likelihood risk.

The GNWT has a mature and robust risk management system that will be in place and updated throughout the project. Construction in a northern climate is not without risks, however, the lessons learned on constructing Highway 1 to Wrigley, the various bridges and bridge-culverts along the Mackenzie Valley Winter Road, and the Inuvik to Tuktoyaktuk Highway will guide the mitigation of the construction risks.

The risk to the environment is always foremost in construction considerations and strong project management. Solid quality control and quality assurance coupled with the environmental compliance monitoring by the Department of Transportation and the Mackenzie Valley Environmental Impact Review Board will ensure the environment is protected to the best of our abilities.

Continued public and political support is vital to a successful project. Mitigating the risk of loss of support is done through open and frequent communication. As with the Inuvik to Tuktoyaktuk Highway Project, this project will establish website communications, monthly meetings with regulators and all project participants, as well as periodic meetings with the Hunters and Trappers Associations and regional governments. Managing expectations from start to finish is important to open communications.

A detailed risk matrix framework for the project is attached in Appendix 8.

P3 Requirements

As a project over $100 million, the *P3 Suitability Assessment Questionnaire* has been completed and attached to the proposal as Appendix 10.

Appendices Document

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Appendix 1

Mackenzie Valley Highway: Wrigley to Norman Wells: Proposal Submitted to Infrastructure Canada March 2014 and related correspondence

Northwest Territories Executive Council

MAR 3 1 2014

The Honourable Denis Lebel
Minister of Infrastructure, Communities and
Intergovernmental Affairs
SUITE 800 66 SLATER STREET
OTTAWA ON K1A 0A3

Dear Minister Lebel:

Proposal to Construct the
<u>Mackenzie Valley Highway from Wrigley to Norman Wells</u>

Almost fifty years ago, as part of the Roads to Resources Strategy, the federal government started the construction of the Mackenzie Valley Highway to the Arctic Coast with the vision of a strong and prosperous Canada, connected from coast to coast to coast. In 1977, along with the release of the Berger Inquiry findings and the resulting 10-year moratorium on Northern oil and gas development, construction of the Mackenzie Valley Highway was halted near Wrigley.

Thirty five years later, things have certainly changed. The political and economic difficulties that impeded the completion of the Mackenzie Valley Highway almost four decades ago have improved. Northerners are now enthusiastic partners in exploration and development. Estimates indicate the NWT could hold as much as 37 per cent of Canada's marketable light crude oil resources and 35 per cent of the Canada's marketable natural gas resources.

The northernmost segment of the highway, linking Inuvik to Tuktoyaktuk, is under construction. The benefits that will flow to Canada from continuing to pursue the completion of the Mackenzie Valley Highway are greater now than ever.

Together, our governments have the momentum to complete the next segment of the highway. Completion of the southernmost segment of Mackenzie Valley Highway from Wrigley to Norman Wells will improve social and economic opportunities and provide long-term energy security for the people of Canada. This 313-kilometre segment will connect the North's oil and gas centre, Norman Wells, to southern Canada. Consistent with Canada's Northern Strategy, the Mackenzie Valley Highway will ensure a sovereign, strong, and prosperous nation for generations to come.

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Government of the Northwest Territories, P.O. Box 1320, Yellowknife, NT Canada X1A 2L9

It is with great pleasure and promise of a prosperous future that we submit a proposal to collaborate on the construction of the $700 million Mackenzie Valley Highway from Wrigley to Norman Wells for consideration under the National Infrastructure Fund of the new Building Canada Plan.

Thank you for your consideration.

Sincerely,

for

Robert R. McLeod Premier	Tom Beaulieu Minister, Transportation	Robert C. McLeod Minister Responsible for Infrastructure

Attachment

c. The Right Honourable Stephen Harper, P.C., M.P.
Prime Minister

Ms. Lisa Raitt
Minister, Transport Canada

Ms. Penny Ballantyne
Secretary to Cabinet

Wrigley Norman Wells

MACKENZIE VALLEY HIGHWAY

A PROPOSAL FROM THE GOVERNMENT OF THE NORTHWEST TERRITORIES UNDER THE

NATIONAL INFRASTRUCTURE FUND

NEW BUILDING CANADA PLAN 2014-2024

Northwest Territories Transportation

April 2014

MESSAGE FROM THE GOVERNMENT OF THE NORTHWEST TERRITORIES

Almost fifty years ago, as part of the Roads to Resources Strategy, the federal government started the construction of the Mackenzie Valley Highway to the Arctic Coast with the vision of a strong and prosperous Canada, connected coast to coast to coast. In 1977, along with the release of the Berger Inquiry findings and the resulting 10-year moratorium on Northern oil and gas development, construction of the Mackenzie Valley Highway was halted near Wrigley.

The political and economic difficulties that impeded the completion of the Mackenzie Valley Highway almost four decades ago have changed. Northerners are now enthusiastic partners in exploration and development. The NWT is home to a wealth of natural resources, including metals and minerals, oil and gas, and hydro potential on par with James Bay. Estimates indicate the NWT could hold as much as 37 per cent of Canada's marketable light crude oil resources and 35 per cent of the country's marketable natural gas resources. Turning northern potential into national prosperity will take strategic partnerships and investments in key transportation infrastructure that will facilitate exploration, support development and ensure NWT resources can reach world markets. Access to the territory's wealth of resources is currently restricted by the NWT's transportation limitations. The long-promised road to resources is needed now.

Our fiscally prudent management practices have earned the GNWT its sixth Aa1 credit rating from Moody's Investor Service. We have demonstrated that we are a reliable and responsible partner with the proven ability to deliver results for the people of the NWT and all Canadians.

The northernmost segment of the highway, linking Inuvik to Tuktoyaktuk, is under construction. The benefits that will flow to Canada from continuing to pursue the completion of the Mackenzie Valley Highway are greater now than ever.

Together, our governments have the momentum to complete the next segment of the highway. Completion of the southernmost segment of Mackenzie Valley Highway from Wrigley to Norman Wells will improve social and economic opportunities and provide long-term energy security for the people of Canada. This 313-kilometre segment will connect the North's oil and gas centre, Norman Wells, to southern Canada. Consistent with Canada's ***Northern Strategy***, the Mackenzie Valley Highway will ensure a sovereign, strong, and prosperous nation for generations to come. The NWT has the potential to fuel nation building projects that will have profound impacts, north and south of 60, today and for generations to come. We cannot do it alone. Federal support is essential to turn this promise into reality.

It is with great pleasure and promise of a prosperous future that we invite the Government of Canada to partner with the Government of the Northwest Territories on the construction of the $700 million Mackenzie Valley Highway project from Wrigley to Norman Wells for consideration under the National Infrastructure Fund of the new Building Canada Plan.

Robert R. McLeod
Premier

Tom Beaulieu
Minister of Transportation

Robert C. McLeod
Minister Responsible for Infrastructure

ACHIEVING CANADA'S TRANSPORTATION VISION

The nation's strategic vision for transportation identifies a critical link between Canada's economic prosperity and growth potential and its interdependence on transportation infrastructure to move valuable natural resource commodities to national and international markets. In addition to maintaining existing infrastructure to respond successfully to global pressures, bold investments are necessary to construct basic infrastructure in resource-rich areas where little or no infrastructure currently exists.

The abundant petroleum and mineral resources identified in the Sahtu region of the Central Mackenzie Valley in the Northwest Territories (NWT) is a case in point. At present, overland industrial development activity is limited to the operating season of a publicly constructed winter road. The Mackenzie Valley Winter Road is a temporary snow and ice solution for investors, resource exploration, and community residents alike. A permanent solution to gain year-round access can be realized through the construction of an all-weather highway from Wrigley, the highway's current terminus, to Norman Wells in the Sahtu region.

An economic analysis of the influences of building a Mackenzie Valley all-weather highway calculated the direct, indirect, and induced benefits for Canada. The 2009 analysis concluded that strategic investments in an all-weather highway are vital to support growth in the hydrocarbon sector over the next five to six decades. Effecting strategic commitments now will contribute to the long-term success of Canada's economy, which requires basic infrastructure such as all-weather highways to access and move resources across territorial, provincial, and international borders.

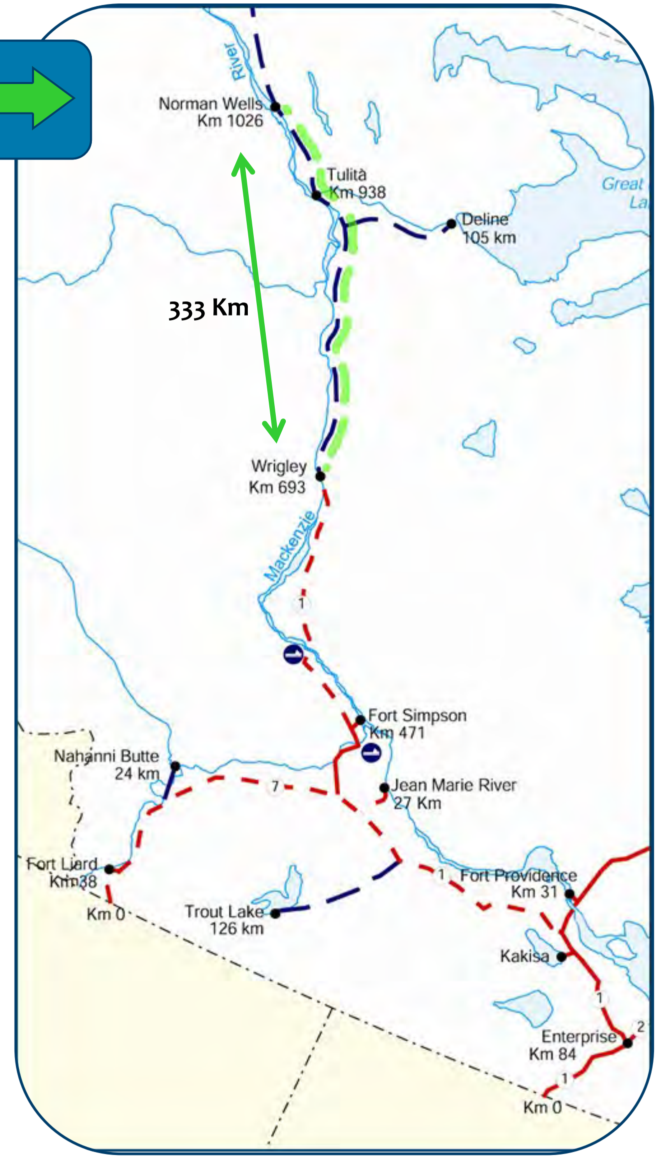
Strong commitments to continue investing in basic infrastructure in the Mackenzie Valley corridor remain necessary before Canada can fully realize the benefits of the region's economic potential and maintain a competitive edge in the global marketplace. Innovative investment partnerships between government and industry could make this strategic Canadian corridor a reality.

The vision of an all-weather highway through the Mackenzie Valley to the Arctic Coast has been a strategic priority for Canada since as far back as 1958. Construction of this nationally significant highway is viewed as another link to connecting Canada from coast-to-coast-to-coast and realizing the federal government's 'Road to Resources' through the NWT as envisioned by previous Canadian leaders.

This same vision is restated in a number of GNWT strategic investment documents, including *Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories* and in the successful funding proposals *Corridors for Canada* and *Corridors for Canada II.*

The GNWT has continued developing infrastructure in the Mackenzie Valley since 2000 through funding partnerships with the federal government resulting in the construction of permanent bridges at water crossings and grade improvements along the length of the

Mackenzie Valley Highway proposed extension
Wrigley to Norman Wells



Four priorities of Canada's *Northern Strategy*: exercising Arctic sovereignty; promoting social and economic development; protecting environmental heritage, and improving and devolving Northern governance.

winter road. In addition to extending the window of operation and reducing environmental concerns at stream crossings, these investments are strategically located on the alignment of the proposed all-weather highway.

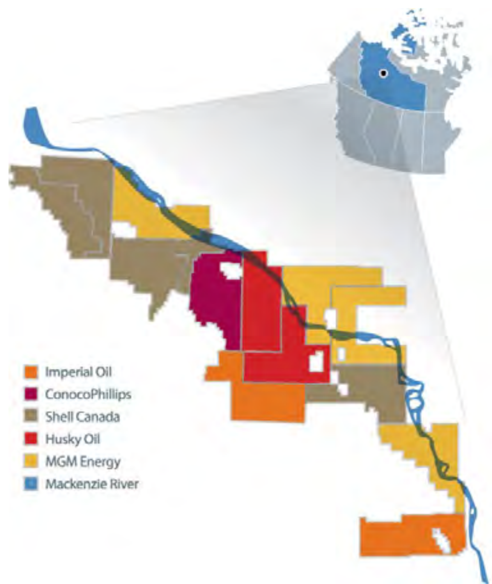
Strategic investments to extend the existing all-weather highway into the Central Mackenzie Valley will promote an attractive business environment for industry, manage industrial development effectively, and maximizes benefits that accrue from resource development. These outcomes align with the priorities stated in Canada's ***Northern Strategy*** specifically by promoting social and economic development in the NWT. Progress to achieve the outlined priorities coupled with the vision of prosperity for NWT and Canadian residents requires investing in permanent transportation infrastructure such as the proposed extension of the all-weather highway into the Central Mackenzie Valley. Investing now will ensure additional large-scale resource exploration and development activities are able to proceed thereby creating numerous opportunities for business and industry in the NWT and the rest of Canada and warrant resource development to continue contributing to self-reliant communities and a strong and prosperous Canada.

The Government of the Northwest Territories is proposing a funding partnership with the Government of Canada under the National Infrastructure Fund of the New Building Canada Plan. Our proposed $700 million investment partnership will continue the federal government's 'Road to Resources' program by extending the Mackenzie Valley Highway from Wrigley to Norman Wells in the Sahtu region of the Central Mackenzie Valley.

ACHIEVING CANADA'S TRANSPORTATION VISION

The central Mackenzie Valley is an under-explored frontier basin host to conventional and unconventional oil and gas deposits of substantial proportion. In 2011 and 2012, five different resource companies received 14 license blocks from Aboriginal Affairs and Northern Development Canada to explore the Canol Shale, an area with potential to yield significant discoveries of oil and gas in the Central Mackenzie Valley. The Canol Shale is believed to be the source rock of the Norman Wells oil discovery, which has yielded millions of barrels of oil since its discovery in the 1920s. Industry experts believe the region has the potential to produce one to two million barrels of petroleum from the Canol Shale formation. Results of this exploration activity hold the potential to significantly strengthen and diversify the Canadian and NWT economies. In 2011, for example, the petroleum industry committed investing $534 million to test eleven parcels of land in the Sahtu region and signed access and benefit agreements with local Aboriginal land corporations.

Increased development activity in the Central Mackenzie Valley, facilitated by all-weather highway access, will result in increased revenue flows to Canada through royalties and taxes. The benefits of exploration and development, in terms of business and employment opportunities, will continue to improve and support the quality of life for Northerners and

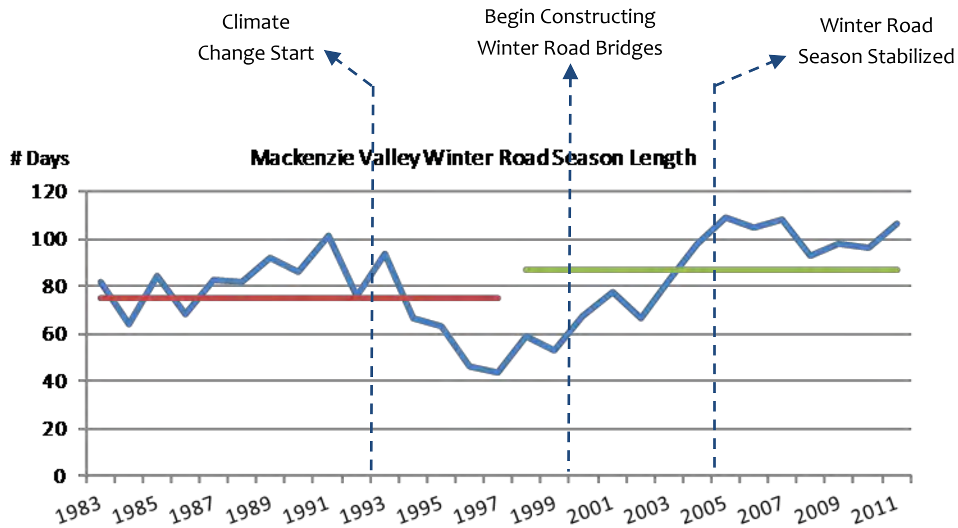


Canadians. According to the 2009 economic analysis, NWT petroleum developments are expected to generate the following influences over the next 30 years:

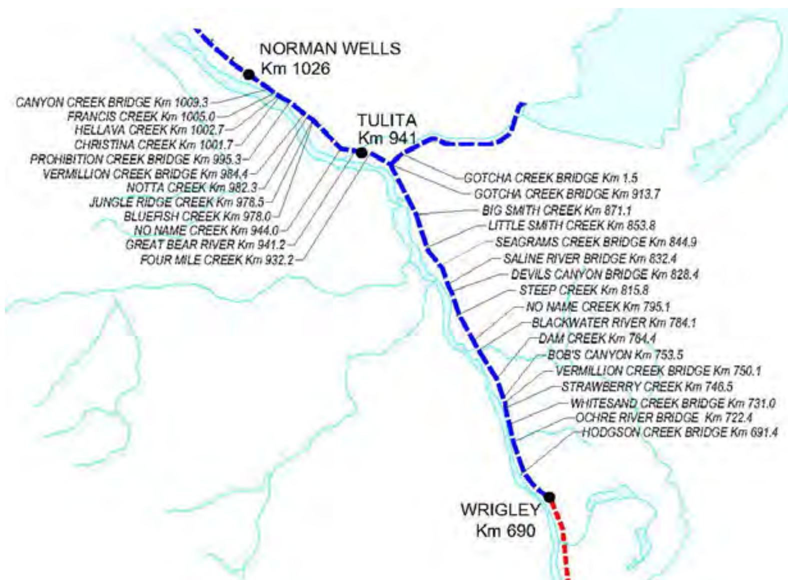
- Contribute up to $58.9 billion to the national gross domestic product
- Create between 86,000 to 181,000 person-years of employment across Canada, 71,118 to 159,719 of which would be created outside the NWT
- Generate up to $15 billion in government revenue, of which the vast majority would flow to the federal government

The Central Mackenzie Valley also holds significant mineral resource potential. However, unlike the successful diamond industries in the NWT's Slave Geologic Province, mineral deposits in the valley require significant transportation infrastructure to export large volumes of ore. The lack of all-season transportation infrastructure to move equipment, goods, and people increases the cost of exploration programs, the main obstacle to further explore and develop the deposits.

A seasonal public winter road constructed north of Wrigley into the Central Mackenzie Valley provides a surface transportation option for approximately three months per year. The unpredictable factors affecting the length of the winter road's operating season though, translate into a business concern for mineral, oil, and gas investors involved in exploring the areas economic potential. The existing limited transportation window also increases the cost development and exploration activities. The variable nature of the current transportation system adds uncertainty to development projects and poses challenges for community mobility, resupply, industry initiatives, and economic diversification.



Significant improvements have been achieved increasing the duration of the winter road operating season since the installation of permanent infrastructure began in 2000 .



Permanent bridges installed on the Mackenzie Valley winter road between Wrigley and Norman Wells since 2000 have resulted in longer operating seasons and greater access for industry and residents

Since 2000, the governments of Canada and the Northwest Territories have successfully invested more than $120 million in permanent structures and grade improvements along the Mackenzie Valley winter road as a proactive solution to increase the window of operation and better facilitate resource exploration activities and cost-effective community resupply. Our investments include grade improvements, safety enhancements, and 36 bridges strategically located on the alignment of the proposed all-weather highway, thus chipping away at the overall cost of achieving the long-held Northern vision of year-round access.

The northern-most segment of the envisioned all-weather highway to the Arctic coast is a 170 kilometre section linking the communities of Inuvik and Tuktoyaktuk on the shore of the Arctic Ocean. A partnership between the Governments of Canada and the Northwest Territories initiated the highways construction early in 2014, confirming the strategic benefits of building permanent transportation infrastructure where none currently exists. This 4-year core infrastructure project will promote economic growth, support job creation, increase productivity, generate income, enhance the quality of life in the North, and support Canada's claim to Arctic Sovereignty.

Extending the all-weather highway into the Central Mackenzie Valley north of Wrigley would alleviate increasing problems associated with the reduction of winter road reliability, uncertainty of opening and closing dates, and reduced periods of operation. Bridge building and all-weather road would transform the current discontinuous system to one that functions year-round.

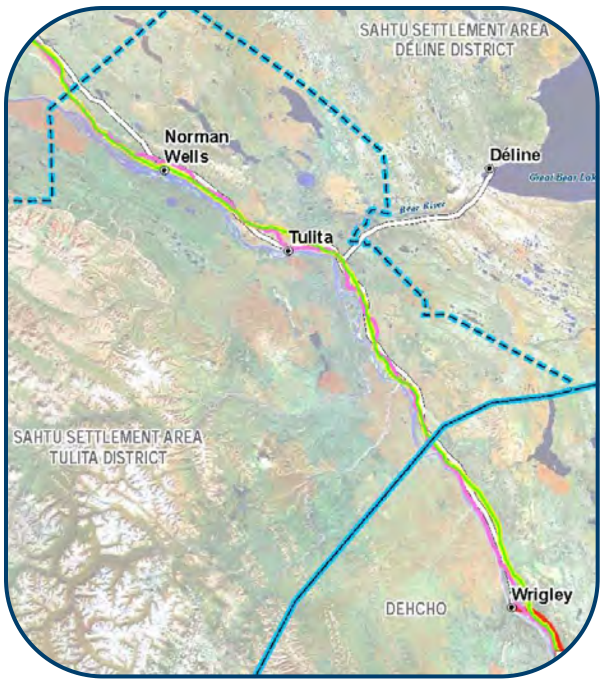
Inclusive partnerships with Aboriginal organizations to lead, develop, and manage PDRs for sections of the Mackenzie Valley Highway in their land claim areas maximized local involvement, input, and control of the planning process. The result was a common demonstration of support for the proposed all-weather highway and the Department of Transportation receiving the 2012 Silver Award for Innovative Management from the Institute of Public Administrators of Canada

A PLAN TO EXTEND CANADA'S 'ROAD TO RESOURCES'

A number of studies were undertaken by the federal government in the 1960's and 70's supporting the construction of an all-weather highway through the Mackenzie Valley. These studies produced a detailed road alignment, environmental data, and engineering design, which eventually added to Project Description Reports (PDR) for an all-weather highway through Aboriginal land claim areas.

A 2010 funding opportunity with the Canadian Northern Economic Development Agency led to inclusive GNWT partnerships established with Aboriginal organizations to lead, develop, and manage PDRs for sections of the Mackenzie Valley Highway in their land claim areas. These partnerships maximized local involvement, input, and control of the planning process resulting in a common demonstration of support for the proposed all-weather highway. In addition, the collaborative approach resulted in the Department of Transportation receiving the 2012 silver award for innovation from the Institute of Public Administrators of Canada (IPAC).

The completed PDRs formed the basis of a submission initiating an environmental assessment (EA) of the project in 2013. The Mackenzie Valley Environmental Impact Review Board (MVEIRB) issued a Terms of Reference outlining the information and analysis required



An all-weather highway extension into the Central Mackenzie Valley from Wrigley to Norman Wells traverses the Sahtu Settlement Area (Tulita) and the Deh Cho region of the NWT.

in a Developer's Assessment Report, a key component of the EA which is anticipated to conclude in 2016/17. Aboriginal land claim organizations will continue to be involved in related activities such as geotechnical investigations, surveys, consultations, and studies into fisheries, vegetation, wildlife, archaeology, terrain, permafrost, and hydrology.

The proposed highway extension from Wrigley to Norman Wells is approximately 333 kilometres in length. The highways alignment, defined by Public Works Canada in the 1970's, is within a footprint already established for the public winter road and incorporates the existing permanent bridges at water crossing locations. Highway design parameters are based on published and accepted guidelines and best practices for developing infrastructure in the NWT, including best practices for permafrost management. The highway design would see a road placed within a 60 metre wide right-of-way (ROW) except where large cut and fill sections will be required. The road surface will average 9 m in width and range between 1.6 and 2 m in depth. These standard embankment widths and

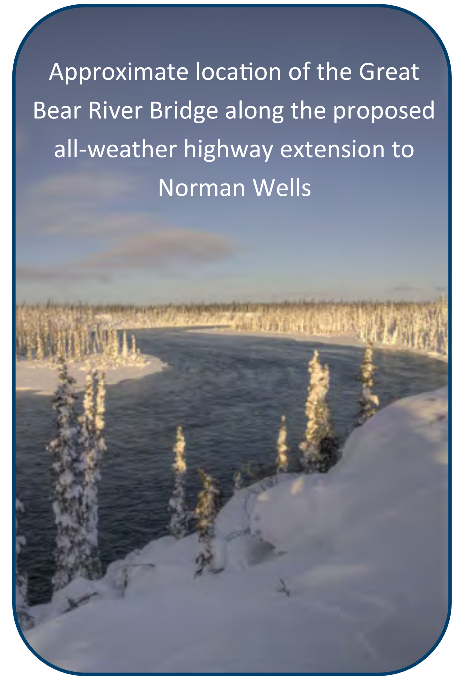
Canada/ NWT Funding Partnership	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	Total
Proposed Cash Flow	10	10	10	10	120	120	120	100	100	100	700

depths could be altered to accommodate site specific conditions.

Typical activities proposed over the project's 7-year duration include embankment construction, development of borrow sources, construction of remaining water course crossings, and supporting activities such as access road development, fuel and material storage, camp operation, and waste management.

The proposal also requires the construction of one major bridge designed in 2006 to span the Great Bear River near Tulita, a community south of Norman Wells. An environmental assessment and water license required for the Great Bear River Bridge are already complete bringing the estimated cost of its construction to $70 million, which is included in the total proposal of $700 million. Upon its completion, the Mackenzie Valley Highway to Norman Wells will be operated as a public highway by the GNWT.

All GNWT projects valued at $50 million or greater must be assessed according to the governments Public-Private Partnership (P3) Policy and Management Framework to evaluate procurement options. The evaluation will include a detailed feasibility analysis comparing the traditional competitive procurement process against a range of P3 models through the development of an opportunity paper and detailed business case. Given the benefits to industry, it is anticipated that highway tolls will be levied to commercial vehicles to help offset a portion of the projected capital and O&M costs.



Approximate location of the Great Bear River Bridge along the proposed all-weather highway extension to Norman Wells

Timing to Extend the Mackenzie Valley Highway - Wrigley to Norman Wells

2014/ 15	2015/ 16 — 2017/ 18	2018/ 19 — 2023/ 24
Canada-NWT Funding Partnership	Environmental Assessment	Highway Construction Project

NATIONAL AND REGIONAL BENEFITS

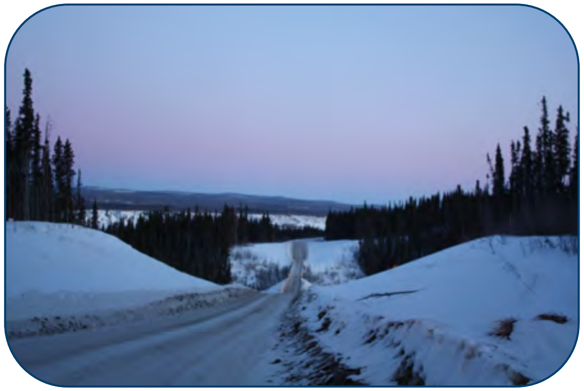
The *Mackenzie Valley All-weather Road Economic Analysis* prepared for the GNWT in 2009 updated a socio-economic study that was included in the 1999 Highway Strategy. This economic analysis looked at the overall Mackenzie Valley Highway (Wrigley to Inuvik) and includes the following anticipated national and territorial outcomes:

The anticipated subsequent benefits of extending the all-weather highway to Norman Wells remain the same as when first proposed by Canada in the 1960s:

- Provide a year-round transportation link between the Central Mackenzie Valley and southern Canada
- Decrease the cost of living by increasing access to good and services
- Significantly reduce the cost of transporting freight
- Stimulate local workforce and business development in the resources sector
- Develop hospitality and tourism markets and other businesses
- Increase access to health care, education, training resources and employment opportunities
- Enable communities and families to interact and share social, cultural, and recreational activities
- Support resource exploration, development, and production to increase viability and stimulate the economy
- Deliver government commitments for economic development in the NWT
- Reduce the cost of delivering government services
- Improving the efficiency of existing facilities that provide emergency response in case of contaminant spillage and pollution prevention
- Providing an effective demonstration of Canada's sovereignty on its share of the northern hemisphere, sea and land

The world is taking notice of the NWT's resource potential with the territory ranking as the 29th out of 96 as the most attractive jurisdiction for mineral exploration and development in the world and the best overall improvement in Canada.

2012-2013 Annual Survey of Mining Companies—The Fraser Institute



Canada ***Northern Strategy*** is based on four priorities: exercising Arctic sovereignty; promoting social and economic development; protecting our environmental heritage, and improving and devolving Northern governance. Progress to achieving these priorities and the vision of prosperity for NWT and Canadian residents requires investing in permanent transportation infrastructure such as this proposed extension of the all-weather highway into the Central Mackenzie Valley.

An all-weather highway from Wrigley to Norman Wells will support the non-renewable resource industry, facilitate the diversification of the NWT economy and improve the quality of life of its citizens through better access to essential services, increased mobility, and a lower cost of living leading to safe and healthy communities.

A partnership between the Governments of Canada and the Northwest Territories under the National Infrastructure Fund of the New Building Canada Plan to extend the all-weather highway to Norman Wells will contribute to our nation's long-term economic productivity and the future prosperity and well-being of all Canadians.

We are a Northern country.
The true North is our destiny – for our explorers, for our entrepreneurs, for our artists.
To not embrace the promise of the true North now, at the dawn of its ascendancy, would be to turn our backs on what it is to be Canadian.

Prime Minister Stephen Harper

Northwest
Territories Executive Council

JUL 1 4 2014

The Honourable Denis Lebel
Minister of Infrastructure, Communities and
Intergovernmental Affairs
SUITE 800 66 SLATER STREET
OTTAWA ON K1A OA3

Dear Minister Lebel:

Proposal to Construct the Mackenzie Valley Highway
from Wrigley to Norman Wells

Thank you for your correspondence of May 14, 2014, concerning the Government of the Northwest Territories' (GNWT) funding proposal to construct the Mackenzie Valley Highway from Wrigley to Norman Wells under the New Building Canada Plan's National Infrastructure Component (NIC).

The NIC provides merit-based funding for projects of national significance within seven categories. Under the NIC, the construction of this segment of the Mackenzie Valley Highway meets the criteria for the *Highways and major roads* category, and the *Highways related to major natural resource development opportunities* sub-category.

Resource deposits in the Norman Wells area of the Central Mackenzie Valley hold the potential to produce two to three billion barrels of petroleum from the Canol Shale formation. An economic analysis conducted in 2009 anticipates NWT petroleum developments to generate substantial contributions over the next 30 years including:

- Up to $58.9 billion in national GOP;
- 86,000 to 181,000 person-years of employment, the majority created in the rest of Canada; and,
- Up to $15 billion in government revenue, the majority flowing to Canada.

Extending the Mackenzie Valley Highway to Norman Wells will provide an essential link between NWT petroleum deposits, national and international markets.

The GNWT is eager to collaborate with Canada to deliver a project that, upon completion, will:

- Increase productivity from 3 months to year-round by creating road access from the resource-rich Central Mackenzie Valley to southern Canada;
- Support resource exploration, development, and production by increasing viability, stimulating the economy, and promoting an attractive business environment for industry;

.../2

- Decrease the cost of living and increase opportunities in nearby communities by increasing access to good and services, health care, education, training resources, employment opportunities, and reducing the cost of delivering government services;
- Enable communities and families to interact and share social, cultural, and recreational activities;
- Improve public safety and the efficiency of emergency response;
- Provide an effective demonstration of Canada's sovereignty on its share of the northern hemisphere; and,
- Greatly reduce travel time, freight expense, and environmental footprints by decreasing air travel dependencies.

In light of the formal business case guide released after the development of the Government of the Northwest Territories' original proposal, our government is working diligently to create a revised project proposal to meet Infrastructure Canada's business case guide.

The Government of the Northwest Territories is now modifying our Mackenzie Valley Highway proposal put forward in March 2014 to reflect the recently released business case guide from Infrastructure Canada.

Thank you for your ongoing collaboration and we look forward to sharing the business case in the coming weeks.

Sincerely,

Robert R. McLeod
Premier

Tom Beaulieu
Minister, Transportation

Robert C. McLeod
Minister Responsible for Infrastructure

Attachment

c. The Right Honourable Stephen Harper, P.C., M.P.
Prime Minister

Ms. Lisa Raitt
Minister, Transport Canada

Ms. Penny Ballantyne
Secretary to Cabinet

Appendix 2

Project Description Report for the Mackenzie Valley Highway: Wrigley to Norman Wells submitted to the Mackenzie Valley Environmental Impact Review Board

Northwest Territories Transportation

Mackenzie Valley Highway

Updated Project Description

August 2014

Department of Transportation,
Government of the NWT
Yellowknife, Northwest Territories

Project Number: 123510598

Northwest Territories Transportation

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1 INTRODUCTION

The Department of Transportation (DOT) of the Government of the Northwest Territories (GNWT) is proposing to extend the Mackenzie Valley Highway (MVH) from Wrigley to Norman Wells. This updated project description replaces the project description contained in the "Mackenzie Valley Highway Environmental Scoping Document" dated January 2013 and is submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) for the purpose of re- scoping the Environmental Assessment of the proposed Mackenzie Valley Highway development (MVEIRB file EA1213-02).

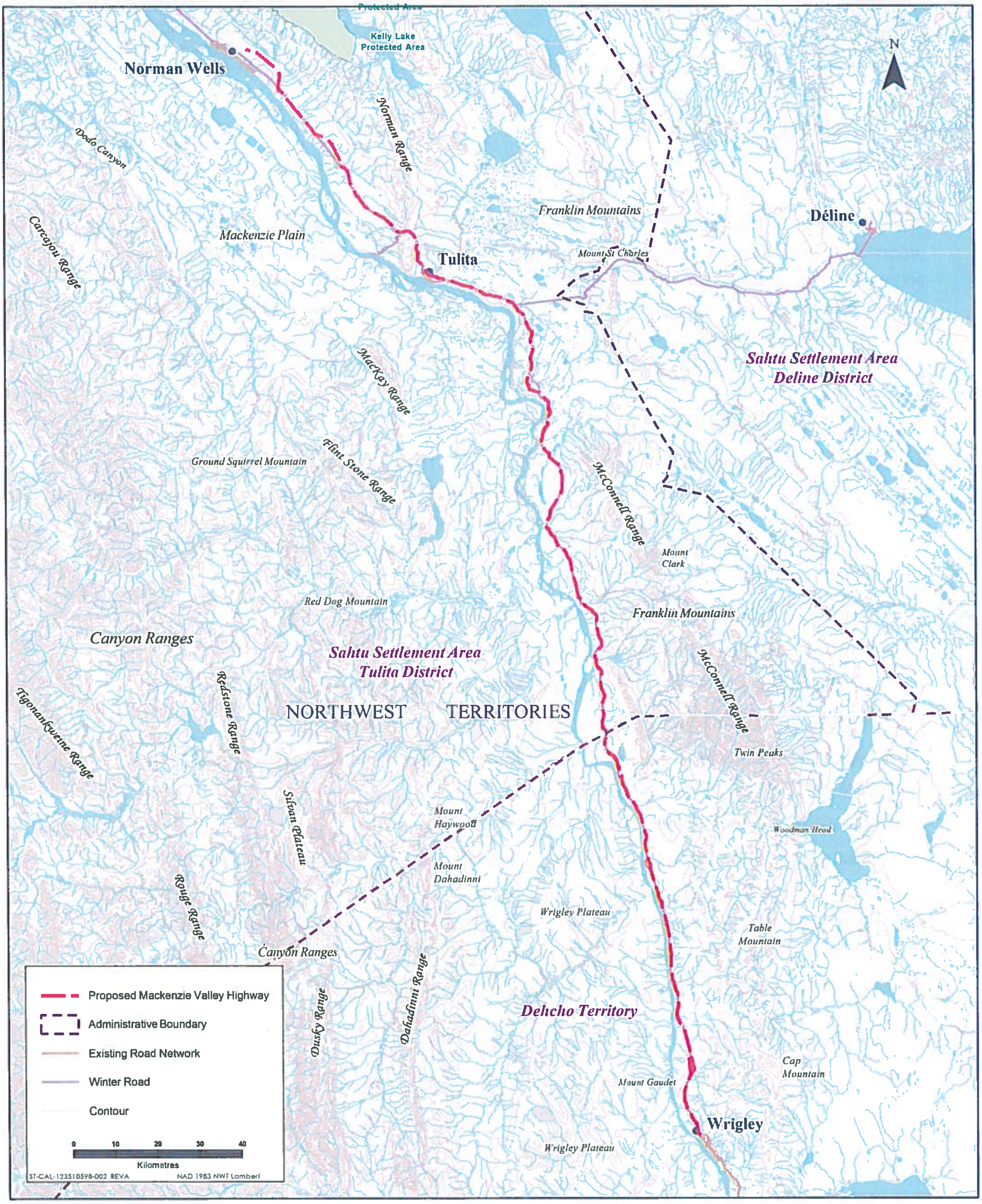
1.1 Project Overview

The Mackenzie Highway (Hwy 1) currently extends from the Northwest Territories/Alberta border to the community of Wrigley in the central Mackenzie Valley. This Project proposes the construction of an all-season highway between the communities of Wrigley and Norman Wells, much of the route following the existing footprint of the Mackenzie Valley Winter Road. The development includes the following components:

- Construction of a 321 km all-season gravel highway from Wrigley to Norman Wells;
- Construction of watercourse crossing structures;
- Construction and operation of temporary and permanent borrow sources;
- Construction and operation of permanent highway maintenance areas;
- Construction and operation of temporary support infrastructure and workspaces including, camps and laydown and staging areas;
- Ongoing highway operations and maintenance; and
- Reclamation of areas not required for ongoing operations.

The Project will pass through the Dehcho Territory and a portion of the Tulita District of the Sahtu Settlement Area (SSA) within the Northwest Territories (NWT). Figure 1-1 illustrates the route of the proposed MVH. Table 1-1 illustrates the length of the proposed Project in each of these regions.

The MVH will be operated and maintained as part of the NWT Public Highway System.



Sources: Base Data - Her Majesty Government of Canada. Thematic Data - ERBC

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Northwest Territories
MACKENZIE VALLEY HIGHWAY

Proposed Mackenzie Valley Highway Alignment

Figure 1-1

Table 1-1 Mackenzie Valley Highway Route Segment Lengths

Region	MVH KM Post	Length (km)
Dehcho (Wrigley to Sahtu Settlement Area (SSA) Boundary)	690 to 796	106
Tulita District (SSA Boundary to Tulita)	796 - 936	140
Tulita District (Tulita to Norman Wells)	936 to 1011	75
Total		**321**

1.2 Project Approvals

The proposed Project will be constructed on Territorial Lands, Commissioner's Lands and Private lands as identified in the Sahtu Dene and Métis Comprehensive Land Claim Agreement (SDMCCLA). Anticipated project activities requiring approvals and the associated approval agencies are illustrated in Table 1-2.

Table 1-2 Construction Activities and Agency with Jurisdiction - Mackenzie Valley Highway

Project Activities	Approval Agency
Pre- Construction Phase	
Environmental Baseline Studies Programs	Aurora Research Institute
Wildlife Baseline Studies	GNWT Department of Environment and Natural Resources
Fisheries Baseline Studies	Fisheries and Oceans Canada
Archaeological Field Investigations	GNWT Prince of Wales Northern Heritage Centre
Geotechnical Investigations	Mackenzie Valley Land and Water Board
Thermal Analysis	Mackenzie Valley Land and Water Board
Topographic Studies	Mackenzie Valley Land and Water Board
Hydrographical Studies	Mackenzie Valley Land and Water Board
Detailed Design	Mackenzie Valley Land and Water Board
Construction Phase	
Rights to access land	Tulita District Land Corporation GNWT Department. of Lands
Camps and staging areas	Mackenzie Valley Land and Water Board
Right-of-way clearing/winter road/detour construction	Mackenzie Valley Land and Water Board

Table 1-2 Construction Activities and Agency with Jurisdiction - Mackenzie Valley Highway

Project Activities	Approval Agency
Pre- Construction Phase	
Borrow source and access road development	GNWT Department. of Lands Tulita District Land Corporation Mackenzie Valley Land and Water Board
Watercourse crossing construction	Fisheries and Oceans Mackenzie Valley Land and Water Board
Embankment construction	Mackenzie Valley Land and Water Board

2 PROJECT BACKGROUND

2.1 Introduction

The concept of building an all-weather highway through the Mackenzie Valley to connect southern Canada with northern communities originated in the 1960s, although it was not until 1972 that the federal government announced that the Mackenzie Highway would be extended from Fort Simpson to the Dempster Highway. Field surveys and design work for the route was initiated and construction of the highway started in Fort Simpson but was halted approximately 18 km south of Wrigley in 1977, after 210 km were completed. Following devolution of responsibility for the highway system from the federal government, the GNWT developed its Highway Strategy in 1989 committing to the extension of the MVH. By 1994, the remaining 18 km of the highway to Wrigley was completed. Preliminary engineering, environmental and financial studies to support planning for the construction of the remainder of the MVH to Inuvik were undertaken in 1999. More recently, between 2010 and 2012 the DOT GNWT entered in to agreements with Aboriginal organizations in the Tulita District of the Sahtu Settlement Area (SSA) and the Dehcho Region to prepare Project Description Reports (PDRs) which evaluated environmental conditions, included community consultations and presented a preliminary design and routing for the MVH (5658 NWT Ltd., and Govt. Northwest Territories, 2011 and Pehdzeh Ki First Nation and Govt. Northwest Territories, 2011).

The project description presented in this report has considered the results of these past studies and the vast experience of DOT in planning, constructing and operating highways throughout the NWT.

2.2 Purpose of the MVH Project

The vision of an all-weather highway through the Mackenzie Valley to the Arctic Coast has been considered a strategic priority for Canada as far back as 1958 by the federal government. This road was seen as the final link to connect Canada from coast to coast to coast. This vision has been recently restated in a number of GNWT strategic documents, including the Department of Transportation's 2000 Highway Strategy, *Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories*, and two funding proposals in pursuit of this vision, *Corridors for Canada* and *Corridors for Canada II*. Connecting Canada to the Arctic coast is also important to the socioeconomic future of Canada. The completion of the Mackenzie Valley Highway to the Arctic coast will provide enormous opportunities for residents of the Northwest Territories and all Canadians. Its completion is a cornerstone of the GNWT's plan for present and future economic development in the NWT. While the GNWT is committed to extending the MVH to the Dempster Highway and is currently constructing an all-weather road between Inuvik and Tuktoyaktuk, fiscal constraints limit the current proposal to extending the highway to Norman Wells.

Construction of the highway from Wrigley to Norman Wells is consistent with the GNWT's vision and is intended to provide the following specific benefits:

- provide a year round transportation link connecting the central Mackenzie Valley with the Northwest Territories all – weather highway system and southern Canada;
- decrease the cost of living for residents by increasing access to goods and services;
- increase access to health care, educational resources, and employment opportunities;
- enable opportunities for communities and families to interact and share social and cultural connections and participate in recreational and sporting activities;
- support resource exploration, development, and production to stimulate the regional economy;
- mitigate effects of climate change on the current winter road system;
- create tourism and hospitality opportunities;
- reduce the cost of delivering government services; and
- delivery of government's commitment to economic development in the NWT.

2.3 Proponent

The GNWT will act as the proponent, coordinating the involvement of other potential partners in the development of the Project. Contact information for the GNWT is provided below.

Rhonda Batchelor
Director, Environmental Affairs
Department of Transportation
Highways Building, 2nd Floor
4510- 50th Avenue
P.O. Box 1320
Yellowknife, NT X1A 2L9
T. 867.920.3460
F. 867,920.2565

3 DEVELOPMENT SCOPE

The proposed Project includes the construction of an all-weather highway between the communities of Wrigley and Norman Wells. The development includes the following components:

- Construction of 321 km all-season gravel highway from Wrigley to Norman Wells;
- Construction of watercourse crossing structures;
- Construction and operation of temporary and permanent borrow sources;
- Construction of permanent highway maintenance areas;
- Construction and operation of temporary support infrastructure and workspaces including, camps; laydown and staging areas; and
- Reclamation of areas not required once construction is completed.

Operation and maintenance of the highway will occur, but are not considered to be within the scope of development subject to assessment. Section 13, Schedule 1 of the Exemption List Regulations, issued under authority of the *Mackenzie Valley Resource Management Act* exempt "operation and maintenance of a highway" from Preliminary Screening because their impact on the environment is considered insignificant.

During preparation of the regional PDRs, installation of a fibre optic cable in the highway Right of Way was initially included as a project component. It is no longer a component of the MVH project proposal.

Planned improvements to the Mackenzie Valley Winter Road (MVWR) are not included in the scope of this project. Only those works which contribute to the construction of the all-weather MVH are intended to be included within the scope of the development subject to environmental assessment. Because the MVWR provides ongoing and critical access for residents and businesses along the Mackenzie Valley, maintenance and/or repair work may need to be undertaken during the course of the MVH's environmental assessment.

3.1 Development Location

The proposed Project is located in the Mackenzie Valley region of the NWT, between Norman Wells in the north and the terminus of the all-weather highway at Wrigley in the south (Figure 1-1). The coordinates of the segments of the Project in each of the settlement regions are presented in Table 3-1.

Table 3-1 Development Location

Project Feature	KM	Latitude (N)	Longitude (W)
Norman Wells (north end)	1011	65°17'34"	126°44'11"
Boundary of Sahtu Settlement Area - Tulita District and Dehcho Region	796	64°01'08"	123°28'44"
Wrigley (south end)	690	63°13'58"	124°16'26"

3.2 MVH Alignment

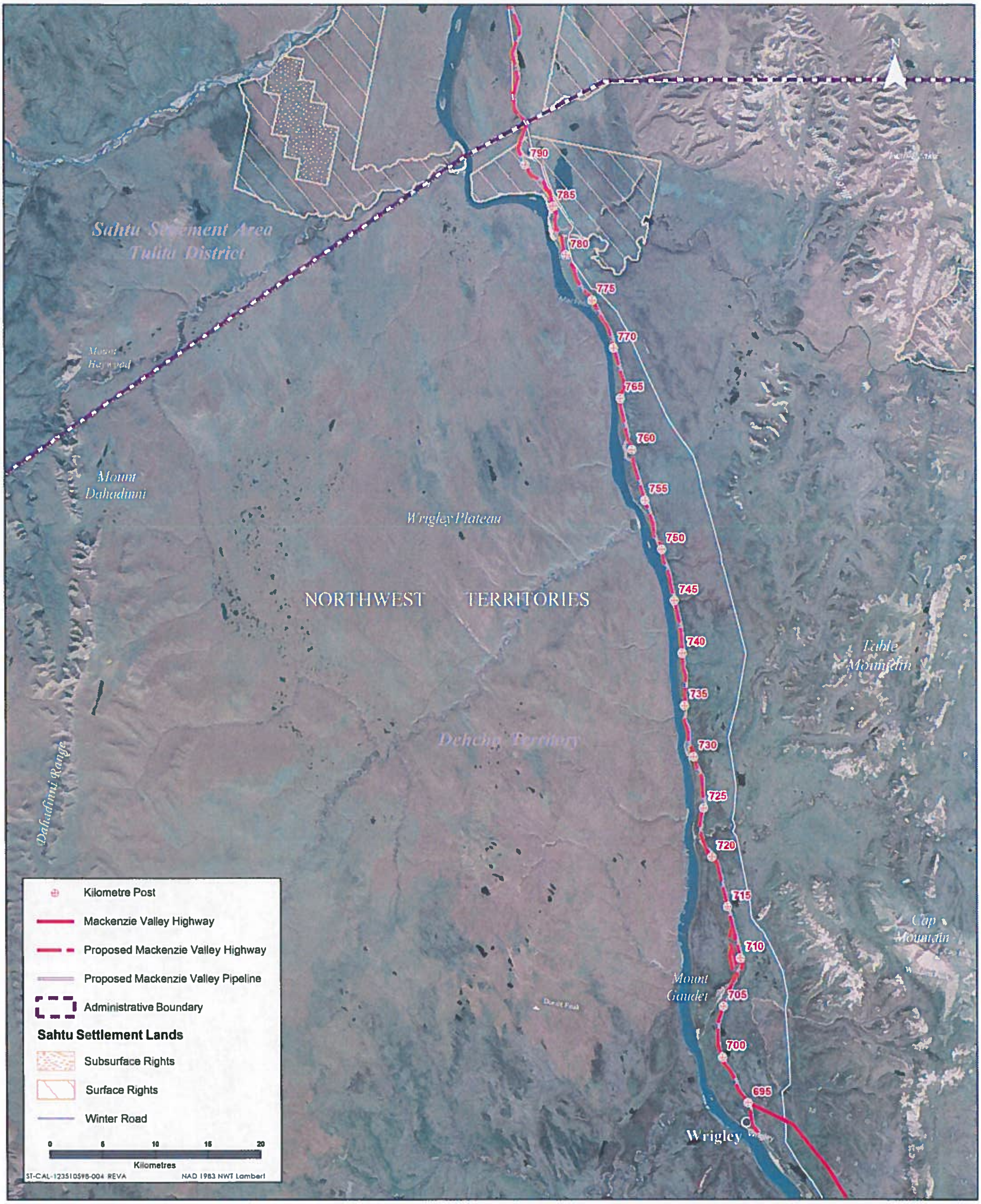
Several potential alignments for the Project had been identified prior to initiation of the most recent routing studies in 2010. These included the original Public Works Canada (PWC) alignment identified in the 1970s, the existing winter road alignment between Wrigley and Norman Wells and the approved Mackenzie Gas Project (MGP) corridor (IORVL 2004).

Studies in 2010 were undertaken which contributed additional options for identifying a preliminary alignment and site-specific alternatives. Available information was used by the authors of the recent PDRs in initial desktop routing studies to suggest a preliminary alignment, minor alternatives, potential watercourse crossing locations and potential borrow material sources, based on the following objectives:

- Utilize the existing winter road alignment from Wrigley to Norman Wells as much as practicable;
- Minimize footprint through traditional use, conservation and special management areas;
- Avoid known potential ice rich and unstable terrain;
- Avoid steep grades and deep valleys;
- Optimize bridge lengths;
- Avoid locations with cultural or heritage resources potential;
- Situate the route on or near potential borrow sources to minimize the need and/or length of temporary or permanent access roads; and
- Optimize natural topography to minimize construction material requirements.

The preliminary alignment and site-specific alignment options were also conditioned by the findings of engineering analysis, previously conducted field study records and overview planning studies, and comments received during consultations.

The two PDRs initiated in 2010 ultimately proposed the alignment shown in Figure 1-1, and again in Figures 3-1 and 3-2. These alignments are subject to further analysis and ground truthing during the detailed design process.



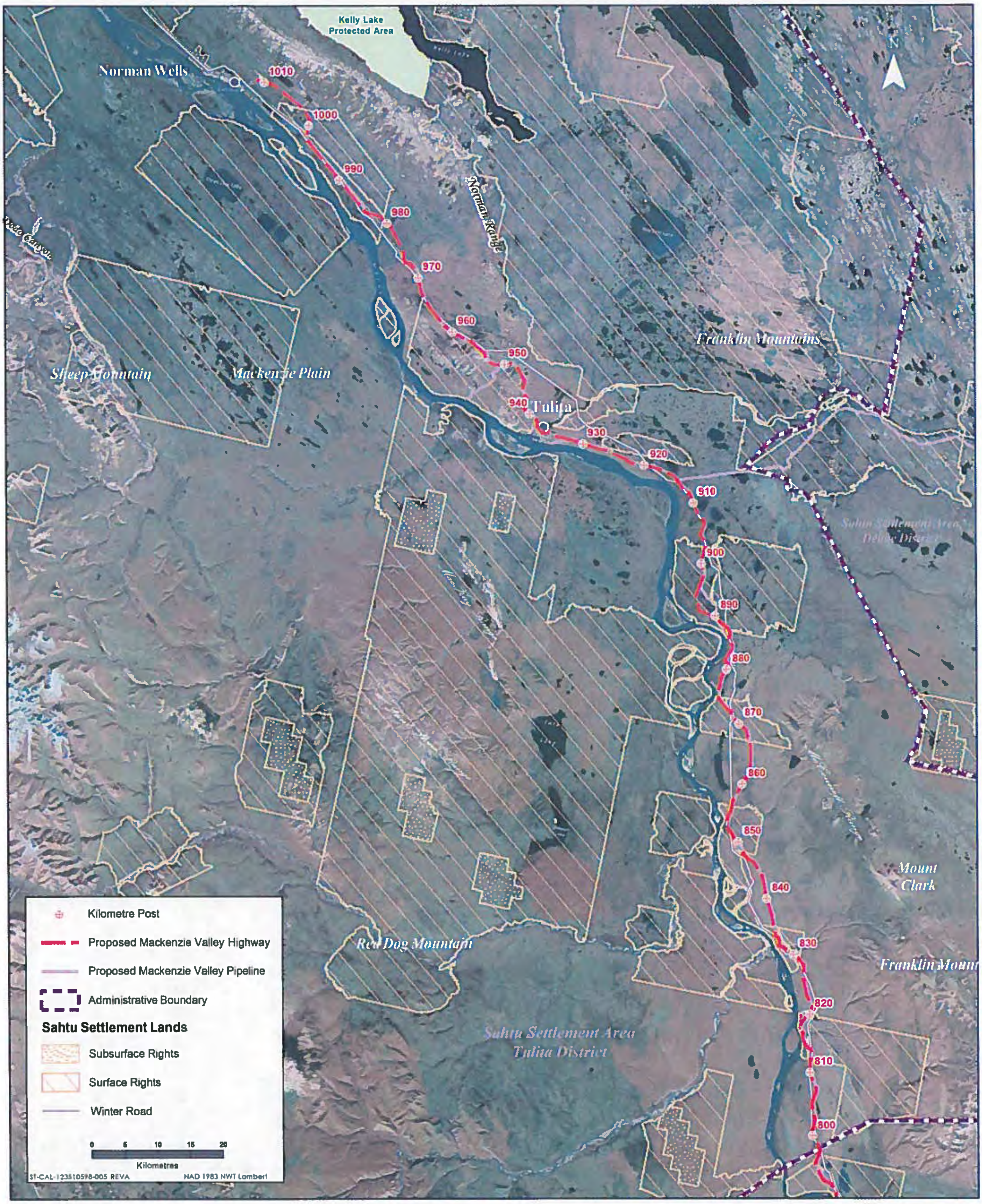
Sources: Base Data - Her Majesty Government of Canada. Thematic Data - ERBC. Imagery provided by Microsoft BING

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Northwest Territories
MACKENZIE VALLEY HIGHWAY

Dehcho Region Alignment

Figure 3-1



Sources: Base Data - Her Majesty Government of Canada. Thematic Data - ERBC. Imagery provided by Microsoft BING

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency

Northwest Territories
MACKENZIE VALLEY HIGHWAY

Sahtu Settlement Area - Tulita District Alignment

Figure 3-2

3.3 Design Considerations

The route and operational design of the Project is guided by:

- safety requirements;
- engineering and environmental considerations; and
- incorporation of local and traditional knowledge.

The design of the Project takes into consideration and makes considerable use of data and information collected during the planning of the Mackenzie Gas Project.

3.3.1 Design Parameters

The RAU-90 design designation, approved by the GNWT (TAC 2010) has been applied during routing and design analysis. This design standard is considered to be appropriate for passenger and commercial traffic volumes of up to 100 vehicles per day (vpd)[1], well above the estimated traffic volumes for the highway of 50 vpd (including estimated future increases due to development and tourism)[2]. The design criteria may be reduced in some areas where the existing terrain and soil conditions constrain the design alignment of the Project.

The right-of-way (ROW) will be limited to 60 m in width, except where large cut and fill sections will be required. The road surface will average 9 m in width and range in depth. Standard embankment widths and depths may be altered to accommodate site specific conditions. The posted speed limit will be 80 km per hour with advisory speed posted where the design standards have been reduced.

3.3.2 Site Specific Considerations

Site specific design exceptions and operation controls (e.g. reduction in posted speed limits) will be required in some locations to address challenges presented by terrain conditions. Analysis undertaken during preparation of the PDRs has identified several locations where operational controls may be required; however, further analysis will be undertaken during future design activities. There may be design exceptions such as horizontal curves, vertical curves, speeds and grades.

3.3.3 Incorporation of Traditional Knowledge

The DOT continues to take into account traditional knowledge in truthing the footprint suggested in the various preliminary design options, included in previously conducted studies, and as communicated during Project-specific consultations.

[1] RAU 90 Geometric Design Guidelines, Transportation Association of Canada

[2] Project Description Report for the Construction of the Mackenzie Valley Highway, Tulita District, Sahtu Settlement Area

In the Sahtu Settlement Area - Tulita District, traditional knowledge was obtained from the draft Sahtu Land Use Plan (SLUPB 2010)[3], Rakekee Gok'e Godi: Places We Take Care Of (Sahtu Heritage Places and Sites Joint Working Group 2000), Spirit of the Mountains: Shuhtagot'ine Nene and Naats'ihch'oh Traditional Knowledge Study (SENES 2009), Traditional Knowledge Study Report: Great Bear River Bridge (EBA 2006), Mackenzie Gas Project Environmental Impact Statement (IOL et al., 2004), and in project specific consultations July 2010, March 2011 and October 2011.

Traditional knowledge collected during development of the PDRs informed the preliminary design with respect to:

- The location of cultural, wildlife and harvesting areas;
- Proposing areas of potentially sensitive terrain; and
- Identifying potential mitigations;

Traditional knowledge holders will continue to be engaged during subsequent Project phases.

3.4 Development Phases and Schedule

Project activities can be summarized by two phases: pre-construction and construction. It should also be mentioned that the highway will be subject to operation and maintenance activities once it is completed. Subject to regulatory approval and confirmation of federal funding, construction could start in mid-2017 and continue to 2022. It is currently proposed that construction will progress concurrently from both ends of the Project. A procurement process for this Project has not been determined.

3.4.1 Pre- Construction: Supplemental Baseline Collection, Ground Truthing, Detailed Design Production, Construction Planning

Pre-construction activities required during this stage are focused on collecting the data that is necessary to support the subsequent submission of the MVH project to regulatory processes. The work identified below will contribute specific and directly relevant data to the detailed design, construction planning and assessment of potential effects of the project. Specifically, this would include:

- Environmental baseline studies;
- Hydrotechnical investigations at watercourse crossings;
- Thermal Analysis;
- Topographical Analysis;
- Detailed highway and bridge design;
- Geotechnical investigations along the route and at borrow sources;
- Development of monitoring and management plans;

[3] The Sahtu Land Use Plan was approved in August 2013.

- Acquisition of project permits and authorizations; and
- Tendering of construction and supply contracts.

3.4.2 Construction

The construction phase includes:

- ROW clearing;
- Offsite fabrication of bridge components and mobilization;
- Development of supporting infrastructure such as camps, workspaces and staging areas, and fuel storage areas;
- Construction and operation of borrow sources;
- Embankment construction;
- Construction of watercourse crossing structures; and
- Reclamation of abandoned sites after the alignment is ready for traffic (year one or two of operation).

Certain construction activities, such as borrow source development and staging will occur year-round, but some activities including, winter road and highway embankment construction will occur primarily in winter and continue over a four year period. Construction activities and timing are summarized in Table 3-2; further detail is provided in Section 3.5.

Table 3-2 Development Activities and Timing *

Project Activity	Start	Duration
Pre-Development Phase		
Site investigations and assessment (such as environmental studies and engineering, geotechnical investigations, thermal analysis, hydrographical analysis and topographical analysis.)	Winter 2014/15 and 2015/16	2 years
Ongoing public engagement	May 2010	All phases
Environmental Assessment	February 2014	3 years
Detailed design and permitting	Fall 2014	2 years
Completion of Access and Benefits Agreements	Spring 2015	1 year
Construction Contracting and Procurement	2017	During construction
Construction Phase		
Right-of-way clearing	2017	3 years
Development and operation of camps, barge landings, staging areas and temporary workspaces	Fall 2017	Ongoing through construction
Mobilization/demobilization	Summer 2017	4 years
Borrow source development	Fall 2017	4 years

Table 3-2 Development Activities and Timing *

Project Activity	Start	Duration
Installation of watercourse crossing structures	January 2017	4 years
Embankment construction	Winter 2018	4 years
Compaction and surfacing	June 2018	4 years (summer)
Reclamation of abandoned sites after the alignment is ready for traffic (year one or two of operation)	Year 2	4 – 5 years
NOTE: * Timing is subject to completion of EA and receipt of federal funding		

3.4.3 Operation and Maintenance

The operations phase includes ongoing maintenance and repair activities to support highway operation. Operation and maintenance activities will be conducted year-round and as noted in Section 3 are not considered to fall within the scope of the assessment.

3.5 Highway Construction Approach

Construction activities for the MVH will occur year round; however, many activities will be undertaken during winter, depending on the results of thermal analysis. The advantages of winter (December-March) construction are as follows:

- The Project can be accessed using temporary ice roads or snow trails, without the need to construct costly all-weather access roads;
- Winter construction allows the placement of construction material directly onto frozen ground. This approach enables the establishment of a frozen core for the Highway and helps protect sensitive and ice rich terrain; and
- Winter construction reduces effects on wildlife, vegetation and soils;

Winter construction has the following disadvantages:

- Work is challenging for both personnel and equipment, with extreme cold temperatures common at the beginning of the construction season in late December and early January;
- Activities are conducted in periods of minimal daylight;
- Excavation of frozen material in borrow sources will likely require the use of drill and blast methods to be able to source the required volumes of material for construction;
- Excavation and placement of frozen material directly on top of geotextile placed on the natural ground makes it more difficult to achieve compaction of the embankment layers; and
- Potential sensory and physical disturbance to over-wintering wildlife.

Although much of the construction may be executed during winter, it is expected that summer and fall construction will be feasible for some activities, especially in areas where permafrost is not present. With construction expected to be completed over a 4 year period, approximately 3-5 construction spreads will be active in any given year depending on the method of procurement used.

Table 3-3 summarizes the seasonality of proposed construction activities.

Table 3-3 Seasonality of MVH Project Construction Activities

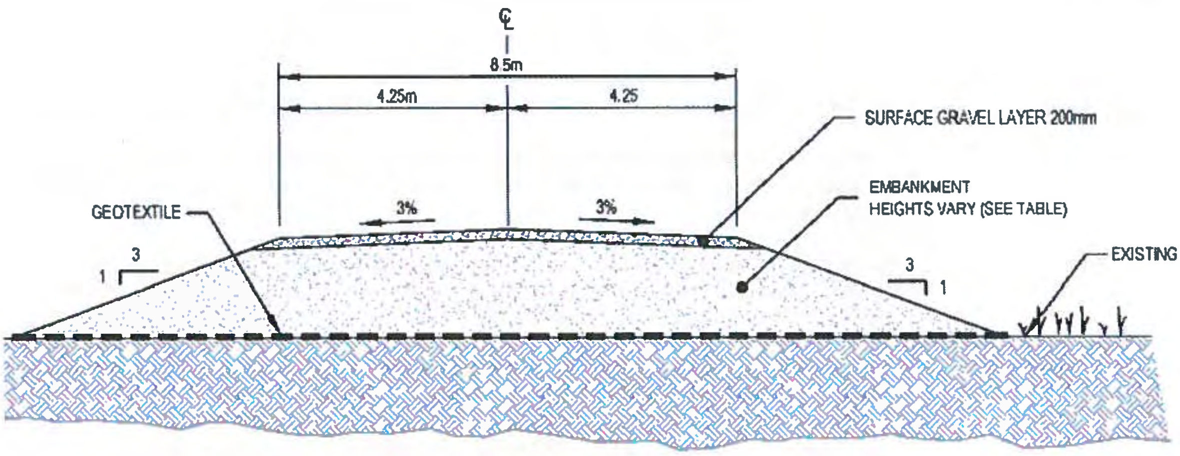
Season	Activities
December-January	Clearing of right-of-way and construction of winter roads; camp set up and mobilization
January-March	Borrow source development; clearing; hauling and embankment construction, mobilization to bridge sites and piling for bridge abutments; erection of bridge piers and abutments, culvert installation
April-June	No activities requiring access off of previously constructed all-weather roadways. Could include production and stockpiling of borrow material assuming equipment has been mobilized to the particular borrow source
July-November	Any activity that does not require overland access or can be accessed by previously constructed segments of the Highway. Could include compaction of previously constructed embankment and placement of surfacing material (if feasible based on geotechnical conditions -amount of thaw and moisture content of material); culvert installation, borrow material processing, launching of bridge girders and deck components mobilization on all-weather roads and/or river barge.

3.5.1 Embankment Construction

The highway embankment construction methods will vary according to a number of factors including the presence of permafrost, ice rich soils, bedrock and other terrain features. The embankment is primarily expected to be constructed using a fill approach; however, a cut-and-fill approach may be utilized in areas where terrain conditions will impact the highway's vertical or horizontal alignment. A generalized highway cross-section based on the fill approach is illustrated in Figure 3-3.

Embankment designs will be finalized during detailed design, following completion of detailed geotechnical investigations and topographical survey. Final embankment designs will be selected to prevent or minimize the expansion of the active layer under the embankment and will take into account predictions of ice content, as well as local terrain and permafrost characteristics.

Right-of-way clearing, geotextile and fill placement will primarily occur in winter but may also be completed during summer depending on the presence of permafrost. Embankment compaction, grading, and surfacing, and base course placement will occur in summer. Where cut-and-fill construction is required, stripping and removal of organic material, and drilling and blasting of rock may occur in summer or winter. Hauling, placement, and compaction of base course will occur in summer. Other site-specific activities, such as bedrock material stockpiling, placement of riprap, infill or low-lying areas or construction of other erosion control mitigation may occur year-round depending on site characteristics and access considerations.



TYPICAL HIGHWAY CROSS SECTION

TERRAIN TYPE	DESCRIPTION	EMBANKMENT HEIGHTS
1	DRY (ICE POOR) TILL AND OUTWASH DEPOSITS	1.4 m
2	WET (ICE-MEDIUM TO ICE-RICH) TILL AND OUTWASH DEPOSITS	1.4 to 1.6 m
3	WET SILTS AND CLAYS (ICE-RICH)	1.6 to 1.8 m
4	THICK ORGANIC PEATLANDS AND ICE-RICH PERMAFROST	1.8 m

ST CAL-123510598-003 REVA

Sources: Base Data - Her Majesty Government of Canada Thematic Data - ERBC

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency

Northwest Territories
MACKENZIE VALLEY HIGHWAY

Typical Embankment Cross Section

Figure 3-3

3.5.2 Watercourse Crossings

The proposed route will cross a number of watercourses requiring construction of bridges or culverts. At this time, detailed investigations of watercourse crossings have not been conducted to confirm the total number and type of watercourse crossings; however, it is anticipated that there are over 300 minor crossings and approximately 40 major crossings. Structures have already been constructed across some of these crossings. some of which already have structures. The final number and location of crossings are subject to change following completion of hydro-technical analysis and detailed design.

3.5.3 Borrow Sources

Granular materials will be required for embankment construction, construction of temporary support facilities and permanent maintenance areas required during the operations phase. Estimated granular quantities for the construction phase are provided in Table 3-4 and are based on preliminary design estimates. Material estimates will be defined to a greater level of accuracy during detailed design.

Potential granular material sources have been identified from preliminary studies and existing information. The selection of the borrow sources to be used for development will be refined and truthed through more detailed investigation and design in the pre-construction phase. Borrow source investigations will include geotechnical investigations and acid and leachate testing to confirm quantity and quality of materials, access planning, evaluation of environmental constraints, consultation with landowners and preparation of management plans for those sources proposed for development. A summary of sources identified during the preliminary design stage, as reported in the PDRs for each region, is presented below.

Table 3-4 Estimated Granular Requirements for Construction of the MVH Preliminary Design

Item	Quantity		
	Sahtu Settlement Area - Tulita District	Dehcho	Total
Embankment	7,310,000 m^3	3,780,000 m^3	11,090,000 m^3
Base course	433,000 m^3	220,000 m^3	653,000 m^3
Gravel sub base	1,200,000 m^3	600,000 m^3	1,800,000 m^3

3.5.3.1 Sahtu Settlement Area - Tulita District Segment

Table 3-5 lists the potential borrow sources identified within the Sahtu Settlement Area - Tulita District.

Table 3-5 Potential Borrow Sources in the Sahtu Settlement Area - Tulita District (south of Norman Wells)[4]

Source No.	Offset and Direction from Alignment (km)	Station	Estimated Requirements (m^3)	Estimated Volume of Source (m^3)
9.037PA	0.90 W	796+400	150,901	4,600,000
9.034PB	0.25 W	803+000	321,783	N/A
9.024AP	0.40 NE	815+700	485,386	1,000,000
9.017P	0.80 N	829+600	225,288	2,700,000
9.010PA	0.70 SW	839+300	332,425	N/A
9.002PB	0.80 SW	850+200	303,614	N/A
1788	2.50 E	863+000	460,754	Unknown
1768	0.00	872+400	483,538	Unknown
20.086P	0.25 N	888+800	511,724	11,700,000
1750	0.00	897+000	209,562	Unknown
8.058P	0.50 NE	907+400	262,669	N/A
1746	0.00	912+000	219,553	Unknown
1942	0.00	926+100	277,138	Unknown
1419	1.00 N	934+800	117,065	
1449	0.00	937+700	14,208	Unknown
1428	0.50 S	949+400	415,500	Unknown
7.090P	0.60 NE	962+700	316,333	N/A
1633	0.00	973+600	181,466	Unknown
7.078P	2.70 NE	988+100	239,458	900,000
7.070P	4.50 NE	996+100	219,467	1,000,000
7.057P	0.50 NE	1011+900	299,369	N/A
		Total	6,047,201	21,900,000

4 Project Description Report for the Construction of the Mackenzie Valley Highway, Tulita District, Sahtu Settlement Area

3.5.3.2 Dehcho Segment

Table 3-6 lists the potential borrow sources identified within the Dehcho Segment of the Project.

Table 3-6 Potential Borrow Sources in the Dehcho Territory[5]

Name	Ownership	Location	Type	Estimated Volume of source (1000 m^3)	Existing?
Primary Sources					
10.043P	Territorial	9 km S of Wrigley	Granular	19,700	Yes
10.030P	Territorial	17 km N of Wrigley	Granular	684	Yes
10.020P	Territorial	31 km N of Wrigley	Granular	1,600	Yes
10.007P	Territorial	56 km N of Wrigley	Granular	1,200	Yes
9.044PB 9.044PA	Territorial	13 km S of boundary	Granular	15,000	Yes
9.037PB 9.037PA	Territorial	2 km S of boundary	Granular	4,600	Yes
9.034PB 9.034PB	Territorial	5 km N of boundary	Granular	3,800	Yes
Secondary Sources					
9.024AP	Private	18 km N of boundary	Granular	1,000	Yes
10.044BP	Territorial	12 km S of Wrigley	Granular	N/A	Yes
10.038PA	Territorial	1 km N of Wrigley	Granular	N/A	No
10.0120P	Territorial	9 km N of Wrigley	Granular	N/A	No
10.037P	Territorial	3 km N of Wrigley	Granular	N/A	No
10.033P	Territorial	12 km N of Wrigley	Granular	N/A	No
10.022P	Territorial	29 km N of Wrigley	Granular	N/A	Yes
10.014AP	Territorial	38 km N of Wrigley	Granular	N/A	No
10.013P	Territorial	43 km N of Wrigley	Quarry	N/A	No
10.014AP	Territorial	38 km N of Wrigley	Granular	N/A	No
10.013P	Territorial	43 km N of Wrigley	Quarry	N/A	No
10.004P	Territorial	27 km S of boundary	Granular	N/A	No
10.003P	Territorial	23 km S of boundary	Granular	N/A	No

[5] Mackenzie Valley Highway Extension Pehdzeh Ki Ndeh – Dehcho Region

Table 3-6 Potential Borrow Sources in the Dehcho Territory[5]

Name	Ownership	Location	Type	Estimated Volume of source (1000 m^3)	Existing?
10.001P	Territorial	17 km S of boundary	Granular	N/A	No
9.091P	Territorial	12 km S of boundary	Granular	N/A	No
9.038PB	Private	6 km S of boundary	Granular	N/A	No
9.038PA	Private	3 km S of boundary	Granular	N/A	No

3.5.4 Support Infrastructure and Activities

Construction of the Project will require a variety of temporary support infrastructure including camps, staging and stockpile areas, access roads, fuel storage and waste disposal sites.

3.5.4.1 Construction Camps and Contractor Maintenance Areas

Temporary construction camps will be required to house workers, and provide project management and maintenance infrastructure. Camps are expected to be located no more than 50 km apart and will be combined with other infrastructure (e.g., borrow sources) to minimize project footprint. Primary camps will accommodate the 150 -180 workers that are likely to be required on a specific construction spread. Pioneer camps accommodating up to 20 workers may be required at specific facilities such as borrow sources and staging areas.

Primary camps are expected to include the following infrastructure and activities: accommodation, offices, maintenance shops, equipment and material storage, fuel storage, helipads, water use, solid waste and wastewater disposal sites.

3.5.4.2 Staging Areas

In addition to storage areas at camps, stockpile sites and staging areas will be required to store equipment and supplies and provide workspaces during construction. Staging areas will be required at strategic locations to provide for efficient mobilization and construction. Potential locations include:

- Intersection of the MVH with the existing all-weather highways to the south;
- Adjacent to existing resupply infrastructure (e.g. communities);
- At borrow sources; and
- At other strategic locations along the proposed route.

The specific location of staging areas will be identified during the detailed design stage.

Staging areas may include:

- Laydown areas for storage of equipment and supplies (culverts, bridge components, geotextiles, etc.);
- Granular material stockpiles;
- Pioneer camps and maintenance facilities;
- Fuel storage areas;
- Waste storage areas; and
- Helicopter pad and access road.

3.5.4.3 Access/Haul Roads

In some locations all-weather access roads may be required to support year round construction. All-weather access roads will be located along the proposed highway footprint as much as possible but may need to be constructed off the right of way to access borrow sites selected for permanent or long-term use.

The driving surface width of any access or haul road will likely be 10 to 20 m. The cleared width required would be approximately 50 m. The specific alignment and type of all access roads will be confirmed in the early stages of detailed design in the development of the Project.

3.5.4.4 Barge Landings

Equipment and supplies may be mobilized to some construction spreads by barge on the Mackenzie River. Laydown areas will be required at barge landing sites to store materials until they can be mobilized to the highway ROW.

Only established barge landing sites will be utilized, including sites in the following communities:

- Norman Wells;
- Tulita; and
- Wrigley.

3.5.4.5 Explosives

Drilling and blasting operations will be required in:

- borrow pits where the granular material is frozen; and
- bedrock cuts and rock quarries.

Explosives used will be primarily ammonium nitrate and diesel fuel (ANFO) with commercial products used for “wet” holes. Storage of ammonium nitrate prills will be on site in a secured location and in accordance with the appropriate legislation and permits.

Drilling and blasting operations will be timed and controlled taking local fisheries, wildlife, and other relevant environmental factors into account.

3.5.4.6 Fuel and Fuel Storage

Fuel will be stored and used by camps and other operations as required. All fuel will be stored in accordance with the Environmental Code of Practice for Aboveground Storage Tank Systems containing Petroleum Products (CCME 2003) and conditions specified in permits and licences. Fuel management plans and emergency spill response plans will be developed prior to project commencement.

3.5.4.7 Water Use

Water will be required for construction of winter roads, to support summer construction activities and for camp use. Specific volumes of water required and potential locations of water sources will be determined during the detailed design stage.

3.5.4.8 Waste Management

Table 3-7 lists the wastes that are expected to be produced during the construction of the Project. Most of the wastes will be those resulting from camps, which are expected to be similar to those of municipal solid waste (MSW) streams. To minimize risks of animal attraction to camps, all food and food contaminated waste will be stored separate from all other wastes in airtight sealed container(s), and enclosed in animal proof containers while in bulk storage prior to final transport, treatment, or disposal. Industrial waste will encompass all other wastes not defined as camp sourced MSW.

Table 3-7 Wastes expected to be Generated

Type of Waste	Description
Camp Wastes	
Recyclable Material	Paper, glass, bottles, cans, metals, certain plastics
Food Contaminated	Biodegradable waste, food and kitchen waste, animal and vegetable wastes: typical of restaurants, hotels, markets, etc.
Composite	Waste clothing, non-recyclable plastics, etc.
Human Waste	Sewage related, black water
Grey water	Kitchen and washing related liquid waste
Industrial Waste	
Recyclable/reusable Construction and Demolition	Building materials, etc.
Non-recyclable Construction and Demolition	Inert material, such as soil and granular material.
Hazardous Materials	Contaminated soil/snow/water, waste fuel, used oil, other crankcase fluids, solvents, glycol, batteries, tank, drum, container rinsings, empty drums

A Waste Management Plan (WMP) will be developed to ensure wastes are handled, stored, transported, and disposed of in a manner that will prevent the unauthorized discharge of contaminants, mitigate impacts to air, land, water, and minimize risks of animal attraction, while maintaining the health and safety of personnel and wildlife. The WMP will address the generation, treatment, transferring, receiving, and disposal of waste materials for the Highway. The WMP will:

- identify waste sources and related types, including but not limited to liquid, solid, non-hazardous, hazardous and approximate quantities;
- describe all on-site or remote treatment and disposal methods;
- describe all waste streams to be transported off site and final disposal locations;
- describe the related waste segregation strategies for the identified waste sources and types to accommodate their respective storage, treatment, transport, and disposal; and
- describe food and food contaminated waste management methods to mitigate animal attraction from source to transport, treatment, or disposal.

NON- HAZARDOUS WASTES

Non-hazardous wastes will be recycled or disposed of in landfills constructed within the development footprint. Wastes will be incinerated prior to disposal in landfills designed and constructed to meet regulatory requirements. Design and operational procedures will limit the total number of landfills established during construction.

HAZARDOUS WASTE

Hazardous waste generated during construction will be stockpiled at staging areas and transported to approved disposal facilities.

Consistent with Environment and Natural Resources' requirements to track the movement of hazardous waste from registered generators, to carriers, to receivers according to the Guideline for the General Management of Hazardous Waste in the NWT, a Hazardous Waste Management Plan (HWMP) will be developed for the Project. The HWMP will encompass all phases of the development and will apply to transporting, storing, handling and disposal of hazardous wastes. The HWMP will include, but will not be limited to:

- identify hazardous waste sources, types, and approximate quantities to be produced (including liquid, solid, dangerous goods and non-dangerous goods);
- description of waste segregation methods;
- description of all on-site treatment and disposal methods; and
- description of all hazardous wastes that will be transported to approved receiving facilities.

WASTEWATER

Camps will generate wastewater in volumes similar to water use. Wastewater will be treated in accordance with applicable legislation and licence requirements. Wastewater treatment will be addressed in the Waste Management Plan.

3.6 Reclamation and Closure

Once the alignment is ready for traffic (year one or two), reclamation of abandoned sites will begin. Closure will be in accordance with permit requirements.

Mackenzie Valley Review Board

Terms of Reference

EA1213-02

Mackenzie Valley Highway

Government of the Northwest Territories

December23, 2013

Mackenzie Valley Review Board
200 Scotia Centre
P.O. Box 938
Yellowknife, NT
X1A 2N7
Tel: (867) 766-7050
Fax: (867) 766-7074

Table of Contents

1. Introduction

1.1. Overview

This document outlines the information required for the environmental assessment of the Mackenzie Valley Highway extension project. The Department of Transportation (DOT), Government of the Northwest Territories (GNWT) is proposing to construct a 321 km all-weather road from Wrigley to Norman Wells. The developer is the GNWT. The proposed route for the extension of the Mackenzie Valley Highway ("the highway") is shown on Figure 1.

This Terms of Reference will direct the developer to organize existing material, and conduct additional studies and analyses as appropriate, in order to submit a Developer's Assessment Report. That report will then be used to inform all interested parties about the developer's views of the potential impacts of the proposed development during the analytical phase of the environmental assessment.

1.2. Background

The concept of building an all-weather highway through the Mackenzie Valley to connect southern Canada with northern communities originated in the 1960s, although it was not until 1972 that the federal government announced that the Mackenzie Highway would be extended from Fort Simpson to the Dempster Highway. Construction of the highway started in Fort Simpson but was halted in 1977, approximately 18 km south of Wrigley following completion of 210 km.

The GNWT developed its Highway Strategy in 1989 after authority for the Northwest Territories (NWT) highway system was devolved from the federal government. By 1994, the remaining 18km of the highway to Wrigley was completed. Preliminary engineering, environmental and financial studies to support planning for construction of the remainder of the proposed highway to Inuvik were completed in 1999.

In 2010, the DOT of the GNWT signed Memoranda of Understanding with the Gwich'in Tribal Council; 5658 NWT Ltd representing the Tulita Land Corporation, the Norman Wells Land Corporation, the Fort Norman Metis Land Corporation and the Tulita Dene Band; K'ahsho Got'ine Development Foundation; and the Pehdzeh Ki First Nation to complete Project Description Reports to support further planning for the development of the highway in their respective territories. The Project Description Reports were completed in 2011 and 2012 providing preliminary design and environmental planning information for each territory.

In August 2014, in accordance with the revised priorities of the GNWT, DOT re-scoped the project footprint for the all-weather highway. The re-scoped project refers to the 321 km all-weather highway from Wrigley to Norman Wells rather than the entire 818 km to the Dempster Highway south of Inuvik.

1.3. Referral to environmental assessment

In February 2013, the DOT submitted a land use application to the Mackenzie Valley Land and Water Board for clearing of a section of the Mackenzie Valley Highway in the Gwich'in Settlement Area. The Mackenzie Valley Land and Water Board prepared to initiate a preliminary screening of the highway according to Section 124 of the *Mackenzie Valley Resource Management Act* (MVRMA). Under authority of Section 126(2)(a) of the MVRMA, the DOT referred its own application, including the entire 818 km Mackenzie Valley Highway to the Mackenzie Valley Review Board (Review Board) for environmental assessment. The current Terms of Reference pertain to the re-scoped project as submitted in August 2014.

1.4. Legal context and the Terms of Reference development process

This environmental assessment is subject to the requirements of Part 5 of the *Mackenzie Valley Resource Management Act* (MVRMA). Section Three of the Review Board's *Environmental Impact Assessment Guidelines* describes the environmental assessment process in detail. That document, as well as the Review Board's Rules of Procedure, other guidelines, reference bulletins and relevant policies applicable to this assessment are available online (www.reviewboard.ca) or by contacting Review Board staff.

In accordance with subsection 115(1) of the MVRMA, the Review Board must conduct an environmental assessment of the proposed development with regard for the protection of the environment from significant adverse impacts, and the protection of the social, cultural and economic well-being of Mackenzie Valley residents and communities. Subsection 114(c) of the MVRMA further requires the Review Board to ensure that concerns of Aboriginal people and the general public are taken into account. Accordingly, the Review Board has developed these Terms of Reference based on an examination of information from the following sources:

- Information collected from participants at community scoping meetings held by Review Board staff held in September 2013 as follows:
    - Wrigley- September 9, 2013
    - Tulita- September 10, 2013
    - Fort Good Hope- September 11, 2013
    - Inuvik- September 17, 2013
    - Norman Wells- September 18, 2013
- Information submitted by the developer during preliminary screening including the Project Description Reports and the developer's Terms of Reference for Environmental Assessment Draft for Review (September 2013)
- Updated Project Description Report (August 2014) and MVEIRB's issued Terms of Reference (December 2013)
- Information on the Review Board public registry
- Review Board experience in the conduct of environmental assessment.

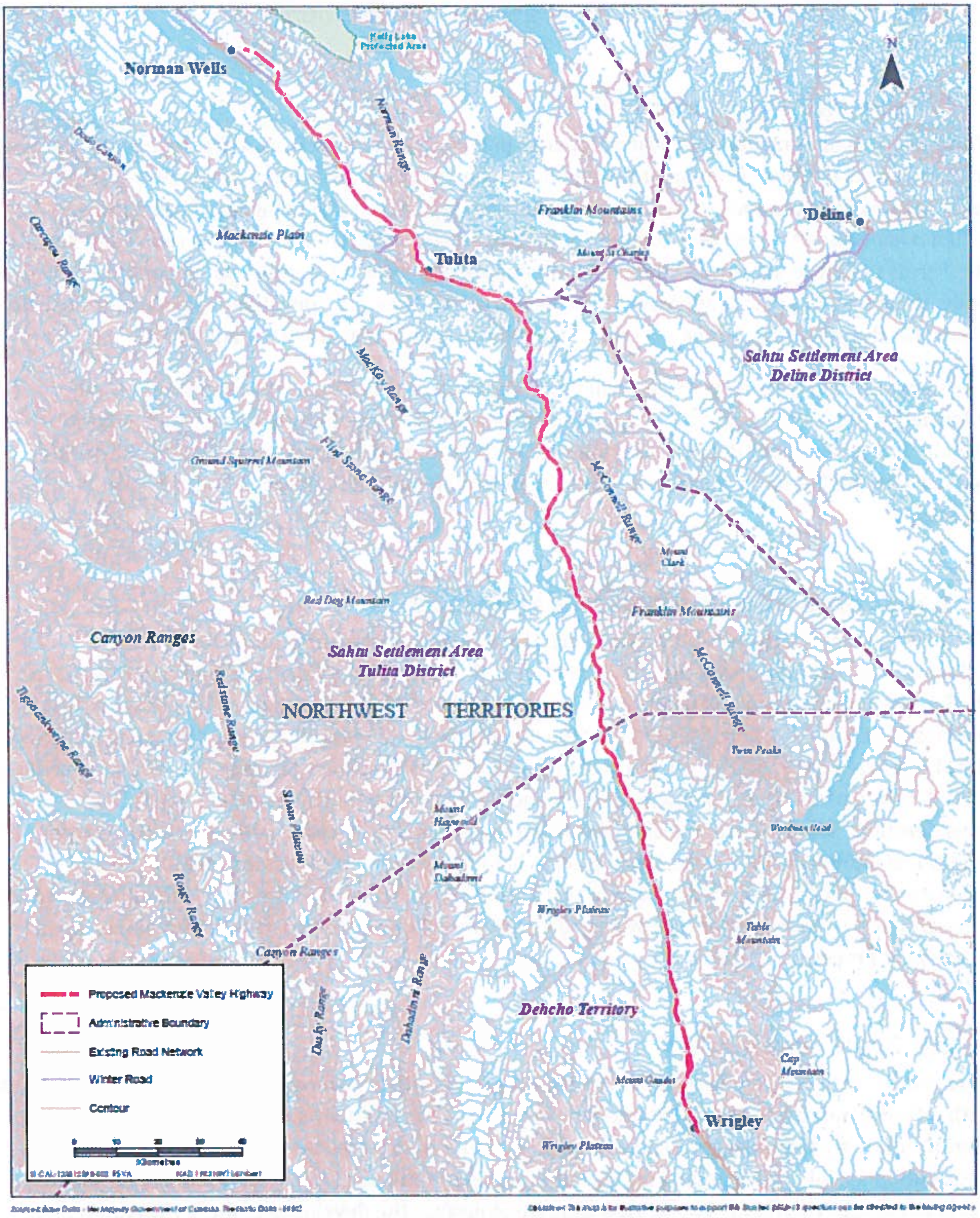


Figure 1 – Mackenzie Valley Highway Extension

2. Developer's Assessment Report general requirements

2.1. Presentation of material

The Review Board encourages the developer to present information in user-friendly ways. The use of maps, aerial photos, development component/valued component interaction matrices, full explanation of figures and tables, and an overall commitment to plain language is encouraged. When it is necessary to present complex or lengthy documentation to satisfy the requirements of the Terms of Reference, the developer should make every effort to simplify its response in the main body of the text and place supporting materials in appendices. The developer will also produce all electronic documents in Adobe portable document format in files smaller than 10 MB.

The Developer's Assessment Report will be submitted as a stand-alone document. Relevant information and analyses from previous project descriptions should be incorporated into the Developer's Assessment Report and combined with the supplementary material and analyses required by this Terms of Reference. The developer will make all referenced information accessible.

2.2. Incorporation of traditional knowledge

The Review Board considers both traditional knowledge and scientific knowledge in its deliberations. In addition, paragraph 115(1)(c) of the MVRMA provides as a guiding principle for the Review Board the importance of conservation to the well-being and way of life of the aboriginal peoples of Canada to whom Section 35 of the Constitution Act 1982, applies and who use an area of the Mackenzie Valley. The developer will make all reasonable efforts to assist in the collection and consideration of traditional knowledge relevant to the highway for the Review Board's consideration. Where it is applicable, the developer will make all reasonable efforts to incorporate traditional knowledge from Aboriginal culture holders as a tool to collect information on and evaluate the specific impacts required in this Terms of Reference. The developer should refer to the Review Board's *Guidelines for Incorporating Traditional Knowledge into the Environmental Impact Assessment Process.*

2.3. Public engagement

Engagement with communities, other Aboriginal groups, other governments, or other organizations with interests related to areas that might be affected by the highway should be considered in this section. Aboriginal groups, government agencies and other interested parties may have information useful to the conduct of this impact assessment and all reasonable efforts should be made to engage with them. The Review Board encourages the developer to meet with interested groups outside the environmental assessment process, and to place any information from those discussions they consider may be relevant to the Review Board's decision on the public record.

The following items are required for consideration of public engagement:

•An engagement log describing dates, individuals and organizations engaged with, the mode of communication, discussion topics and positions taken by participants, including:

- All commitments and agreements made in response to issues raised by the public during these discussions, and how these commitments altered the planning of the proposed Mackenzie Valley Highway;
- All issues that remain unresolved, documenting any further efforts envisioned by the parties to resolve them;
- Description of all methods used to identify, inform and solicit input from potentially-interested parties, and any plans the developer has to keep engagement moving forward;
- How the developer has engaged, or intends to engage, traditional knowledge holders in order to collect relevant information for establishing baseline conditions and the effects assessment of potential impacts, as well as a summary table indicating where and how in which of the subsequent sections traditional knowledge was incorporated (see Review Board's Guidelines for Incorporating Traditional Knowledge in Environmental Impact Assessment).

2.4. Summary materials

The following summary materials are required:

- Plain language summary in English, South Slavey and North Slavey;
- A concordance table that cross references the items in the Terms of Reference with relevant sections of the Developer's Assessment Report; and
- A commitments table listing all mitigation measures the developer will undertake, including but not limited to those described in the project application. These should be organized by subject (e.g. water quality, wildlife) for easy reference.

2.5. Approved Land Use Plans

The proposed highway runs through the Sahtu Settlement Area, which has an approved and legally binding Land Use Plan. The developer must clearly demonstrate throughout each section of the DAR how the project conforms to the approved Land Use Plan and/or if an exemption from the Land Use Plan would be required for any specific activities.

3. Scope considerations

3.1. Scope of development

Under subsection 117(1) of the MVRMA, the Review Board determines the scope of development for every environmental assessment it conducts. The scope of development consists of all the physical works and activities required for the project to proceed.

Within this document the scope of development includes the construction, existence and use of an all-weather Highway from the community of Wrigley to Norman Wells, as well as the restoration of any segments of the existing seasonal public highway deemed to be unsuitable for use as a base of an all-weather road. The development includes the following components:

- Clearing the current right of way, including intermittent new sections between Wrigley and Norman Wells;
- Construction of a 321 km all-season gravel highway from Wrigley to Norman Wells, much of which follows an existing seasonal public highway;
- Construction of watercourse crossing structures;
- Construction and operation of borrow sources and access to the borrow sources;
- Establishment and use of highway maintenance areas;
- Establishment and use of temporary construction support infrastructure and workspaces including camps, and laydown and staging areas; and,
-
- Reclamation of facilities not required for ongoing highway operations.

The scope of development will consider the impacts caused by the existence and use of an all-weather highway, which may occur and only take effect once the construction of the highway is complete and the road has come into operation.

Ongoing maintenance activities of the highway will occur, but are not considered to be within the scope of development subject to assessment because their impact on the environment is considered insignificant. The highway is expected to operate for an indeterminate period and therefore reclamation of the highway is not included in the scope of the development. The scope of the project does not include the ongoing operation and planned capital improvements to the existing winter road system between Wrigley and Norman Wells.

In the Developer's Assessment Report the developer is required to fully describe all required facilities and activities for the development. The Review Board may amend the scope of development at any time during the environmental assessment if the proposed development changes.

The developer shall identify all permits, licences or other regulatory approvals necessary for the different phases of the development. The developer shall also document all land tenure agreements required for the development.

3.2. Scope of Assessment

3.2.1. Overview

The scope of assessment defines which issues will be examined in the environmental assessment. The scope of assessment includes all potential impacts on valued components of the biophysical and the human environment (for example, wildlife species or community wellness) from the development, by itself and in combination with other past, present and reasonably foreseeable future developments.

To determine the scope of assessment, the Review Board considered the developer's Updated Project Description Report, comments from reviewers on the MVEIRB's Terms of Reference and the results of community scoping sessions held in Wrigley, Tulita, Norman Wells, Fort Good Hope and Inuvik. The results of the Fort Good Hope and Inuvik sessions were included in this review as residents from other affected communities may have been in attendance.

3.2.2. Issues prioritization – Key lines of inquiry

The developer will consider the following when preparing the specific material the Review Board requests. The developer is encouraged to seek clarification from the Review Board in writing if specific requirements in the Terms of Reference are unclear. If the developer finds that a question cannot be answered, the developer must provide a reasonable rationale explaining why the question could not be answered.

The purpose of scoping is not only to identify issues, but also to prioritize them and if possible, focus study on the most important issues. The Review Board has prioritized issues based on information gathered at community scoping meetings.

3.2.3. Key lines of inquiry

The highest priority issues are called "key lines of inquiry". These require increased attention because they are important to communities along the proposed highway route and are of particular interest to the Review Board. The developer is required to give special consideration to the following key lines of inquiry in the DAR:

- **Local social and economic considerations; and,**
- **Caribou, moose and harvesting;**

Key lines of inquiry are the topics of greatest concern that require the most attention during the environmental assessment and the most rigorous analyses in the Developer's Assessment Report. These are designated as key lines of inquiry to ensure a comprehensive analysis of the issues most likely to cause significant environmental impacts or significant public concern. Data collection and analyses for the key line of inquiry in the Developer's Assessment Report should be at a level of detail appropriate for other interested parties to understand the technical material prior to any technical sessions on these topics.

The key lines of inquiry will be presented in comprehensive stand-alone sections in the Developer's Assessment Report. This will facilitate close examination of the developer's response to these key lines of inquiry, and will require only minimal cross-referencing with other parts of the report and appendices.

3.2.4. Subjects of note

The developer will consider all other valued components described in Section 7 as subjects of note. Every issue identified in this Terms of Reference requires a sufficient analysis to demonstrate whether the development is likely to cause significant adverse impacts. These subjects of note need to be considered by the developer but are of lower priority than the key lines of inquiry.

3.3. Geographic scope

The geographic scope will include all areas that may be affected by activities within the scope of development. For all biophysical or socio-economic valued components (e.g. community wellness, wildlife), the developer will specify the study area boundaries used for the assessment for each component. The geographic scope for each valued component must be appropriate for the characteristics of that component. The developer will provide justification and rationale for all study area boundaries chosen.

3.4. Temporal scope

The highway is intended to operate over the long term. The developer will use temporal boundaries for this environmental assessment according to potential long-term impacts on valued components, assuming that the highway is in operation for an indeterminate period of time.

For project specific (that is, non-cumulative) impacts, the temporal scope will include all phases of the highway lifespan including construction, use, and in some instances reclamation, and extends until no potentially significant adverse impacts are predicted. For cumulative impacts, the temporal scope includes the period of the effects of past, present and reasonably foreseeable future projects that are predicted to combine with the impacts of the highway[1].

[1] See the Review Board's *Environmental Impact Assessment Guidelines (*Appendix H) for further guidance.

The developer will place special focus on the consideration of times during the development when activities are particularly intense (such as during initial construction) or when valued components are particularly sensitive to potential impacts (such as key times for wildlife, fish spawning or wildlife harvesting periods). The developer will also give special attention to appropriate temporal boundaries for considering any impacts that may require long-term monitoring and management after during highway operations such as impacts on communities along the highway route.

The developer is required to define and provide rationales for the specific temporal boundaries it used to examine the potential impacts on each of the valued components considered in its impact assessment.

3.5. Consideration of alternatives

The DAR must identify and describe alternative methods for highway construction, scheduling phases, and technical design that are, from the perspective of the developer, technically and economically feasible. In describing the preferred methods, the DAR should identify the relative consideration of environmental effects, and technical and economic feasibility. The criteria and/or constraints used to identify any alternative methods as acceptable or unacceptable, and how these criteria and/or constraints were applied, must be described.

The developer will describe the alternative methods of carrying out the components of the development, including:

- A description of the alternative methods considered, how or why they are not technically and/or economically feasible, and the rationale for rejecting any alternatives that are excluded from further assessment; and,
- The criteria and rationale for selecting the preferred alternative methods.

The developer will identify and describe the alternative routes or segments of the route considered for the development including:

- A description of each alternative considered, how or why they are not environmentally, technically and/or economically feasible, and the rationale for rejecting any alternatives that are excluded from further assessment; and,
- The criteria and rationale for selecting the preferred route, and the environmental, social and technical (including safety) constraints associated with them.

The developer will provide some level of environmental assessment of the alternative routes or segments to substantiate their inclusion as viable alternatives, even if they are not being considered as the developer's preferred route.

The developer will indicate how community engagement and consultation and traditional knowledge have influenced the determinations on route options.

4. Assessment methodology

4.1. Impact assessment steps

In order to facilitate the consideration of the specific questions posed in this section, the developer is required to address the following impact assessment steps. In assessing impacts on the biophysical and human environment, for each valued component in Section 6, the DAR will identify the highway's potential impacts (direct and indirect) relative to baseline conditions and trends, describe the methods used to identify these impacts in sufficient detail to allow reviewers to fully understand how these conclusions were reached, describe proposed mitigations to reduce or avoid impacts, and predict residual impacts after mitigation. The developer will provide its views on impact significance.

The developer will describe how the predicted impacts are expected to arise from the proposed development. This will include describing the mechanisms for cause and effect and providing supporting references (including where Traditional Knowledge was used). Where professional judgment has been used in determining impacts, this must be made clear. The developer will also provide a discussion on the uncertainty involved with each prediction. For each predicted impact, the developer will describe:

- the nature or type of the impact;
- the geographical range of the impact;
- the timing of the impact (including duration, frequency and extent);
- the magnitude of the impact (what degree of change is expected);
- the reversibility of the impact; and,
- the likelihood and certainty of the impact.

An example summary matrix has been included as Appendix __. Please use the example table to help summarize the narrative description in the DAR.

4.2. Developer's opinion on significance of impacts

The criteria described above will be used by the developer as a basis for its opinions on the significance of impacts on the biophysical and human environment. The Review Board will make the ultimate determinations of significance after considering all the evidence on the public record later in the environmental assessment. For more information on the above criteria, please refer to section 3.11 of the Review Board's *Environmental Impact Assessment Guidelines* available on the Review Board's public registry.

5. Description of the existing environment

The developer shall provide a description of existing conditions in sufficient detail to enable an understanding of how the valued components might be affected (positively or negatively) by the proposed development.

5.1. Biophysical information requirements

The developer will provide a description of all existing regional data used in developing the environmental baseline. Where the developer generated its own data the methodology, accuracy and precision of measurements will be provided. The developer should also describe any analysis conducted to utilize data from outside the study region to characterize the baseline environmental conditions within the study region. This would include a description of any models etc. (including assumptions and accuracy) utilized to characterize baseline conditions where local measurements are not available. The description of the baseline conditions should be sufficient to allow for a thorough assessment of the project effects.

5.1.1. Terrain, geology, soils and permafrost

Describe the existing terrain, geology, soils and permafrost in the project study area(s), including a description, location, and geographic extent of the following features:

- topography and geology, including key terrain features such as rivers, lakes and wetlands and other important processes and features;
- bedrock type and depth;
- unconsolidated surficial materials and terrain types, including thickness of landforms; and,
- soil types, including group, series and type, as applicable.

Describe borrow materials including:

- locations;
- ice content;
- size of borrow areas;
- volumes to be removed;
- quality of materials at each location;
- capacity for borrow materials to produce acid drainage or leachate
- existence and extent of ice rich permafrost areas that may be excavated; and,
- ownership.

Provide a description of permafrost and ice-rich soils in the area of the highway, including:

- distribution (thickness and lateral extent) on land, water, shoreline and slope crossings, including a discussion of taliks;
- permafrost processes, features and landforms and their stability, including slopes, shorelines and stream banks;
- ground ice conditions, temperature and ground thermal regime;
- active layer thickness, seasonal frost, penetration, thaw sensitivity and frost susceptibility;
- how fires affect ground temperature regimes and permafrost;
- describe thaw slumps in the project area; and,
- how regional climate variation and documented warming of ground temperatures in the region may affect ground conditions.

5.1.2. Climate

Provide a description of the existing or baseline climate conditions and climatic variability and trends, including, but not necessarily limited to:

- the location of recording stations and length of record for any meteorological data presented;
- prevailing climatic conditions, seasonal variations, predominant winds including direction and velocity, temperature and precipitation (snowfall, snow depth, rain, fog, wind);
- spatial and temporal boundaries for the description of climate; and,
- any current climate-related extreme events that may affect the highway, and frequency of occurrence.

In support of the baseline description:

- define the variability/trends within the "current" climate normal period and within the historical period of instrumental record;
- discuss the contribution of traditional knowledge to the understanding of climate conditions and variability; and,
- identify the location of recording stations and length of record for any meteorological data presented.

Changes in climate, in terms of direction, magnitude and climate element affected, can be expected to vary at a regional scale. Accordingly, the description of baseline conditions should be presented in a manner that reflects this variability and facilitates subsequent discussion of how changes in climate could change the highway, or particular highway components.

5.1.3. Water quality and quantity

Provide a description and maps of the existing water resources within or near the boundaries of the study area(s) including:

- waterbodies, watercourses and major drainage areas;
- watercourses that have year-round flow;
- the extent of connectivity to adjacent watercourses including any potential seasonal variation;
- seasonal and perennial springs including ephemeral streams located within or near the boundaries of the study area(s);
- naturally occurring icings; and,
- describe the recharge ability of lakes that will be used for winter road watering or ice mining.

Provide a description of major drainages and watercourses, including the basis for their selection. For each major drainage or major watercourse, as appropriate, provide a description of its hydrological characteristics, including:

- flow regimes, variability and seasonal patterns;
- channel and bed morphology and stability;
- bank stability and areas of erosion;
- sediment load – suspended and bed load;
- active and historical floodplains;
- freeze/thaw timing;
- taliks/permafrost distribution and stability beneath waterbodies; and,
- the role of wetlands (e.g., bogs, fens and peat plateaus).

In the vicinity of communities and along highway routes being considered, describe flood regimes, ice-jamming and scour. In each major drainage, identify locations of existing and planned water use (domestic, municipal, camp, etc.) in relation to the proposed highway routes. For each area of water use that may be affected by the highway, identify quantity of use, existing water quality and variations, existing sources of water quality impairment and their locations in relation to highway routes alternatives, and groundwater resources and hydrogeology where relevant to the highway.

5.1.4. Fish and fish habitat

Provide a description of the existing fish and fish habitat within the highway area, including:

- a description of fish habitat present at each of the planned water crossings, including references (such as photographs and diagrams) at those locations;
- fish species including forage fish (non-harvested) and any other aquatic resources of value present;
- seasonal and life cycle movements and sensitive periods;
- habitat requirements for each life stage;
- local and regional abundance, distribution and use of habitat types, including aquatic and riparian vegetation;

- known sensitive or important areas in terms of habitat type (e.g., spawning, overwintering, refugia, feeding), species and timing of use;
- for species at risk or of concern , also describe specific location, population status, limits and size, sensitivity and limiting factors;
- baseline contaminant concentrations in harvested species, that may change as a result of the highway and as available;
- any known issues with respect to health of harvested species (e.g. parasites, disease, condition);
- species of particular importance to subsistence harvesters;
- species subject to exclusive or preferential rights granted by land claims;
- species of particular importance to the guiding or outfitting industries;
- areas subject to exclusive harvesting rights granted to land claim beneficiaries;
- harvest pressures (subsistence, sport fishing and commercial harvesting) by species, season and geographic area; and,
- listing of existing non-native species.

5.1.5. Wildlife and wildlife habitat

Provide a description of the existing wildlife and wildlife habitat within the study area(s), including:

- wildlife species present;
- distribution and abundance, seasonal movements, habitat requirements (e.g., breeding, calving, feeding) and sensitive time periods;
- for species at risk or of concern, also describe specific location(s), population status and trends, limits and size, critical habitat, sensitivity and any other limiting factors;
- species subject to exclusive or preferential rights granted by land claims;
- species of particular importance to the guiding or outfitting industries;
- habitat types including local and regional distribution and abundance;
- species of importance to subsistence harvesters;
- habitat or sites of special value or sensitivity, including species use and timing;
- areas subject to exclusive harvesting rights granted to land claim beneficiaries;
- migratory patterns, routes and timing in relation to highway route alternatives, construction activities, and operation;
- harvest pressures (subsistence, resident and non-resident harvesting and commercial harvesting) by species, season and geographic area;
- listing and location(s) of existing non-native species;
- current and historic levels of natural and human-caused fragmentation and connectivity;
- baseline contaminant concentrations in harvested species, that may change as a result of the highway; and,
- any known issues with respect to the health of harvested species (e.g. parasites, diseases, condition).

5.1.6. Birds and bird habitat

Provide a description of the existing bird resources with the study area including:

- bird species present;
- abundance and distribution, seasonal movements, habitat requirements (breeding, moulting, staging, feeding) and sensitive periods;
- for species at risk or of concern, also describe specific location(s), population status and trends, limits and size, critical habitat, sensitivity and limiting factors status and trends;
- species subject to exclusive or preferential rights granted by land claims;
- habitat types including local and regional abundance and distribution;
- baseline contaminant concentrations in harvested species, that may change as a result of the highway;
- any known issues with respect to health of harvested species;
- areas subject to exclusive harvesting rights granted to land claim beneficiaries;
- species of particular importance to subsistence harvesters;
- habitat or sites of special value or sensitivity, including species use and timing;
- harvest pressures (subsistence and sport hunting) by species, season and geographic area; and,
- listing and location(s) of existing non-native species.

5.1.7. Vegetation

Provide a description of the existing vegetation within the study area(s), including:

- vegetation and vegetation assemblages;
- any classification system followed, as appropriate;
- identification of species or assemblages that are rare, valued, protected or designated (e.g., vulnerable, threatened, endangered);
- for any species at risk or of concern , also describe specific location, population status, limits and size, sensitivity and limiting factors;
- historic and current human use of vegetation, including subsistence and commercial harvesting, (e.g., berry picking, forestry);
- baseline contaminant concentrations in harvested species or vegetation (e.g. berries) that may change as a result of the highway and as available;
- locations and quantities of merchantable timber;
- listing and location(s) of existing non-native species;
- frequency of forest fires; and,
- post-fire vegetation succession, if applicable.

5.2. Human environment baseline information requirements

5.2.1. Demographics

Provide a description of the social and demographic profile(s) and trends in the study area, including the following:

- population and population trends by community and by region;
- number of persons per household and number of households; and,
- in/out migration by community and region, and factors that could contribute to migration patterns.

5.2.2. Regional and local economies

Provide a description of the local and regional economies and their performance, including:

- gross domestic product (GDP);
- employment rate;
- employment by industry and occupation, including occupations related to traditional activities;
- job vacancy and unfilled positions, labour force growth, participation and balance between wage and non-wage sector activities and earnings growth;
- poverty levels and annual level of social assistance benefits and recipients;
- local consumer prices and cost of living, particularly with respect to food, fuel, utilities, transportation and affordable housing;
- level of local households consuming harvested meat and fish and current harvest activities;
- current and projected land-based enterprises and economic activities, including those related to tourism, outfitting, commercial harvesting, recreation, renewable and non-renewable resources;
- number of licensed businesses with breakdown by Aboriginal ownership; and,
- local and regional economic development goals and objectives as identified in public consultations and regional land use plans.

5.2.3. Education, training and skills

Provide a description of the education, skills and training levels in the communities relevant to the highway, including graduation and achievement rates including high school or higher, and trade certification levels.

Describe adult basic education and literacy programs in the communities along the highway route and identify any other education, training and/or certification programs and institutions available within the region to residents of the highway area that are relevant to the highway.

Describe the timing and duration of education and skills development programs that would be required for highway-related employment.

5.2.4. Infrastructure and institutional capacity

Describe the local and regional infrastructure and institutions, including current levels of use of existing social, institutional, family, health and community services and local, regional and territorial infrastructure, which government organizations provide them, and the capacity of these to meet current, additional and new needs. Particular attention will be given to:

- health facilities and services, including medivac services;
- emergency response and law enforcement services;
- waste disposal and management;
- water and sewage facilities;
- power and fuel services;
- transportation systems (barging, roads, airports);
- telephone/ communication service;
- fire protection;
- housing stock, costs and availability;
- safe houses and shelters;
- child care and elder care services;
- schools and education facilities;
- recreational facilities;
- management of renewable resources;
- supply of aggregate and granular materials; and,
- planned major capital projects or planned major social or institutional changes in the highway area.

5.2.5. Human health and community wellness

Provide a description of the status of human health and community wellness in the study area, including:

- the physical, mental and social health of residents of the areas affected by the highway; and,
- support systems and programs available regionally and locally to address human health and community wellness (e.g., health services, elder care, child care, counseling, alcohol and drug treatment, healing centres)

This description of health status should include indicators of determinants of health, including physical, social, cultural and economic aspects.

5.2.6. Harvesting

Provide a description of current and traditional harvesting, focusing on subsistence and commercial harvesting, including harvesting activities and other traditional uses by Aboriginal peoples within study area.

This will include harvest levels, participation, locations (with specific attention to high use areas and areas of sensitivity, and seasonal access), transmission of culture, and contributions to household economies. Describe any recent and current encroachments and restrictions of harvesting activities (i.e. by competing uses of land and resources or related regulations).

Describe outfitting and trapping activities and related use areas (active and fallow).

5.2.7. Land use

Describe traditional and current land use patterns, designations and special management areas in the study area, including:

- land uses, including but not limited to the following:
  - traditional use areas;
  - special harvesting sites;
  - traditional trails;
  - seasonal and permanent camp areas (i.e., individual work, recreational, commercial);
  - parks and recreation areas;
  - transportation corridors;
  - granular resources; and,
  - industrial zones such as the Norman Wells oil pipeline (line 21).
- land use designations, including but not limited to the following:
  - protected areas;
  - areas of high conservation value/ecological sensitivity;
  - ecologically important areas; and;
  - caribou protection measures.
- valued aesthetic locations and their attributes; and,
- lands and features of special interest or value, and their attributes;

5.2.8. Heritage resources

Describe the existing archaeological, paleontological, and historic resources, collectively referred to here as heritage resources, within the study area. Include:

- archaeological, paleontological and historic sites and resources;
- culturally important sites;
- burial sites; and,

- heritage resource potential.

6. Development description

The developer will fully describe the facilities and activities associated with all phases of the development, including a discussion of the need for the project, alternative methods of carrying out the project and development schedule.

6.1. Project components and activities

The development description for the all-weather highway should address the following topics, where applicable:

- All-season gravel highway from Wrigley to Norman Wells;
- Design standards;
- Land requirements (footprint, location, permanent or temporary, ownership, zoning);
- Right of way clearing;
- Road construction methods;
- Water crossing structures and locations;
- Borrow source locations, quality and quantities, activities and methods;
- Temporary winter or all-season access roads to borrow areas;
- Camps, staging areas, laydown areas, access roads and other support facilities;
- Fuel storage and management;
- Explosives manufacturing plant, storage, transportation, and use;
- Equipment requirements (by phase);
- Solid waste management;
- Water use;
- Wastewater treatment;
- Mobilization/demobilization;
- Frequency of vehicle and aircraft movement during construction;
- Expected traffic volumes during operational phase;
- Clean-up /restoration of work areas during construction phase;
- Reclamation;
- Procurement and implementation approach;
- Training, employment and business opportunities;
- Land ownership and jurisdiction including any implications to land quantum of settled land claims that the highway crosses;
- What mechanisms will be used to secure tenure of the right of way; and,

- Land requirements including footprint, location, permanent or temporary, ownership, and zoning.

6.2. Development phases and schedule

The development description must also contain an overall and seasonal activity schedule for the development and describe the following aspects of the development in relation to development phases and schedule:

- Identify which government agencies or departments are responsible for the maintenance and operation of the highway.
- Identify the roles and responsibilities of the communities along the route (if any).

6.3. Life of the project

The developer will clearly describe the operational life of the highway and how this development fits with the overall goals, objectives and long term planning of the GNWT for territorial highways. In this discussion, the developer will include the following:

- Identify which government agencies or departments are responsible for the long term maintenance and operation of the highway;
- Identify and quantify the anticipated short, medium and long term use/users of the highway; and,
- Discuss how government would respond to and manage the highway, if an increase in the number of heavy industrial users evolves over time (which may, for example, result in increased operation, protective services and maintenance costs).

7. Assessment of environmental impacts and cumulative effects

The developer will be responsible for the identification and assessment of effects of the development on the biophysical and human environment and for the assessment of cumulative effects resulting from the development in combination with past, present and reasonably foreseeable developments and activities. The Review Board acknowledges that much of the proposed development corridor has recently been subject to considerable study of baseline conditions and assessment of potential effects of the proposed Mackenzie Gas Project, also a linear development. The developer is encouraged to utilize information and lessons learned from the assessment of this project in the preparation of its DAR. Further, the developer is encouraged to utilize lessons learned from the existing Norman Wells pipeline.

7.1. Effects Assessment

For each valued component described in this section, the following topics will be addressed, consistent with the methodology identified in Section 4 of these ToR.

- **Identification of potential environmental effects**: The potential interactions of the development with the valued component and resulting potential environmental effects to the valued component will be identified. The developer will present quantitative or qualitative parameters to measure potential environmental and cumulative effects on the valued component. The spatial and temporal boundaries for the assessment of effects on the valued component will be presented and justified.
- **Mitigations and residual effects**: The developer will describe all mitigations that will be put into effect during project design, construction or operation to mitigate potential environmental effects. The developer will assess potential effects on the valued component after implementation of mitigations. Residual effects will be clearly identified and characterized based on methodology presented in DAR.
- **Assessment of cumulative effects**: For each residual effect resulting from the development, the developer will conduct an assessment of the potential for cumulative effects resulting from a combination of effects of the development with effects from other past, present and reasonably foreseeable human activities and developments. The way in which a cumulative effect may occur and its potential spatial and temporal scope will be discussed. Residual cumulative effects will be identified. The developer will characterize the significance of residual project and cumulative environmental effects and identify mitigations that may exist for cumulative effects beyond those for project specific effects.

7.2. Key lines of inquiry

This environmental assessment will focus on priority issues termed key lines of inquiry. The key lines of inquiry are:

- Local social and economic considerations; and,
- Wildlife harvesting, in particular caribou and moose.

Requirements for the key lines of inquiry are described below. The developer will focus its Developer's Assessment Report on these topics.

7.2.1. Local social and economic considerations

The potential direct and indirect social and economic impacts of an all-season highway were raised as concerns in communities along the route. During scoping sessions, community members identified existing social problems that could be worsened, and new issues that could arise as a result of the development. Part of this Key Line of Inquiry deals with the potential effects of the development on community life, including human health and community wellness. It also deals with the capacity of social infrastructure including services to meet potentially increased demands.

Please describe existing conditions and evaluate potential effects <u>from the project</u> on the following, at both the general and community-specific levels, including:

- **Availability of drugs and alcohol** and related social changes at the community, family and individual levels;
- Human **safety** including collisions on the all-weather road, collisions with pedestrians in town, drunk driving, and the capacity for emergency response to accidents in communities and remote areas;
- Predicted changes in **demands for social infrastructure** (including, policing and crime, health services, and social services), and the adequacy of existing social infrastructure to meet those changes (including potential shortfalls); and,
- Capacity of public **physical infrastructure** such as existing roads, water sources, quarries and quarry materials, and waste management facilities.

During scoping, several communities voiced interest in potential economic benefits of the project, and expressed concerns to the Review Board about their readiness and capacity to take full advantage of these opportunities. Please describe and evaluate potential effects of the project on the following, at both the general and community-specific levels, including:

- Direct and indirect **employment opportunities** generated by the development and the potential for uptake of these opportunities locally by Aboriginal peoples;
- **Employment opportunities** for every year of construction and operation, with particular reference to length of employment, form of employment (full time, part time, seasonal), skills category;
- Measures, plans and commitments for **maximizing local and Aboriginal employment** and businesses;
- Maximizing local and Aboriginal participation in contractor and sub-contractor business opportunities;
- Effects on capacity of local businesses to service other sectors during the construction phase;
- **Cost of living** and consumer prices for different types of goods;
- Proposed **education and training programs** required for highway-related construction and operation employment, including:
  - Local and regional training opportunities;
  - Timing and duration of programs, in relation to the highway development schedule;
  - Skills and experience gained in the highway workforce that could be applied to; other available projects or sectors;
  - The number of people expected to be employable and available;
  - The potential for local development of skills for senior professional positions (e.g. labourer/heavy equipment operator vs. supervisor /manager); and,
  - Proposed programs that would be provided by or required from the construction contractor.
- The development's **contribution to the Gross Domestic Product**, provided separately for direct, indirect and induced economic activities for the regional and (to the extent possible) territorial and national economies; and,

- Highway-related impacts on harvesting and the **traditional economy** (see item Caribou, moose and harvesting below) and their effects on community income and household economies

7.2.2. Caribou, moose and harvesting

Describe and evaluate the potential impacts of the highway, for the preferred and alternate routes, on caribou and moose, and what this means to harvesting. This section will also include any impacts to harvesting of other species. This will include both construction and operation periods. For moose and caribou[3], this will include an examination of:

- Sensitive or important areas or habitat;
- Direct and indirect alteration of habitat including highway footprint impact;
- Sensory disturbance, and predicted changes in behaviour (including habitat avoidance and effective habitat loss in relation to highway facilities or activities), energetics, health and condition;
- Wildlife movement patterns, home ranges, distribution and abundance;
- Wildlife mortality due to harvesting and vehicle collisions;
- Disruption of sensitive life stages or habitat (e.g., migration, calving, denning, overwintering);
- Population cycles;
- Predator-prey relationships;
- Increased human-wildlife interactions; and,
- Contaminant levels in harvested species that could be changed by the highway;

Regarding harvesting, this section will examine:

- Changes in access, including increased access to the land and surrounding lakes, as well as increased access to an environmentally and culturally sensitive areas;
- Changes in hunting and fishing pressures from people who do not reside in the communities along the route, and how highway-related changes in harvest pressures could impact the resource;
- Sensory disturbances of other harvested wildlife species;
- Changes in the abundance and distribution of harvested resources, including caribou, moose and other wildlife (e.g. furbearers, waterfowl) that would adversely affect harvesting;
- Disturbance of harvest patterns, or loss or alteration of high-value harvest areas including:
    - Changes to harvest effort as perceived by harvesters;
    - Changes in harvester travel patterns;
    - Changes in harvest levels;
    - Changes in harvesters' costs; and,

[3] For other wildlife species, please see sections 7.3.6 to 7.3.9.

- Competition among harvesters within and between communities as a result of increased access and loss or alteration to the land resulting from the project.

- Contaminant levels in harvested species that could be changed by the highway; Measures to avoid or minimize changes in the abundance, distribution, or quality of harvested species, or mitigate the consequences of such changes;
- Mechanisms to control project workforce-related hunting, fishing, or disturbance of wildlife; and,
- Mechanisms of resource management agencies and other parties to manage hunting, and fishing by:
  - Resident hunters and fishers;
  - Non-resident hunters and fishers; and,
  - Aboriginal harvesters.

7.3. Subjects of note

7.3.1. Terrain, soils and permafrost

Describe and evaluate the potential effects of the project on terrain, geology, soils and permafrost including a consideration of:

- Slope and soil stability, erosion and subsidence;
- Granular resource extraction areas (including quantity and quality of granular resources);
- Thaw slumps and compaction of organic peat lands and potential for melt of ice rich ground;
- Snow distribution and consequences on ground thermal regime; and,
- Drainage beside and beneath the road, channelization and non-channelization flow and permafrost degradation.

With respect to potential impacts of the highway on permafrost, include consideration of:

- Permafrost as a design feature in the road bed, failure modes analysis and associated contingency plans;
- Thermal conditions, active layer thickness, thaw depth, distribution and stability;
- Ice rich soils (thaw settlement, thermokarst) permafrost thaw and related settlement;
- Frost heave or frost susceptible soils in thin permafrost as well as seasonally frozen soils;
- Thaw or settlement-related impacts on drainage and surface hydrology (see also water quality and quantity);
- Shorelines, channels, and taliks; and,
- Combined impacts of the highway and fires.

7.3.2. Air quality

Describe existing air quality in the highway area, including airsheds, emission sources, seasonal variations, existing and historic air quality, and visibility (as related to highway safety such as known fog areas).

Describe and evaluate the potential impacts of the highway on air quality including a consideration of:

- Dust and carbon emissions from vehicles, equipment and stationary sources;
- Emissions by source for each highway phase, including quantity, timing and duration, normal operation conditions and upsets;
- How changes in air quality could have an impact on humans, wildlife and vegetation; and,
- Ice fog, dust and visibility.

Relevant territorial, provincial and federal air quality legislation, standards or guidelines should be discussed, including their purpose in relation to the highway phases. The discussion of air quality impacts should also consider guidance and standards from the Canadian Council of Ministers of the Environment.

The developer will provide an assessment of the potential health impacts to humans, wildlife, and vegetation related to highway emissions for all project phases. Dust suppression techniques must also be discussed and evaluated in this assessment.

7.3.3. Noise

Describe existing noise levels along the proposed highway route, including sources, types and boundaries, and any relevant standards, guidelines or objectives. The developer will describe and evaluate the potential impacts of highway-related noise, including a consideration of:

- Highway components and activities that could produce noise levels of concern, including source location, timing and duration;
- Sensory disturbance to fish, birds and wildlife, including boreal caribou and moose;
- Disturbance of harvest and recreational activities, including tourism;
- Potential impacts to wildlife harvesting activities; and,
- Impacts to communities.

Relevant territorial, provincial and federal noise standards or guidelines should be discussed, including their purpose and use in relation to the project phases.

The developer will provide a comparison of anticipated noise levels along the highway with current industrial, municipal or ambient noise levels.

The developer will provide an assessment of the potential health impacts arising from highway-related changes in noise levels, including potential impacts of sleep disturbance and annoyance.

Describe the proximity of the highway to receptors of the human environment, such as residences, cabin, camps and harvesting areas as well as valued components of the biophysical environment.

7.3.4. Water quality and quantity

Describe and evaluate the potential impacts of the highway on water quality and quantity, including a consideration of:

- Changes to surface drainage patterns and surface water hydrology including changes caused by highway-related impacts on terrain, soils and permafrost;
- Hydrogeological resources;
- Drinking water quality for humans and wildlife;
- Recreational water quality;
- Discharge or seepage of wastewater effluent, contaminants, chemical additives, etc.;
- Changes to water quality at water crossings (bridges, culverts and other wetted areas);
- Changes to water quality due to thaw slumps and other slope instability at water crossing;
- Changes to snow distribution and potential impacts on drainage;
- Issues related to borrow extraction including melting of ground ice and potential changes to drainage patterns etc.;
- Erosion, sediment deposition, sediment re-suspension;
- Dust and dust suppression;
- Increased turbidity;
- Flow or water levels including potential for glaciation and icings at watercourse crossings;
- Water withdrawal and volume of withdrawal (e.g., for ice roads, potable water, dust suppression);
- Impacts of the highway on navigation on navigable waterbodies;
- Potential effects on the aquatic environment including biota: and,
- Water use during gravel extraction.

The developer will provide site specific water quality objectives set out as narrative statements pertaining to turbidity and total suspended solids (TSS) to assess the level of protection required for waters potentially affected by the construction and operations of the highway in order to maintain current and future water uses.

7.3.5. Sediment Quality

Describe and evaluate the potential effects of the project on sediment quality, including consideration of:

- Potential effects related to changes in water quality and quantity;
- Potential issues associated with clearing of vegetation;
- Potential increases in TSS concentration associated with construction, modification and use of roads and water crossings; and,

- Potential effects on the aquatic environment;

7.3.6. Species at risk and species of concern

The purpose of the federal *Species At Risk Act* (SARA) is to prevent wildlife species from being extirpated or becoming extinct; to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity; and, to manage species of special concern to prevent them from being endangered or threatened. Section 79 of SARA requires that the Review Board ensure that during an EA, all SARA-listed species are identified and any adverse impacts of a development on them are thoroughly assessed and mitigated, regardless of whether the impacts are deemed significant.

The developer must consider any change that the highway may cause to a listed wildlife species, its critical habitat or the residences of individuals of that species, as those terms are defined in subsection 2(1) of SARA (see definition of impact on the environment in SARA Appendix 3, Definitions). Accordingly, the developer will take into account the requirements of SARA and provide the information necessary to evaluate the potential impacts of the highway on the species contemplated by this Act including mitigation and monitoring. All direct, indirect and cumulative effects should be considered. Species under consideration should also include those listed on Schedule 1 of SARA, and those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

In addition to considering those species identified through engagement and consultation events with communities, and any other species deemed necessary by the developer, the developer will also take into consideration the GNWT's *Species at Risk (NWT) Act* which applies to any wild animal or plant species managed by the GNWT, on both public and private lands, including private lands owned under a land claim agreement.

Discuss the potential impacts of the highway on species of concern and proposed mitigation in relation to applicable legislation, policy, management plans, recovery strategies, action plans or land use planning initiatives. In part, the developer will demonstrate to the Review Board how the Sahtu Land Use Plan and the results of any traditional knowledge and community consultation activities have been used to shape the approach taken to assess impacts to species of special management concern.

7.3.7. Fish and fish habitat

The developer will describe and evaluate potential impacts of the highway on valued components related to fish and fish habitat, including:

- Alteration or loss of fish habitat due to development activities during all project phases;
- Effects of proposed watercourse crossings and temporary vehicle crossing method;
- Standards or guidelines related to watercourse crossings that would be applied;

- Relevant policies, management plans or other measures to protect or enhance fish and fish habitat, including timing restrictions, protected areas or regulations;
- Disruption of sensitive life stages or habitat (e.g., spawning and incubation, rearing, overwintering) including loss of substrate habitat, known sensitive or important sites;
- Effects on riparian areas;
- Impacts related to changes in water quality or quantity;
- Distribution or abundance;
- Sensitive or important areas or habitat;
- Contaminant levels in harvested species that could be changed by the highway, if applicable;
- Potential effects on fish health;
- Blockages to movement;
- Blasting (if required);
- Dredging or disposal of sediments;
- Effects of water withdrawal;
- Potential for increased pressure on the resource that could arises from improved access;
- Reclamation of in-stream and riparian work areas during construction and also during maintenance operations; and,
- Criteria for evaluating the success of mitigation or reclamation measures, and indicate when and how this evaluation would be conducted (see also follow-up and monitoring).

7.3.8. Wildlife and wildlife habitat

For wildlife other than those species included in section Caribou, moose and harvesting), please describe and evaluate the potential impacts of the highway on wildlife or wildlife habitat including a consideration of:

- Direct and indirect alteration of habitat including highway footprint impact;
- Visual or auditory disturbance, including habitat avoidance and effective habitat loss in relation to highway facilities or activities;
- Wildlife mortality due to increased harvesting and vehicle collisions;
- Disruption of sensitive life stages or habitat (e.g., migration, calving, denning, overwintering);
- Wildlife movement patterns, home ranges, distribution and abundance;
- Sensitive or important areas or habitat;
- Population cycles;
- Predator-prey relationships;
- Increased human-wildlife interactions;
- Contaminant levels in harvested species that could be changed by the highway; and,
- Wildlife health and condition.

Specifically, the developer will discuss the duration and geographic extent (e.g. distance of noise related disturbance) of potential impacts in relation to how wildlife populations and harvest activities could be affected.

7.3.9. Birds and bird habitat

Describe and evaluate the potential impacts of the proposed highway on valued components related to birds and bird habitat, including a consideration of:

- Sensitive or important species, areas or habitat within the study area;
- Disruption of sensitive life stages or habitat including, nesting, rearing, staging, moulting, migrating;
- Direct and indirect alteration of habitat within the study area;
- Visual or auditory disturbance, including habitat avoidance in relation to highway facilities or activities and light disturbance;
- Bird distribution, abundance, health and condition;
- Contaminant levels in harvested species that could be changed by the highway;
- How highway-related changes in harvest pressures could impact the resource;
- Attraction of predators of birds and bird eggs to the project, or the provision of nesting or denning habitat for predators and scavengers; and,
- Potential mortality from collisions with temporary or permanent structures, wires or vehicles.

7.3.10. Vegetation

The developer will describe and evaluate the potential impacts of the proposed highway on vegetation including a consideration of:

- Alteration or loss of species, or vegetation assemblages that are rare, valued, protected or designated sensitive or important areas or habitat;
- Amount of merchantable timber removed during right of way clearing, and the potential for facilitating use of waste timber by communities;
- Introduction of non-native and/or invasive species;
- Effects of highway emissions including dust;
- How changes in right of way clearing might impact permafrost and the highway itself;
- Changes to the soil, hydrological or permafrost regimes related to vegetation changes;
- Re-establishment of vegetation and reclamation of borrow sites and other disturbances (particularly identification of vegetation types and seed mixes to be used, and identification of the specific borrow site to be re-vegetated, and those borrow sites that will not be re-vegetated); and,
- Vegetation control during operations.

7.3.11. Biodiversity

The developer will describe the changes to the biodiversity of the study area(s) during construction, operations and any post-reclamation and the significance of these changes in a local and regional context. Describe how the highway could result in changes to biodiversity, including a consideration of:

- Ecosystem and habitat loss;
- Habitat fragmentation / barriers to movement and gene flow;
- Ability of habitat or species to recover;
- Response to edge effects;
- Changes to species distribution and abundance;
- Invasive/non-native species (vegetation and wildlife); and,
- Changes to special management areas and species of special management concern (see Sahtu Land Use Plan).

7.3.12. Country foods

Many of these biophysical components are, or are linked to, the country foods harvested by local residents. The developer will identify these linkages and other impacts in a separate discussion on the potential contamination of country foods. The discussion will include the identification of which country foods are consumed, or expected to be consumed, which contaminants are of concern and an indication of whether transport pathways of contaminants into country foods will result from the proposed project and associated activities.

7.3.13. Culture and traditional land use

Describe and evaluate the potential effects of the development on culture and traditional land uses (beyond those described in response to the discussion of impacts on harvesting in section Caribou, moose and harvesting). This will include:

- Aboriginal languages;
- Traditional lifestyles, values and culture; and,
- Cultural and spiritual sites and activities.

Describe activities taken with community members to ensure that all cultural sites along the route have been identified, and the developer's degree of confidence that it has identified all such sites.

7.3.14. Land use

Describe and evaluate the potential impacts of the highway on land use, including a consideration of:

- Effects and management of increased access;

- Effects to traditional land use, tourism, outfitting, hunting, fishing, recreation and other non-traditional uses;
- Effects and changes to industrial land use and changes in access;
- Patterns of use and changes in these patterns;
- Effects to protected areas, parks, and environmentally and culturally sensitive areas;
- Aesthetics; and,
- Potential effects to other valued components.

Discuss the conformity of the proposed highway-related land uses with the existing Sahtu Land Use Plan.

7.3.15. Heritage resources

Describe and evaluate the potential impacts of the proposed highway on cultural heritage and special management areas, including a consideration of the following:

- Known site locations and areas of high potential for undiscovered sites;
- Consultation on site identification and management;
- Mitigations and management plans to protect known and undiscovered sites; and,
- Effects of increased access on sites.

8. Effects of the environment on the project

The developer will consider the effects of the environment on the highway. The developer will describe how the highway is engineered and designed to integrate into its environmental surroundings and operate safely and reliably over its life. The developer will describe and discuss how physical and biological changes in the environment could have implications for the highway. This should include considerations of the following:

- Long-term climate change scenarios (e.g., loss of permafrost, increased evaporation and evapotranspiration, greenhouse gas emissions);
- How likely changes in permafrost will affect the amount the granular material required for care and maintenance of the highway;
- Short-term climatic and extreme weather events (e.g., major precipitation, wind, fog, drought);
- Landslides and ground movement;
- Changes in permafrost regime;
- Subsidence;
- Seismic activity; and,
- Fires.

9. Potential accidents and malfunctions

The developer will describe and evaluate possible accidents or malfunctions, their probable and potential effects on the environment, including impacts on social, economic, and cultural elements of the environment and human health to people in close proximity of accidents or malfunctions, including spills of contaminants for the life of the highway. The developer will describe the process for the implementation of any mitigation measures or contingency plans. The developer must demonstrate a commitment to having an Environmental Protection Plan and Emergency Response Plan that would address potential accidents and malfunctions for the life of the construction project. In part, the Emergency Response Plan must include:

- Plans for alerting and evacuating employees during an emergency;
- Pertinent information in the case of an emergency (people in charge, equipment available, plans and maps to locate works);
- The developer's internal emergency intervention structure and decision-making mechanisms;
- The means of communication with the external emergency preparedness organization;
- The measures considered to protect the people that could be affected; and,
- The means to quickly alert the people that could be affected; in collaboration with the municipal, Aboriginal and other government organizations concerned, advising public authorities of the alert and subsequent information about the situation.

Particular attention should be focused on sensitive elements of the environment that could be affected in the event of an accident or malfunction over the life of the highway, and that could potentially make the consequence worse (e.g., proximity of cabins, heritage sites or environmentally sensitive sites). Where potentially significant impacts could occur as a result of an accident or malfunction, the developer will assess the probability of such an occurrence, taking into account weather or extreme external events that present contributing factors.

The developer will identify and discuss, for each project phase, the potential accidents or malfunctions that may occur as a result of the highway, including a consideration of:

- Spills of a hazardous material (on land, ice and in water - freshwater and marine);
- Explosion and/or fire;
- Transportation, storage, manufacture and use of explosives;
- Transportation accidents (air, land, water);
- Harvesting;
- Social and cultural elements of the environment; and,
- Human health.

10. Cumulative Effects Assessment

The cumulative effects of the proposed highway must be assessed. The cumulative effects assessment must demonstrate to the Review Board that any significant cumulative effects are adequately considered and can be successfully mitigated. The analysis of the cumulative effects must enable the Review Board to gain an understanding of the incremental contribution of all projects or activities in the vicinity of the highway, and of the highway alone, to the total cumulative effect on the valued components over the life of the highway. The developer must identify and assess the cumulative biophysical and socio-economic effects of the project in combination with other past, present or reasonably foreseeable projects and activities within the study area(s). While a project-specific assessment of cumulative effects is not responsible for assessing all cumulative impacts from other human activities, it must consider how the project's effects could interact cumulatively with the effects of other human activities, and the contribution of the highway to the overall effect.

The cumulative effects assessment must follow the guidance of the Review Board's *Environmental Impact Assessment Guidelines*, which refers specifically to cumulative effects assessment and includes a description of how to consider reasonably foreseeable future developments. The assessment of cumulative effects of the project must include the following, but may also address other items:

- Identify the valued components, or their indicators, on which the cumulative effects assessment is focused, including the rationale for their selection. These are valued components affected by the highway in combination with other past, present or reasonably foreseeable future developments. Present spatial and temporal boundaries for the cumulative effect assessment for each valued component selected. Emphasize valued components with special environmental sensitivities or where significant risks could be involved.
- Identify the sources of potential cumulative effects. Specify other past, present or reasonably foreseeable future developments that may substantially affects the valued components identified above. These may be in the vicinity of the project footprint, or may affect a mobile resource that moves into its vicinity (like a river or a caribou herd).
- Predict the combined effects of the highway and the other activities identified above.
- Identify how the developer or others will mitigate the identified cumulative impacts.

Key Lines of Inquiry and Subjects of Note contain important cumulative effects components. In addition to providing a detailed assessment in the response to each of these, a stand-alone assessment of the cumulative effects of the proposed development in combination with past, present and reasonably foreseeable future developments is required. As a minimum, this section in the DAR must provide summaries of the analysis and results for any cumulative effects assessment done and presented under any individual Key Lines of Inquiry or Subjects of Note.

The cumulative effects assessment will consider regional plans (including Sahtu Land Use Plan and the Dehcho Draft Land Use Plan), species recovery plans, management plans and objectives and guidelines in an integrated manner in order to understand the aspirations of people and communities in the region. The developer will make reasonable and conservative assumptions about relevant cumulative effects from other activities where there is an absence of data, where these effects could combine with those of the proposed highway. The developer will consider climate trends (per section 8) in the cumulative context as well as the project specific context.

The developer will also provide a discussion of potential future developments that could occur as a result of, or use of, this highway (e.g., Mackenzie Gas project, oil and gas development in the central Mackenzie Valley). Include a discussion of implications for long-term use, maintenance and management of the highway. It is also important to note that there may be opportunities within the project or others to mitigate the predicted cumulative effects.

11. Follow-up and monitoring

"Follow-up" means a program for verifying the accuracy of the environmental assessment of a project, and determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project. The developer will:

- Clearly describe the regulatory and non-regulatory monitoring requirements that may be required during construction and use of the all-weather highway;;
- Provide a description of the purpose of each program, responsibilities for data collection, analysis and dissemination, and how results will be used in an adaptive management process;
- Describe how project-specific monitoring will be compatible with the NWT Cumulative Impact Monitoring Program or other regional monitoring and research programs; and,
- Describe how the results of follow-up monitoring and the management response framework would be used and incorporated into land use permit and water licence applications in support of highway construction;

The developer is encouraged to discuss and adopt common data collection and monitoring protocols with local and regional monitoring programs including GNWT-Wildlife and the Sahtu Renewable Resources to facilitate project impact analysis.

Guidance on a management response framework, how to link monitoring results to management decisions, and how management activities are developed adaptively in response to changes in the environment can be found in the Wekeezhi Land and Water Board document *Guidelines for Adaptive Management – a Response Framework for Aquatic Effects Monitoring. Draft. Oct 17, 2010.*

11.1. Environmental and socio-economic effects monitoring

Measuring the effectiveness of mitigation, which includes reclamation of facilities used only for construction, requires that both the baseline and the future effects can be quantified. The effectiveness of mitigation measures can only be determined by a monitoring approach that is based on testable or answerable questions, and includes adequate sampling and statistical procedures. To the extent possible, the developer should present data in the DAR that may be used for a baseline or benchmark in setting targets, thereby providing the foundation needed in the future to demonstrate the effectiveness of mitigation measures. Where the developer does not present such data for bench marks and targets, the developer will commit to a schedule and a process by which such data will be provided and used in the development of follow-up and monitoring targets. The targets will be used in defining the expected success of mitigation. As not all socio-economic indicators or data are conducive to measurement using targets, the developer should clearly state where qualitative and quantitative goals are used in place of targets.

The developer will prepare a table with effects monitoring requirements. For each effect of concern, this table will include, at a minimum, information on what the indicators and the parameters for the measurement will be and what the target or management goal will be.

11.2. Developer's socio-economic effects management, policies and commitments

Describe any management plans, policies, commitments, and arrangements directed at promoting beneficial or mitigating negative impacts to social, cultural, or economic conditions where they have been presented as a form of mitigation.

Discuss any requirements for contractors and sub-contractors to comply with these policies. Include information on the following:

- Recruitment, training, hiring, pay equity and employment policies, including those policies specifically for Aboriginal and local candidates, and those promoting participation;
- Contracting and procurement policies, including those which promote local sourcing, and participation of local businesses and how this will be accomplished;
- Employment policies, including policies on alcohol and drugs on the job site, harassment policies, firearms policies, work and pay schedules, and any policies related to worker access to harvesting areas;
- Commuting and work rotation of workers and contractors;
- Policies to managing hunting, fishing and gathering on, or from, the work site by non-aboriginal employees and contractors, while respecting the harvest rights of Aboriginal employees and contractors;
- Occupational health and safety and related training, and emergency response plans for workplace accidents;
- Scheduling of construction activities to accommodate needs of Aboriginal harvesters (employees, contractors, and non-employees);
- Scheduling of work activities to accommodate needs of Aboriginal employees and contractors to pursue other traditional activities; and,
- Promoting activities and programs that increase community stability and wellness.

12. Conclusion

The Review Board anticipates that the requirements described in this document will help the Department of Transportation produce a Developer's Assessment Report that clearly describes its predictions of impacts from the highway and the likely effectiveness of proposed mitigation and management plans while providing sufficient basis for the Review Board and parties to analyze and evaluate those predictions.

Appendix 3

Design Criteria

DESIGN DESIGNATION	RAU - 90	*Rural Arterial Undivided*
DESIGN SPEED	90 (km/h)	*Posted Speed Limit – 80 (km/h)*
DESIGN GUIDLINES AND REFERENCE		*All design parameters must meet or exceed the National Standards established by applicable governing / regulatory bodies. For exemptions to any of the criteria established herein, a technical memo must be submitted to the Director of Highways and Marine Division with substantiation and rationale for the change prior to approval.* *Following resources govern the design:* • *TAC Geometric Design Guidelines* • *CAN/CSA-S6-06 Canadian Highway Bridge Design Code* • *Transportation Association of Canada's Guide to Bridge Hydraulics – 2nd Edition 2001* • *GNWT Transportation Regulatory Authority's requirements for Bridges & Bridge-Culverts*

ROADWAY DESIGN

HORIZONTAL ALIGNMENT		
Desirable Curve Radius Minimum Curve Radius	500 (metres) 250 (metres)	*This desirable is applicable for the entire length of the roadway. The minimum radius is also applicable for the entire length of the roadway, however, exceptions will be permitted on a site specific basis. The minimum radius for the horizontal alignment through site specific areas shall be **250** metres. (**500 m min in Kahsho Gotine PDR)***
Minimum Sight Distance	250 (metres)	*Horizontal sight distances are to be verified on all curves.*
Passing Sight Distance (minimum)	560 (metres)	*There is no requirement for continuous passing opportunities for the entire length of roadway. However, the Designer should endeavor to allow for passing opportunities along a minimum of 30% of the roadway length. Passing opportunities should be equally spaced along the entire length of the roadway with a desirable spacing of approximately ten (10) kilometres.*
Superelevation (e max)	0.06 m/m	
Minimum Spiral Parameter - "A" Value	N/A	*Refer to appropriate Superelevation Tables for minimum and desirable "A" Parameters for each curve radius and design speed. Spirals not required on all curves requiring superelevation.*
VERTICAL ALIGNMENT		
Minimum Stopping Sight Distance Minimum Decision Sight Distance Minimum Passing Sight Distance	170 (metres) 280 (metres) 604 (metres)	*Where the minimum Stopping Sight Distance is used, the sight should be verified using an object height of 0.38 metres and an eye height of 1.05 metres. Where the minimum Decision Sight Distance is used, the sight should be verified using an object height of 0.15 metres and an eye height of 1.05 metres. Where the minimum Passing Sight Distance is used, the sight should be verified using an object height of 1.30 metres and an eye height of 1.05 metres.*
Minimum Crest "K" Value	25	***Desirable "K" Value = 50.***
Minimum Sag "K" Value	30	***Desirable "K" Value = 40.***
Minimum Length of Vertical Curve	80 (metres)	
Maximum Gradient	9 %	*6% Desirable*
Max. Gradient at Bridge Approaches	N/A	*This gradient is applicable for 100 metres in advance of the bridge apron*
Min. Freeboard at Bridge Crossings	N/A	*This minimum is appropriate at all bridge crossings. Measurements for freeboard are between the underside of the girder and the high-high water or high-high ice levels - Refer to Canadian Highway Bridge Design Code CAN CSA S6-06 for further guidance.*
CROSS - SECTION		
Finished Roadway Width	9 (metres) 8.5 min (meters)	*In guardrail installation areas, an additional one (1) metre in width shall be added for each side that guardrail is installed.* ***(10 metre top in Kahsho Gotine PDR)***
Travel Lane Cross Slope	4 %	
Lane Width	3.50 (metres)	
Shoulder Width	0.75 (metres)	*Includes rounding.*
Side Slope / Fill Slope Ratio Normal Minimum (with Toe of Slope in water area) On fills over four (4) metres	 3.0 to 1 3.0 to 1 2 to 1	 *Use Rock fill only in the water.*

Slope Stabilization Requirements	>4.0 (metres)	*Slope stabilization features shall be designed for fills over 4.0 metres in height (i.e. benched embankment, MSE wall, etc.). Refer to the Thermal Analysis Report for further recommendations/direction.*
Minimum Embankment Height (Above Original Ground Level)	1.4 to 1.8 (metres)	*Does not include base courses.* *Refer to the Thermal Analysis Report for further recommendations/direction.*
Surface Gravel Thickness	200mm	*200mm Crushed Granular Base Course.*
DRAINAGE / EQUALIZATION CULVERTS (UPTO 1500 MM DIAMETER)		
Detailed Specifications		**Refer to:** **1. SD-400-01-51** **2. Standard Specifications – Division 4 Structures Sections 1 –** Supply and Installation of Corrugated Steel Pipe Culverts
GUARDRAIL		
		Guardrail shall be designed for in areas with embankment heights of 4.0 metres or greater and/or areas where water bodies are close enough to the highway to be considered a hazard. ***The BC MOT Warrant Guide and practical safety considerations will be used for determining barrier installation locations.*** *Type of guardrail shall be selected to*
ROADSIDE PULLOUTS		
		Roadside Pullouts to be provided at approximate one half (1/2) hour travel intervals.
STRUCTURES DESIGN		
BRIDGE-CULVERTS (1500 mm dia and above) – DESIGN LIFE 75 years		
Type	Structural Plate	*Open - bootom or close structures which meet EIRB requirements*
Minimum Cover	1.5 m	
Bedding Camber		*All bridge-culverts must be installed with camber*
Structural Bedding		• *Top 200mm to be un-compacted & shaped both longitudinally and transverse.* • *Without sub-cut, provide foundation solution that does not include sub-cut and maintain stream bed elevation*
Structural Backfill		*Provide source & specifications of material / method to be used which meets or exceeds CHBDC requirements.*
Ends	Required	*Must be beveled as per CHBDC constraints*
End Treatments	Required	*Must protect against hydraulic uplift, piping, undermining & ice jacking (for example using cut-off walls, impermeable barriers, sufficient load on bridge-culvert ends to prevent uplift, etc.)*
Plate Thickness	Varies	*Provide engineering rationale for selected metal thickness to meet the design life and to accommodate expected rate of section loss.*
Corrosion Protection		*Select appropriate bridge-culvert material and coating to suit site conditions (water, soil)*
BRIDGES – DESIGN LIFE 75 YEARS		
Design Loading	CL-800	
Freeboard	Min 1.5m	*This minimum is appropriate at all bridge crossings. Measurements for freeboard are between the underside of the girder and the high-high water or high-high ice levels to allow for events related to freshet, icing conditions and blockages as historical data and knowledge of stream behavior with new road embankment and structures cannot be fully predicted.*
Approach slabs	Required	*Required at all bridges to mitigate loss of fill at bridge / gravel road interface and to avoid grader / plow damages*
Skew	< 20 degrees	
lanes	2	*2 lanes will provide road width consistency for travellers under various weather/visibility conditions. Safety issue.*
Bridge width	8.5 meters clear curb-to-curb minimum	
Max. Gradient at Bridge Approaches	2%	*This gradient is applicable for 100 metres in advance of the bridge apron*
GENERAL CONSIDERATIONS		

Key Goals		Safety, Durability, and Functionality
		• *Length, height, and mass of pre-fabricated elements must be carefully planned to suit the transportation / haul constraints and launching / lifting machinery availability.* • *Climate change* • *Channel movement* • *Lack of historical knowledge about stream activities (max flows, freshet, icing, overflow, debris, beaver activity)* • *Maintenance requirements* • *Beaver activity, debris, ice/snow accumulation in bridge-culverts, overflow, freshet* • *Snow accumulation from plowing operations between bridge/guardrail on available roadway width and bridge / guardrail type to minimize snow accumulation.* • *Erosion and sediment control*

From Soil Steel Bridges – Design & Construction by Abdel-Sayed, Bakht & Jaeger; McGraw-Hill Inc. 1994:

"Some of the factors that lead to the collapse of a soil-steel bridge are as follows:

- *Use of poor quality soil, containing large quantities of clay and organic matter, in the backfill*
- *Compaction of the backfill in very large layers*
- *Compaction of the backfill in very cold weather, when there are ice lenses in the soil which give rise to the false impression of an adequate degree of compaction*
- *Lack of compaction in areas where the interface radial pressures between the soil and conduit wall are particularly high*
- *Construction of the structure on very flexible foundation without strengthening it as required*
- *Providing skewed bevel ends to the pipe without adequate protection in the form of strong head walls made integral with the conduit wall*
- *Lack of inlet and outlet protection when the structure carries water and is expected to be subjected to sudden and severe floods*

It is emphasized that properly designed and constructed soil-steel bridges are virtually maintenance free and show no sign of distress despite being in service for long periods."

The quotation above corroborates GNWT Transportation's experiences with bridge-culvert design, construction, and maintenance issues for the past 30 years.

Northwest Territories Transportation	Proposed **DESIGN CRITERIA / STANDARDS** **MVH Highway**	**Approved** **Kevin McLeod** Director Highways & Marine Date:

Appendix 4

DRAFT: Economic Study of the Mackenzie Valley All-Weather Highway
Nichols Applied Management

DRAFT

Economic Study of the Mackenzie Valley All-Weather Highway

Highway Construction Only – Excluding anticipated resource development induced impacts

Submitted to	Department of Transportation Government of the Northwest Territories
By	**Nichols Applied Management** **Management and Economic Consultants** **Suite 2401, 10104 – 103 Avenue NW** **Edmonton, Alberta T5J 0H8**
	February 2014

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1. Introduction

1.1 Background to the Report

The Mackenzie Valley Highway connecting Wrigley to Inuvik consists of both permanent and temporary winter road segments and bridges. The Department of Transportation (DOT) of the Government of the Northwest Territories (GNWT) wishes to upgrade the portion of the Mackenzie Valley Highway that connects Wrigley to Norman Wells from a temporary winter road to a permanent all-weather highway.

The GNWT DOT is seeking federal funding to support the highway upgrade project. Specifically, the DOT is preparing an application for funding under the National Infrastructure component of the *New Building Canada Fund (NBCF)*. Per the guidelines set forth in the NBCF, the GNWT submission must include an estimate of "the economic advantages and broader public benefits" of an all-weather road.

Nichols Applied Management Inc. (NAM) has conducted two separate economic analysis – a cost-benefit analysis (section 3) and an economic impact analysis (section 4) - of the proposed highway upgrade to support the GNWT submission.

1.2 Regional Setting

The Mackenzie Valley Highway (MVH) begins as a paved highway at the Alberta – NWT border, and extends north and west via Enterprise to Kakiska at which point the road surface turns to gravel and extends further north through Fort Simpson and on to Wrigley, at which point the all-weather road surface comes to an end (Figure 1.1).

Approximately 2,341 people (5.6% of the NWT population)[1] live in the communities located beyond the end of the all-weather road, specifically: Tulita, Norman Wells, Deline, Fort Good Hope, and Colville Lake. Vehicle access to these communities is currently only available via a network of winter roads that consists of:

- a 333 km winter road between Wrigley and Norman Wells;
- a 149 km winter road between Norman Wells and Fort Good Hope;
- a 105 km access road to Deline; and
- a 165 km winter road from Fort Good Hope to Colville Lake.

The winter road network is operational for approximately 15 weeks per year, generally beginning in late December and closing in early to mid-April. A considerable lengthening of the

[1] 2011 Statistics Canada Census Profile of NWT Census Division Region 2.

winter-road season has occurred since 2005 as a result of targeted construction programs along the Wrigley to Norman Wells portion of the road. It is likely that the winter road season has now been maximized as a result of these projects which included:

- 10 permanent bridges over water courses;
- adjustments to the winter road alignment and grade in selected places; and
- 13 permanent pipeline crossings and improved signage.

Outside of the winter road season, access to the communities north of Wrigley is limited to air or marine craft. Air service operates year-round to the regional airport in Norman Wells and to the smaller community airports in Tulita, Fort Good Hope, Deline and Colville Lake. Barge service is available for approximately 3 – 4 months a year once the Mackenzie River is clear of ice. Barge services are one part of the Mackenzie Valley intermodal transportation network that links the all-weather highway network to the Mackenzie River via loading docks at the towns of Hay River and Fort Simpson. The Hay River loading dock is also serviced by the CN Rail line – the only rail line in the NWT

All components of the NWT transportation system are susceptible to environmental interruptions – low flows or river debris during high flows can limit barges,[2] storms and wind can ground planes, and spring melt and winter storms can limit road transportation. An all-weather highway would contribute to a more reliable year-round transportation network in the region.

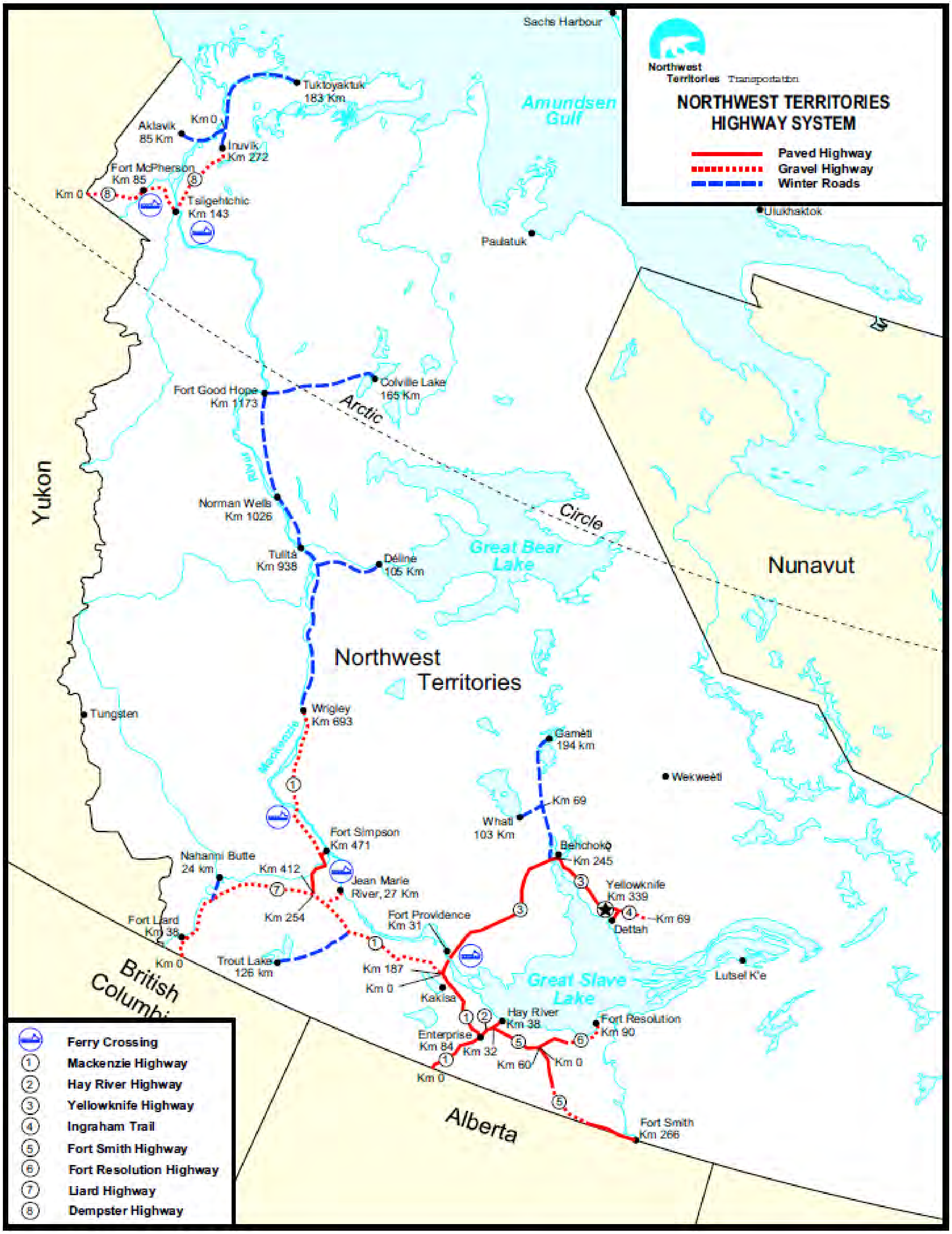
1.3 The Mackenzie Valley Highway Project

The proposed upgrade to the Mackenzie Valley Highway (the project) being contemplated by the GNWT DOT consists of replacing the winter road between Wrigley and Norman wells with a gravel surface two lane highway, similar to the existing Fort Simpson to Wrigley segment.

The GNWT DOT estimates that the cost to upgrade the Wrigley to Norman Wells segment will be approximately $700 million and cost, on average, $1.67 million per year to maintain. Design and construction of the all-weather road is expected to be carried out over a ten year period beginning in the 2014-2015 fiscal year provided the funding application is successful.

[2] In 2014, low water levels at the Ramparts along the Mackenzie River resulted in barges being unable to deliver fuel to Tuktoyaktuk and community supplies to Fort Good Hope. In the case of Fort Good Hope, supplies were off-loaded at Norman Wells and flown to Fort Good Hope using Buffalo Air's Electra.

Figure 1.1: Northwest Territories Highway System



Source: www.dot.gov.nt.ca/_live/documents/content/highway_system_map.pdf

2. Study Approach

This study includes two separate economic analyses of the MVH. They are:

- a cost-benefit analysis (CBA) that weighs the social costs of development against the social benefits resulting from the Project; and
- an economic impact analysis which traces the economic ripple effects of project related expenditures through the economy.

A conceptual overview of the methodologies used for each approach is presented below.

2.1 Cost-Benefit Analysis

A cost benefit analysis is a generally accepted methodology for establishing the net social benefit of a particular investment or activity. Conceptually, a CBA of a highway project such as the MVH involves:

- establishing whose costs and benefits are included in the analysis;
  - only the costs and benefits accruing to individuals and groups said to have standing in the analysis are considered. For example, standing for the MVH analysis could be extended to all residents and the government of the Northwest Territories but exclude individuals from outside the Territories.
- identifying the social costs associated with the construction and maintenance of the highway;
  - social costs include the cost of project construction and regular maintenance
- identifying the social benefits of constructing and operating the highway;
  - social benefits include could include items such as reduced travel time, improved safety, and the reduced cost to move freight into the region.
- assigning a dollar value to each of the identified costs and benefits;
  - costs and benefits are not always goods or services traded in markets. For example, a highway project that reduces the number of fatalities on a highway requires that a dollar value be assigned to a human life. In cases where non-market values are needed, a variety of statistical techniques can be used to arrive at estimated values. In some cases, a qualitative discussion of selected costs and benefits may be appropriate.
- adjusting the value of benefits and costs that occur over time;

- costs and benefits that occur in the future are discounted back to a present value and expressed in equivalent 2014 dollars.

- Subtracting the total social costs of the project from the total social benefits. If the total social benefits outweigh the costs, the project is said to be of a net benefit to society and considered to be an economically efficient and socially desirable investment.

It is important to note that a cost-benefit analysis is concerned with economic efficiency (i.e. maximizing the net social benefit) as opposed to distributive equality. The criterion used for project evaluation in a BCA is simply: do total social benefits outweighing total social costs? Individuals may be made worse off by the proposed project but if their losses are overwhelmed by the benefits accruing to others, the project is considered to be an overall benefit to society.

Additionally, a BCA is limited to the direct costs and benefits resulting from a project. The indirect or induced effects that may occur as project-related impacts ripple through the economy and society are not included in the analysis.

2.2 Economic Impact Analysis

Conceptually, an economic impact assessment (EIA) aims to quantify the economic effects of a project as the spending associated with the project ripples through the economy due to the interconnected nature of various sectors and markets. Specifically, an EIA considers the:

- direct effects of project-related expenditures on goods and services;
- indirect effects of project expenditures as suppliers to the project and related industries expand their output to meet the needs of the project;
- induced effect of the project as the additional income paid to employees of the direct and indirect sectors is circulated through the economy.

Together, the direct, indirect, and induced effects constitute the full economic impact of a project which can be characterized using a number of metrics that include:

- Employment creation (jobs)
- Gross Domestic Product (GDP);
- Household income; and
- Government revenue;

The most sophisticated tool available, and the one used in this study, to estimate the ripple effects of a project or activity is the Statistics Canada Interprovincial Input-Output (IO) Model. This model allows an analyst to estimate the direct, indirect, and induced effects of a project or activity across 235 industries and 473 commodities in all Canadian territories and provinces. A technical discussion of the assumptions and related limitations of the Statistics Canada IO model is included in Appendix B.

3. Cost Benefit Analysis

This section of the report summarizes the anticipated costs and benefits associated with the proposed MVH upgrade.

3.1 Study Perspective

The perspective used when calculating costs and benefits is important, it determines who is given standing in the analysis and effective delineates whose costs and benefits are considered. In this study, two perspectives are considered:

- a territorial perspective, which includes only the costs and benefits that accrue to the GNWT and its people; and
- a national perspective that considers the costs and benefits that accrue to all Canadians and the federal government.

There are two key differences between the two perspectives:

- the territorial perspective considers only the GNWT portion of capital costs and views toll revenue from those based outside of the territory as a benefit.
- the national perspective considers the full capital cost of the project and views toll revenue simply as a transfer from one party to another – no benefit is associated with the toll revenue.

3.2 Project Benefits

The project is expected to generate economic benefits primarily by reducing the cost of moving people and goods into and out of the region. These cost savings are expected to accrue to both:

- the existing freight and passenger shipment pathways; and
- new freight and passenger shipments resulting from the construction of the all-weather road.

The benefits of extending the all-weather highway between Wrigley and Norman Wells that are quantified and included in this study are:

- Reduced cost-of-living related to;
    - realized time-cost savings for existing truck transportation

  - savings related to a shift from high-cost year-round transportation methods (i.e. air) to a lower cost alternative (i.e., truck or personal vehicle)
  - savings related to a change in the scheduling of the transportation of key goods (i.e.: reduced need to 'bulk transport' and stockpile inventory)
- Improved personal mobility;
  - facilitation of residents' mobility during the spring and summer seasons (i.e. latent local resident traffic)
- Increased economic development;
  - facilitation of resource development (i.e. Canol and Indian Hare formation) via transportation cost reductions (i.e., latent resource development traffic)
- Increased tourism;
  - facilitation of summer vehicle access (i.e., induced tourism traffic)
- Improvements in safety;
  - reductions in collision rates on the all-weather versus the winter road
- Toll revenues;
  - collection of toll revenues from commercial and industrial trucks[3]
- Horizon value of the road asset;
  - A horizon value is the value of the roadway as a physical asset to the GNWT at the end of the 20 year study period; and
- Avoided winter road construction costs.

These benefits are expected to accrue annually over the study period of 20 years. The detailed calculation of the benefits and underlying data sources and assumptions is included in Appendix A.

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[3] Using a NWT perspective for the analysis implies that any tolls collected from a NWT operator is simply a transfer; however, tolls collected from non-NWT operators are a net benefit to the NWT.

3.2.1 Intangible Benefits

In addition to the benefits outlined in the preceding section, there are a number of difficult to quantify or otherwise intangible benefits that should be considered when evaluating the project. These include, but likely are not limited to:

- improvements in travel comfort, or reliability, for those with year-round access to an all-weather road rather than a combination of winter road, summer barge and year-round air service;
- the potential changes in carbon emissions resulting from transportation mode shifts,
- the enhancement of Canada's northern sovereignty via the construction of this key component of the Mackenzie Valley All-weather Highway, ultimately capable of connecting southern NWT to the resource-rich Beaufort Delta and Arctic coast.
- offsetting the possible negative effect of climate change on the length of the winter road season.

3.3 Project Costs

The costs of the project is estimated to be $700 million, including the $70 million cost of building the Great Bear River Bridge located near Tulita at km 941 of the Mackenzie Valley Highway. The construction of the project is anticipated to take 10 years (2014-15 to 2023-24) with the first three years allocated to planning, design and assessments (2014-15 to 2017-18) and the final 7 years allocated to highway and bridge construction (2018-19 to 2023-24). The cost schedule for the project is outlined in Table 3.1.

Table 3.1: Road Construction Cost Schedule

Fiscal Year	Phase	NWT Cost Portion (25%)	Canada Cost Portion (75%)	Total Cost
		$ Million		
2014-15	Canada-NWT Funding Partnerships	$2.5	$7.5	$10
2015-16	Environmental Assessment and Design	$7.5	$22.5	$30
2016-17		$7.5	$22.5	$30
2017-18		$7.5	$22.5	$30
2018-19	Highway Construction	$30	$90	$120
2019-20		$25	$75	$100
2020-21		$25	$75	$100
2021-22		$25	$75	$100
2022-23		$22.5	$67.5	$90
2023-34		$22.5	$67.5	$90
Total		**$175**	**$525**	**$700**

Notes: Figures are in 2014 CAD.

Source: Government of the Northwest Territories, Department of Transportation, 2014.

In addition to the one-time construction costs, there will be ongoing costs associated with the operation of the project. These costs include:

- annual maintenance costs of the all-weather highway estimated to be $5,000/km or $1.67 million annually for the 333 km project (2014 CAD); and
- administrative costs related to the collection of tolls. These costs are estimated to be negligible and therefore not included in the analysis.

3.4 Project Net Benefits

The net benefit of the project was estimated under two operational scenarios (tolls and no tolls) and two societal perspectives (territorial and national). Benefits and costs were estimated over a 20 year time horizon (2014 to 2044) using real 2014 Canadian dollars and a discount rate of 8%. The results of the NWT perspective with and without toll revenue are summarized in Table 3.2.

Table 3.2: Cost Benefit Summary: NWT Perspective

Project Impact	No Tolls	Tolls
	$ Million (NPV 2014)	
Benefits		
Cost-of-Living	$23.9	$23.9
Increased Mobility	$45.8	$45.8
Increase Economic Development	$13.3	$13.3
Increased Tourism	$0.8	$0.8
Improvements in Safety	$0.0	$0.0
Tolls Revenue	$0.0	$24.5
Horizon Value	$43.5	$43.5
Avoided Winter Road Construction	$11.6	$11.6
Avoided Winter Road Maintenance	$3.4	$3.4
Costs		
Construction	$114.6	$114.6
Maintenance	$8.3	$8.3
Net Benefits	**$19.3**	**$43.8**
Benefit/Cost Ratio	**1.16**	**1.36**

When considered from the NWT perspective, the project is expected to generate a net social benefit regardless of whether or not tolls are charged to commercial road users. When no tolls are collected, the project will generate an expected $19.3 million in net benefit (NPV 2014). When commercial users are able to use the road freely (i.e.: no tolls) the project generates a net social benefit equal to approximately $44 million (NPV 2014).

Table 3.3: Cost Benefit Summary: NWT vs Canadian Perspective

Project Impact	NWT Perspective	Canadian Perspective
	$ Million (NPV 2014)	
Benefits		
Cost-of-Living	$23.9	$23.9
Increased Mobility	$45.8	$45.8
Increase Economic Development	$13.3	$33.3
Increased Tourism	$0.8	$3.1
Improvements in Safety	$0.0	$0.0
Tolls Revenue	$24.5	$0.0
Horizon Value	$43.5	$43.5
Avoided Winter Road Construction	$11.6	$11.6
Avoided Winter Road Maintenance	$3.4	$3.4
Costs		
Construction	$114.6	$458.6
Maintenance	$8.3	$8.3
Net Benefits	**$43.8**	**-$302.4**
Benefit/Cost Ratio	**1.36**	**0.35**

When the full capital cost of the project is included in the analysis (Canadian Perspective), the project is expected to result in negative net social benefits amount to the equivalent of -$302.4 million (NPV 2014). This result is driven primarily by the inclusion of the full capital cost of the project, whereas the NWT perspective includes only the 25% paid for by the territorial government.

Should the federal government have a stated policy objective of supporting long term development prosperity in the NWT, it may be appropriate to consider the NWT perspective as the relevant analytical framework as the territory and its people will benefit as a result of the support offered by the federal government. The project may also be appealing to the federal government if the assertion of Canadian sovereignty in the north is considered to be of significant value to society.

4. Economic Impact Assessment

The economic impact of the construction and operation of the MVH upgrade was estimated using expenditure data provided by the GNWT and the Statistics Canada Interprovincial Input-Output Model.

4.1 Project Expenditures

The construction and maintenance of the MVH upgrade will require the direct purchase of goods and services in the GNWT, across Canada, and internationally. These initial expenditures will in turn ripple through the economy as businesses expand and people spend their income.

4.1.1 Construction Expenditures by Region

Total capital expenditures associated with the MVH upgrade over the 2015 to 2024 period is estimated to be $700 million, with 25% ($175 million) contributed by the GNWT and 75% ($525 million) contributed by the federal government of Canada. Construction capital expenditures will include wages and salaries paid to construction workers, professional engineering and environmental services, and the direct purchase of goods and services, such as major equipment and gravel.

It should be noted that, on average, the upgrade of the MVH will result in the displacement of $335,000 in annual spending related to the construction of the winter road between Wrigley and Norman Wells. The values shown in Table 4.1 are the present value of the upgrade expenditures net of the present value of the winter road construction expenditures for the next 10 years (2015 to 2024).

Table 4.1: Construction Expenditure by Type

Expenditures	Total NPV ($ Millions)	Total (%)
Engineering and Design	46.50	7
Labour	181.00	28
Fuel and Parts	316.50	16
Materials and Equipment	103.50	49
Total	**647.50**	**100**

It is estimated that approximately $46.5 million (7%) will be spent on engineering and design during the 2015 to 2018 period followed by $181 million, $316 million, and $103.5 million on labour, fuel, and materials and equipment over the 2019 to 2024 period. The goods and services necessary to upgrade the MVH will be procured from the Northwest Territories (NWT), across Canada, and internationally.

4.1.2 Maintenance Expenditures by Region

Once fully constructed, the upgraded portion of the MVH will require regular maintenance in the form of regular grading, ploughing, dust suppression, pothole repair, and culvert maintenance. In a typical year, the expenditures associated with roadway maintenance on the upgraded portion of the MVH will average approximately $1.7 million. It should be noted that the annual maintenance of the all-weather road will displace $0.6 million in annual expenditure related to the maintenance of the winter road between Wrigley and Norman Wells. The values shown in Table 4.2 are net of the displaced winter road maintenance expenditures.

Table 4.2: Average Annual Maintenance Expenditures by Region

Expenditures	Total Average Annual ($ thousands)	Total Average Annual (%)
Engineering	119	7
Labour	476	28
Fuel and Parts	272	16
Materials and Equipment	833	49
Total	**1,700**	**100**

Once the MVH upgrade is complete, it is estimated that in an average year of operations the GNWT will spend approximately $119,000 (7%) on engineering and related services, $476,000 on labour, $272,000 on fuel and parts, and $833,000 on materials and equipment. The goods and services necessary to maintain the newly upgraded portion of the MVH will be procured from the Northwest Territories (NWT), across Canada, and internationally.

4.2 Project Construction Effects

The expenditures associated with the MVH upgrade will constitute income for contractors, suppliers, and workers. These primary recipients will, in turn, spend a portion of this income on goods and services, thus circulation the expenditures throughout the economy, compounding the effect of the Project.

The direct, indirect, and induced effects of the MVH upgrade on GDP, employment, income, and government revenue was estimated using the Statistics Canada Inter-Provincial Input-Output model. The results are summarized in section 4.2.1 through 4.2.4.

4.2.1 Gross Domestic Product

As shown inTable 4.3, over the ten year design and construction period, the MVH upgrade will contribute $693 million to the GDP of the Northwest Territories. The average annual GDP effect represents approximately 1.6% of the NWT GDP in 2013. The project will also contribute an additional $602 million to the GDP in the rest of Canada. The average annual direct, indirect, and induced impact of project construction represents less than 0.01% of Canada's GDP in 2013.

Table 4.3: Total Construction Effect on GDP

Gross Domestic Product	Northwest Territories	Rest of Canada	Total
	[$ millions]		
Direct	183	-	183
Indirect	228	249	477
Induced	282	353	635
Total	**693**	**602**	**1,295**
Total [%]	**54**	**46**	**100**

4.2.2 Employment

As shown in Table 4.4, the total employment effect of the MVH upgrade over the ten year design and construction period will be approximately 6,745 person-years of employment in the Northwest Territories. On an average annual basis, this represents approximately 675 full-time equivalent positions or 0.3% of the territorial labour force. The project will also generate a total of additional 4,225 person-years of employment in the rest of Canada. On an average annual basis, the total employment impact of project construction represents less than 0.01% of Canada's total labour force.

Table 4.4: Total Construction Effect on Employment

Job Type	Northwest Territories	Other Canada	Total
	[Full-Time Equivalent Jobs]		
Direct	1,990	-	1,990
Indirect	2,235	1,635	3,870
Induced	2,250	2,590	5,110
Total	**6,745**	**4,225**	**10,970**
Total [%]	**61%**	**39**	**100**

4.2.3 Income

The economic activity associated with the MVH upgrade will result in wages and salaries being paid to workers throughout the economy. As shown in Table 4.5, the MVH upgrade will result in approximately $613 million of income being paid to workers in the Northwest Territories over the ten year design and construction period, or approximately $61.3 million annually. The project will also generate an additional $293 million of income for workers in the rest of Canada over the construction period, or approximately $29.3 million annually.

Table 4.5: Total Construction Effect on Income

Job Type	Northwest Territories	Other Canada	Total
	[$ millions]		
Direct	183	-	183
Indirect	205	120	325
Induced	225	173	398
Total	**613**	**293**	**906**
Total [%]	**68**	**32**	**100**

4.2.4 Government Revenue

The economic activity associated with the MVH upgrade will result in additional government revenue related to the purchase of goods and services and the employment of individuals (i.e HST, GST, PST, import duties, personal income taxes). Government revenue expands the ability of different levels of government to fund programs and initiatives

As shown in Table 4.6, over the ten year period of design and construction, the MVH upgrade will result in approximately $44 million of revenue being collected by the GNWT (approximately $4.4 million per year), an amount that, on an average annual basis, represents X% of total territorial government revenue in 2013. An additional $23 million is expected to accrue to other provincial and territorial governments. The federal government of Canada is also expected to collect $111 million in revenue related to the MVH upgrade (approximately $11.1 million per year), an amount that, on an average annual basis, represents X% of total federal government revenue in 2013. Possibly relate back to cost of grant.

Table 4.6: Total Construction Effect on Government Revenue

	Northwest Territories	Other Provinces & Territories	Federal Government
	[$ Millions]		
Total	44	23	111
Total [%]	25	13	62

4.3 Project Maintenance Effects

The expenditures associated with the maintenance of the upgraded portion of the MVH will constitute income for contractors, suppliers, and workers. These primary recipients will, in turn, spend a portion of this income on goods and services, thus circulation the expenditures throughout the economy, compounding the effect of the Project.

The direct, indirect, and induced effects of the average annual maintenance expenditures related to the upgraded portion of the MVH on GDP, employment, income, and government revenue was estimated using the Statistics Canada Inter-Provincial Input-Output model. The results are summarized in section 4.1.3.1 through 4.1.3.4.

4.3.1 Gross Domestic Product

As shown in Table 4.7, the average annual maintenance of the MVH upgrade will contribute $1.77 million to the GDP of the Northwest Territories, which would represent 0.04% of 2013 levels. The project will also contribute an additional $1.55 million to the GDP in the rest of Canada. In total, the impact of maintaining the newly upgraded portion of the MVH represents less than 0.001% of Canada's GDP in 2013.

Table 4.7: Average Annual Maintenance Effects on GDP

Gross Domestic Product	Northwest Territories	Other Canada	Total
	[$ Thousands]		
Direct	465	-	465
Indirect	585	640	1,225
Induced	720	910	1,630
Total	**1,770**	**1,550**	**3,320**
Total [%]	**53**	**47**	**100**

4.3.2 Employment

As shown in Table 4.8, the average annual employment effect of maintaining the MVH upgrade will be approximately 15 jobs in the Northwest Territories, which represents approximately 0.01% of the territorial labour force. Maintaining the newly upgraded portion of the MVH will also generate an additional 15 jobs in the rest of Canada related to the supply of goods and services required by contractors or employees of the GNWT. In total, the employment impact of maintaining the highway represents less than 0.001% of Canada's total labour force.

Table 4.8: Average Annual Maintenance Effect on Employment

Job Type	Northwest Territories	Other Canada	Total
	[Full-Time Equivalent Jobs]		
Direct	5	-	5
Indirect	5	5	10
Induced	5	10	15
Total	**15**	**15**	**30**
Total [%]	**50**	**50**	**100**

4.3.3 Income

The economic activity associated with maintaining the MVH upgrade in an average year will result in wages and salaries being paid to workers throughout the economy. As shown in Table 4.9, maintenance of the MVH upgrade will result in approximately $1.6 million of income being paid to workers in the Northwest Territories. The project will also generate an additional $1.8 million of income for workers in the rest of Canada.

Table 4.9: Average Annual Maintenance Effect on Income

Job Type	Northwest Territories	Other Canada	Total
	[$ Thousands]		
Direct	465	-	465
Indirect	525	310	835
Induced	575	445	1,020
Total	**1,565**	**1,755**	**2,320**
Total [%]	**67**	**33**	**100**

4.3.4 Government Revenue

The economic activity associated with maintaining the MVH upgrade will result in additional government revenue related to the purchase of goods and services and the employment of individuals (i.e HST, GST, PST, import duties, personal income taxes). Government revenue expands the ability of different levels of government to fund programs and initiatives

As shown in Table 4.10, maintaining the MVH upgrade in an average year will result in approximately $131,000 of revenue being collected by the GNWT, an amount that represents X% of total territorial government revenue in 2013. An additional $85,000 expected to accrue to other provincial and territorial governments. The federal government of Canada is also expected to collect $312,000 in revenue related to maintaining the MVH upgrade in an average year, an amount that represents X% of total federal government revenue in 2013. Possibly relate back to cost of grant.

Table 4.10: Average Annual Maintenance Effect on Government Revenue

	Northwest Territories	Other Provinces & Territories	Federal Government
	[$ Thousands]		
Total	131	85	312
Total [%]	25	16	59

4.4 Additional Economic Activity

There are several notable additional economic impacts that may result from improved year-round access to the Central Mackenzie Valley that are not captured in the input-output analysis. These include, the benefits of the activities associated with the traffic that will be induced as a result of the all-weather road; namely, tourism and resource development.

It is expected that increased tourism and oil and gas development will lead to increased NWT GDP, employment, labour income and taxation/royalty revenues.

Additional discussion of increased resource development will be included once the IO modelling is complete.

A. Calculating Benefits Technical Appendix

A. Calculating Benefits

The methods used to quantify the benefits of the highway upgrade project are outlined in this appendix.

A.1. Reduced Cost of Living

The project is expected to reduce the freight and passenger transportation costs in to, out of, and within the region. Due to the competitive freight-transport industry in the NWT, it is assumed that a sizable portion of the transportation cost-savings will be passed on to residents of the Sahtu region and subsequently reduce their cost of living.

The transportation cost-savings calculated here encompass both the benefits that will be retained by transport operators as well as the benefits to residents of the region to whom a proportion of the cost-savings will be passed.

A.1.1 Reduced Freight Travel Time

A recent study conducted by PROLOG Canada[4] indicates:

- a realized travel speed of 40 km/hr on the Mackenzie Valley Winter Road between Wrigley and Norman Wells;
- a speed of 75 km/hr on the proposed All-weather Highway; and
- an average 23.5 tonne payload per truck; and
- an hourly operating cost, per truck, of $165 per hour. [5]

Benefits related to existing freight traffic will result from the increased average speed on the all-weather road. Using the assumption listed above, these benefits are estimated to be a $1,363 (2014 CAD)[6] decrease in cost for each round trip between Wrigley and Norman Wells. Using an average payload of 23.5 tonnes, this equates to a $58 (2014 CAD) decrease in cost for each tonne of freight.[7]

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4 PROLOG Canada. 2010. The Northern Transportation Systems Assessment. Phase 2 Report: Infrastructure Needs Assessment. Prepared for Transport Canada.

5 Operating costs are assumed to account for the full opportunity cost of the truck and operator.

6 Adjusted using the Consumer Price Index (CPI) for Yellowknife (October 2010 = 118.4; October 2014 = 125.9)

7 Approximately 15% of avoided costs are driver's fees. Assume a $26.00/hour (2014 CAD) driver wage rate in the NWT. See: www.labour.gc.ca/eng/standards_equity/contracts/schedules/northwest_territories/schedule.shtml

A.1.2 Shift in Preferred Freight Transportation Modes

The increased cost-effectiveness of spring and summer ground transport, relative to air and barge transportation, as a result of the project are expected to be as follows:

- a savings of $4,240/tonne for freight moved via truck as compared to air
    - assuming a $4,408/tonne for air cargo movement between Yellowknife and Norman Wells[8] less $167/tonne for freight moved on a return trip originating at Hwy 1/3 Junction to Norman Wells at 75 km an hour[9]
- negligible cost-savings associated with the shift from barge deck cargo to truck transport
    - barge shipping is highly price competitive with truck transport; however, the decreased need to warehouse goods with a highly reliable, responsive and on-demand truck transport system is predicted to result in a shift to truck transport.[10]

Currently, freight moves into the central Mackenzie Valley using the combination of truck, barge, and air presented in Table A.1.

Table A.1 Freight Transportation to Mackenzie Valley (2014)

Cargo Type	Winter Road	Barge	Plane
Bulk Fuel (tonnes)	5,500	22,500	-
Resource Development (tonnes)	900	8,260	-
Community Re-supply (tonnes)	1,800	3,540	-
Total (tonnes)	**8,200**	**34,300**	**782**

Source: Adapted from PROLOG (2010) Phase 1 and Statistics Canada (2013) Cansim Table 401-0045
Note: Winter road freight uses the 2007 data (highest year reported by PROLOG) to approximate 2014 since traffic volumes suggest a higher freight load in more recent years.
Barge data are PROLOG estimates for 2010 with an adjustment to match truck freight categories.
Plane freight data uses cargo tonnes off-loaded in Yellowknife in 2013 scaled to the Sahtu regional population (5.6% of NWT). This is likely an underestimate of plane cargo shipments.

Following completion of the project and the possibility of the savings described above, it is expected that:

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8 Communication with Buffalo Air suggesting $2/lb is an average price for cargo shipments. First Air shipment rates between Yellowknife and Norman Wells are also approximately $2/lb (See: https://firstair.ca/wp/wp-content/uploads/tariffs/FirstAir_DomesticCargoRatesFrom_Norman_Wells.pdf)

9 Taken from Page 67 of PROLOG. 2010.Northern Transportation Systems Assessment. Phase 2 Report: Infrastructure Needs and Assessment. Adjusted into 2014 CAD using the Consumer Price Index (CPI) for Yellowknife (October 2010 = 118.4; October 2014 = 125.9)

10 Ibid.

- All bulk fuel carried by barge will continue to be shipped by barge;[11]
- 95% of barge deck cargo will shift to truck transport;
- 95% of air cargo is shifted to truck transport;[12,13] and
- truck freight will continue to be transported by truck, but will now be delivered year-round.

In addition to the shifts described above, it is assumed that the future demand for freight will grow as follows:

- bulk fuel is expected to increases at 2% annually and receive a one-time 15% increase shock in 2022 as year-round local vehicle usage begins;
- resource development is expected to increases at 2% annually; and
- community re-supply is expected increases at 2% annually.

The above-described increases in freight volumes are assumed to represent a "business as usual" case. Shocks to the demand for freight as a result of increased resource development are considered latent traffic demands and are considered separately in the following resource development section (A.3).

A.2 Improved Personal Mobility

The cost of personal travel to, from and within the region is expected to decrease due:

- a reduction in the amount of time required to travel; and
- the differential in the cash cost of ground travel as compared to air transport.

A.2.1 Reduced Passenger Travel Time

The project is expected to generate benefits related to the time saved by individuals who are currently using the winter road and will, in the future, be able to travel at a higher speed in the winter season on the all-weather road. During the 15 weeks that a winter road would otherwise be available, the presence of the all-weather road is expected to generate benefits equal to approximately $300,130 per year.

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[11] Ibid.

[12] Ibid.

[13] Some cargo – especially cargo that is labelled as "do not freeze" in the winter will likely continue to be shipped via air.

This estimate was arrived at by assuming:

- a person's time is valued at $14.55/hour (2014 CAD), or one half the NWT average wage rate across all industries;[14]
- an average increase in speed of 35 km/hour on the all-weather road (40 km/hr versus 75 km/hr);
    - a time-cost savings of $0.17/km per person
- 1.62 passengers per light vehicle;[15]
    - a time-cost savings are $0.27/km per vehicle
- 90% of ADT is comprised of light vehicle traffic;[16]
- an average trip length of 207[17] km per personal vehicle trip;
- an average of 92 personal vehicle trips per day (149 passenger movements per day);[18,19]
- a 15 week winter road season; and
- no annual growth in daily personal vehicle travel during the winter season regardless of the presence of the all-weather road.

A.2.2 Shift in Passenger Travel Mode

Ground transportation to, from, and within the central valley is currently limited to the winter road season. All other times of the year travel is by river access (3 – 4 months in the summer) or air transport (year-round).

It is estimated that a total of 49,194 passengers boarded and disembarked from aircraft at the Norman Wells airport in 2013 (Table A.2).[20] It is believed that, in the north, as many as 2/3 of

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14 Source: Statistics Canada CANSIM Table 281-0030.

15 NRCAN (Natural Resources Canada). 2010. The 2008 Canadian Vehicle Survey Update Report. ISBN 978-1-100-16618-6

16 Ibid.

17 Note this is a conservative estimate. The assumed trip length of 207 km is half of the average light vehicle trip length calculated for the winter road using GNWT DOT ADT and VKM data.

18 Approximately 90% of the vehicle kilometers in Canada are from light vehicles (see: NRCAN (Natural Resources Canada). 2010. The 2008 Canadian Vehicle Survey Update Report. ISBN 978-1-100-16618-6). This analysis uses the proportion of vehicle kilometers per vehicle type as a proxy for percentage of trip per vehicle type. Thus, with an average of 102 trips per day at the two winter road traffic counters, an approximate number of light vehicle trips is 102*0.9 = 92 trips.

19 This is conservative and assumes that one personal vehicle trip is counted at both traffic counters. This ensures no double counting of trips, but also results in a likely underestimation of total trips.

the air passengers are government officials. [21] It is unlikely that these individuals will shift to ground transportation despite the all-weather road.[22]

Table A.2 Estimated Passenger Travel by Mode

Volume Metric	Winter Road		All-Weather Road	
	Vehicle	Air	Vehicle	Air
Passenger Trips per day	149	-	149	-
Passenger Trips per year	15,913	49,194	54,281	44,275

Source: Adapted from GNWT DOT Highway Statistics, 2014; GNWT DOT Airport Statistics Report, 2004; and Statistics Canada CANSIM Table 401-0044.

Notes: Ground daily passenger trips are calculated at 90% of 2013's winter road ADT (an average between the two counters) and adjusted using a 1.62 passenger/vehicle adjustment (NRCAN, 2010).
The winter road assumes scenario107 days of vehicle travel. The all-weather road scenario assumes 365 days.
Air passengers were estimated using 2004 Norman Wells numbers scaled using the growth in passengers at Yellowknife airport between 2004 and 2013.
With the all-weather road, there is an assumed 10% decline in passenger volume.

However, it is expected that a proportion of the remaining personal travel will make use of the all-weather road and the access it provides to both Yellowknife and Edmonton – especially for families or groups travelling together. Using the PROLOG (2010) assumption that one tenth of the current passengers would instead make the trip by vehicle – with 4 passengers per vehicle – the following cost savings can be calculated:

- Per passenger return trip costs to Edmonton with the airline Canadian North are $1,266.30 and would take 11 hours return (8 hours flying and 3 hours for airport time) for a time cost of $160.05[23] (2014 CAD) and a total return cost of $1,426.35 per person.
    - Driving a 4,000 km round trip to Edmonton is estimated to cost $580.00 in vehicle and fuel operating costs and would take 50 hours return (driving an average 75 km/hour on NWT Highways and 85 km/hour on AB highways) for a time cost of $727.50 and a total return cost of $1,307.5 per person.

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20 In 2004, 48,048 passengers boarded and disembarked at the Normal Wells regional airport. Adjusting this figure by a factor of 1.02 (the ratio of passengers enplaned/deplaned in 2004 versus 2013 at the Yellowknife airport) gives an estimated passenger volume of 49,194 in 2013.

21 Brownie, Don. 2013. A Northern Transportation Strategy for Canada: Discussion Paper. PROLOG Canada and The Van Horne Institute

22 Using a road allowance rate of $0.58/km, an hourly wage rate of $30/hour and a traveling speed of 75 km/hour, an individual can drive a return trip between Norman Wells and Yellowknife for approximately $2,311.48 (2014 CAD) or fly using Canadian North for approximately $1,029.60 per return trip ($894.60 for a round trip ticket plus $135 for 2.5 hours of flying and 2 hours of airport time; 2014 CAD).

23 This assumes time travel costs for an individual of $14.55/hour which is equal to ½ the NWT's industry aggregate wage value (Source: Statistics Canada CANSIM Table 281-0030).

  - The cost-savings per adult are $118.85 per trip, and the cost-savings per child are $686.30[24] per trip. A family of four would save $1,610.30 per vehicle trip.

- Per passenger return trip costs to Yellowknife with Canadian North are $894.60 and approximately 4.5 hours of travel (2.5 flying and 2 hours for airport time) for a time cost of $65.48 and a total return cost of $960.08 per person.

  - Driving a 2,356 km round trip to Yellowknife costs $341.62 in vehicle and fuel operating costs and would take 31.5 hours (75 km/hr average speed) for a time cost of $458.33 and a total return cost of $799.95 per person.

  - The cost-savings per adult are $160.13 per trip, and the cost savings per child are $552.98 per trip. A family of four would save $1,426.22 per trip.

With an estimated savings of approximately $1,500 for a return trip for a family of four between either Norman Wells and Edmonton or Norman Wells and Yellowknife, and approximately 2,460 fewer annual return air trips out of Norman Wells, annual flight cost-savings are estimated at $922,387 per year.

A.2.3 Increased Personal Travel of Residents

Increased road access (from 3-months to year-round) will result in increased travel opportunities for individuals. Personal and business travel will becomes less dependent on the schedule of air service, less subject to air travel delays and cancellations due to weather, and cheaper as road travel displaces air transportation. The analysis assumes:

- Air travel between Norman Wells and Tulita (distance of 88 km) costs $212.32 one way, or $2.41 per km;

- Air travel takes approximately one hour total, of which 20 minutes is spent flying. This suggests a $0.16/km time cost per person;

- Total air travel costs are, therefore, approximated at $2.57/km per passenger; and

- The cost difference between flying and driving for these passenger trips is estimated at $2.02/km.

At a travelling speed of 75 km/hr, an operating cost of $0.58/km,[25] an average of 1.62 passengers per vehicle, and a travel time cost of $14.55/hr, the cost of travel by vehicle is $0.67/km per passenger (see section A.2.1).

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24 Assumes a time travel cost of zero for children.

25 Canada Revenue Agency 2014 Automobile Allowance Rate for the NWT. See: http://www.cra-arc.gc.ca/tx/bsnss/tpcs/pyrll/bnfts/tmbl/llwnc/rts-eng.html

Assuming individuals continue to use the all-weather highway outside of the winter season at the same level that they use the winter road during the winter season, it is estimated that a total of 54,281 passengers (for a total of 38,369 newly induced passenger trips) will use the highway with an average trip distance of 207 km.[26] There is no assumed growth through time in the number of passengers traveling by vehicle.

A.3 Increased Resource Development Truck Traffic

A.3.1 Conventional Oil and Gas

Traffic movements related to existing oil and gas are included in the baseline freight movements for the central valley. As a result, all cost-savings to current oil and gas extraction activities as result of the all-weather road are included within the cost-of-living calculations (see above).

A.3.2 Future Unconventional Oil and Gas

The Canol and Hare Indian Formations in the Sahtu Region of the Mackenzie Valley promise to provide significant oil and gas opportunities. It is estimated that these shale deposits hold significant oil and natural gas liquids – with estimates that over the next 15 – 30 years cumulative production could equal more than one billion barrels of crude oil.[27] As with all tight oil formations, recent advances (in the last 10 – 15 years) in horizontal drilling and multi-stage hydraulic fracturing have offered the promise of profitable development of these resources.

The three companies with ongoing active exploration in the region are MGM, Husky and ConocoPhilips. Shell and Imperial have yet to propose activities within their exploratory licenses.[28] Currently, there are approximately 5 exploratory wells expected each year between 2014-15 and 2016-17.[29]

While development forecasts/schedules for the Sahtu region formations are unknown, generally the development of an unconventional oil play requires resource evaluation and appraisal (years 1 – 10), pilot production (years 4 – 15), and, finally, commercial development (years 6 – 25+).[30]

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[26] Using the GNWT DOT vehicle kilometer statistics for the Mackenzie Valley Winter Rood in 2013, if 90% of the vehicle kilometers are due to 92 personal vehicle trips per day over the 107 day winter road season, then 4.5 Million vehicle kilometers are the result of 92*107 = 9,844 trips and the average distance per trip is 415 km. An average trip distance of 207 km is, therefore, intended to be a conservative estimate.

[27] DPRA Canada Inc. 2013. Resource Exploration in the Sahtu Settlement Area: Opportunities and Challenges. Available at: http://www.iti.gov.nt.ca/sites/default/files/resource_exploration_sahtu.pdf

[28] K'aalo-Stantec Ltd. 2013. The Canol Shale Play: Possible Outcomes of Early Stage Unconventional Resource Exploration. Available at: http://www.mvlwb.ca/Boards/slwb/Registry/2013/S13A-001%20-%20Conoco%20Phillips%20Canada/S13A-001%20-%20Canol%20Shale%20Potential%20Future%20Development%20and%20Effects%20Considerations%20-%20Discussion%20Paper%20-%20May%2031_13.pdf

[29] DPRA Canada Inc. 2013. Resource Exploration in the Sahtu Settlement Area: Opportunities and Challenges. Available at: http://www.iti.gov.nt.ca/sites/default/files/resource_exploration_sahtu.pdf

[30] Ibid.

ConocoPhillips[31] has created four possible production path scenarios – a combination of resource quality and economic conditions. They assume a 55% probability of finding good reservoir results. This then leads to two different scenarios based upon economic conditions:

- A 73% probability (40% overall probability) that economic conditions (including operating costs, mobilization and equipment costs among others) are prohibitive and no further exploration will occur but a significant discovery license might be sought.
    - We extrapolate this scenario to all oil and gas companies in the region and use this as our resource development trajectory in the absence of an all-weather road
    - No oil and gas activity will continue past the 2016-17 exploration
- A 27% probability (15% overall probability) that economic conditions are favourable and further exploration will occur (3 – 5 vertical wells and 2 – 4 horizontal wells between 2017-18 and 2018-19) and a significant discovery license would be sought with pilots and production tests potentially ensuing.
    - We extrapolate this scenario to all oil and gas companies in the region and use this as our resource development trajectory in the presence of an all-weather road
    - After 2018-19, production is expected to occur at the same rate as the 2017-18 to 2018-19 exploration for all 5 companies

The two horizontal exploratory wells drilled in 2013 resulted in an increased ADT on the Mackenzie Valley Winter Road of approximately 45 trips per day, or 4,680 trips over the winter road season.[32] This suggests that a horizontal well requires approximately 2,340 vehicle trips.[33,34]

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31 Ibid.

32 Department of Transportation ADT Statistics were observed for the Mackenzie Valley Road between 1993 – 2014. Road traffic volumes in 2013 were the highest ever observed on the road by over 45 trips per day. We make the assumption that this volume increase is attributable to the oil and gas exploration activity in 2013.

33 This is potentially conservative since it assumes that one vehicle was counted on both highway counters and does not account for the fact that two different vehicles may have driven past them.

34 All Consulting. 2010. Suggests that a horizontal well requires approximately 1,979 one way truck movements (a total of 3,958 movements). Available at: http://www.dec.ny.gov/docs/materials_minerals_pdf/rdsgeisch6b0911.pdf

The cost-savings associated with these trips occurring on an all-weather road rather than a winter road can be calculated using the following assumptions:[35]

- 58%, or 1,357 trips/well are heavy trucks and that 42%, or 982 trips/well are light vehicles;[36]
- half of the truck trips are return trips between Wrigley and Norman Wells and the other half are trips between Norman Wells and the site location (estimate of 50 km per trip); and
- the all-weather road will offer a 35 km/hour increase in travel speeds resulting in a reduction in time and operating costs of $2.05/km (2014 CAD) for heavy trucks[37] and $0.70/km for light vehicles.[38]

A.4 Increased Tourism-Related Travel

The NWT, and its Sahtu Region, sees few tourists in the months during which the winter road operates (January – April). Therefore, summer season tourism in the region requires passengers fly in and out of community airports or travel the Mackenzie River. While no estimates of the number of tourists that may make use of the all-weather road are available we make the following assumptions for this analysis:

- current tourism numbers to the Sahtu Region are proportional to the population of the region – i.e., 5,400 visitors (6% of the 90,000 visitors to the NWT[39]) would travel to the Sahtu Region;
- visitor numbers in the absence of the all-weather road are assumed to increase annually at an average of 2% per year; and
- visitor numbers in the presence of the all-weather road are assumed to increase annually at an average of 3% per year.
    - This additional growth is attributable to reduced travel costs (i.e., the ability to drive rather than fly) and represents the latent tourism traffic demand.

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35 Drilling is assumed to continue to occur during the winter months when environmental disturbances caused by drilling are minimized. This also results in no shifts in transportation mode utilized and simplifies calculations.

36 All Consulting. 2010. Available at: http://www.dec.ny.gov/docs/materials_minerals_pdf/rdsgeisch6b0911.pdf

37 Using the $165/hour (2010 CAD) operating cost figure from PROLOG Canada's 2010 report on Northern Transportation Systems.

38 Light vehicle costs include the time costs of 2 employees per vehicle at a wage rate of $30/hour. No additional costs related to the vehicle operation are included.

39 Data collected from an address to the speaker available at: http://news.exec.gov.nt.ca/david-ramsay-tourism-numbers-rise-20-percent-across-the-territory/

The cost-savings associated with the all-weather road include:

- A $1,500 cost-savings for each family (see A.2.2) of four that drives the all-weather road rather than flying from Edmonton or Yellowknife
    - this saving is applied to all of the latent travel (i.e., the additional 2% annual growth); and
    - to 10% of the existing tourism travel.

A.5 Safety

The safety differential between driving an all-weather road and a winter road can be extrapolated by comparing collision rate differences between the two road types. Using the Dempster Highway (Hwy 8) as a proxy for the travel conditions of the proposed all-weather road, the collision rates on the Dempster Highway and the Mackenzie Valley Winter Road can be compared to indicate the safety improvements that may result from the construction of the all-weather road.

When using fatalities per million vehicle kilometres as a proxy for safety, there are no observed quantifiable differences in safety rates between the two road types. Over the last 5 years, both roads – the Dempster and the Mackenzie Valley Winter Road – have had no fatal collisions. While these statistics cannot account for the comfort or driving experience difference between the two road types, there are no quantifiable differences in safety between the two roads. Therefore, there are no substantive benefits or cost related to travel safety as a result of this project.

It should be noted that this analysis does not attempt to calculate the safety costs and benefits associated with shifts between transportation modes.

A.6 Toll Revenues

Toll revenues were estimated using information collected for the Deh Cho bridge and provided to the consultants by the GNWT DOT. Using a NWT perspective, any tolls collected from NWT operators are simply a transfer, and using a Canada-wide perspective, any tolls collected from Canadian operators are considered a transfer. It is assumed that 100% of operators are Canadian, and that 40% of operators are based out of the NWT.

Table A.3: Toll Rates

Commercial Vehicle Type	Proportion of Vehicles	Average Toll (per trip)
Tractor and One trailer (% of trucks)	43%	$158.13
Straight trucks (% of trucks)	3%	$83.13
Trains (% of trucks)	54%	$283.13
Representative Toll	**100%**	**$223.38**

Source: PROLOG (2002) Commercial Vehicle Traffic Forecast for the Mackenzie River Crossing at Fort Providence; Government of the Northwest Territories, Department of Transportation (2014) toll rates for the Deh Cho Bridge

Notes: Average tolls were calculated using single toll and monthly toll rates.
The representative toll is a weighted average. Tolls rates are weights using the proportion of vehicles that pay each rate.

The number of commercial vehicles anticipated on the all-weather road was estimated using:

- freight volumes transported by truck and an assumed average load weight of 23.5 tonnes; and
- latent heavy truck movement resulting from oil and gas development in the region
    - 1,357 heavy truck trips per horizontal, multi-fractured oil well

Each commercial vehicle trip was assigned a toll value of $223.38 allowing a total toll revenue calculation. This was then weighted by 60% for the NWT perspective (net, non-transfer, toll revenues), and by 0% for the Canadian perspective.

A.7 Horizon Value of the Highway

The horizon value of the highway is representative of the asset value of the highway at the end of the 30 year time frame used for this analysis. The value of the highway in 2044 (in 2014 CAD) is estimated to equal $437.5 Million, which is equal to a present value of $43.5 Million at a discount rate of 8%.[40]

A.8 Avoided Winter Road Construction and Maintenance Costs

The construction of the all-weather road relieves the need for the annual construction and maintenance of the Mackenzie Valley Winter Road. These annual costs (2014 CAD) are estimated at:[41]

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[40] Utilizing an annual 1.25 percentage point depreciation of the asset value of the highway, the horizon value of the highway is assumed to equal 62.5% of the original construction costs of the highway (1.25% x 30 = 37.5% depreciation). See: Boardman, A, A. Vining, and W.G. Water II. 1993. Costs and benefits through bureaucratic lenses: Examples of a highway project. *Journal of Policy Analysis and Management.* **12(3)**: 532 – 555.

[41] Government of the Northwest Territories, Department of Transportation, 2014.

- $6,046/km for construction; and
- $1,750/km for maintenance.

The winter road construction and maintenance costs will be phased out as the construction of the all-weather road takes place. The analysis assumes that:

- upon completion of the first 4 years of the construction program, the winter road costs associated with the segment between Wrigley and Tulita will be avoided; and
- upon completion of the final 3 years of the construction program, all winter road costs between Wrigley and Norman Wells will be avoided.

A.9 Territorial vs. National Perspective

In order to define the national and territorial perspectives used in the analysis, it was necessary to assume a proportion of road users who are and are not based in the NWT. It was assumed that:

- tourists who benefit from cost-savings are all assumed to be Canadian, but only 25% are assumed to be NWT residents;
- truck operators are all assumed to be Canadian, but only 40% are assumed to be NWT owned; and
- oil and gas truck operators and workers are assumed to all be Canadian, but only 40% are from the NWT.

As a result, any cost-savings that accrued to tourists, truck operators or oil and gas workers were weighted by 25%, 40% and 40%, respectively, when using an NWT perspective for the CBA. All cost-savings were assumed to be realized at the Canada-wide level.

A.10 Cost-savings for Current versus Induced Traffic

A.10.1 Current Traffic Volumes – Freight and Passengers

Cost-savings calculations for current traffic (freight and passengers) volumes can be calculated as:[42]

$$Cost - Savings = V_t^{WR} * (C_t^{WR} - C_t^{AWR})$$

Where:

V_t^{WR} = the volume of traffic (freight or passenger) at time t with the winter road;

C_t^{WR} = the cost of transporting volume (freight or passenger) at time t with the winter road; and

C_t^{AWR} = the cost of transporting volume (freight or passenger) at time t with the all-weather road.

A.10.2 Induced Traffic Volumes – Freight and Passengers

Cost-savings calculations can conservatively be measured for induced traffic (freight and passengers) using:[43]

$$Cost - Savings = 0.5 * (V_t^{AWR} - V_t^{WR}) * (C_t^{WR} - C_t^{AWR})$$

Where:

V_t^{WR} = the volume of traffic (freight or passenger) at time t with the all-weather road;

V_t^{WR} = the volume of traffic (freight or passenger) at time t with the winter road;

C_t^{WR} = the cost of transporting volume (freight or passenger) at time t with the winter road; and

C_t^{AWR} = the cost of transporting volume (freight or passenger) at time t with the all-weather road.

Note that the cost-savings for newly induced (latent) traffic is assumed to be ½ the difference between the current costs of travel and the future cost of travel with the all-weather road. The logic is as follows:

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[42] Harberger, A. 2009. Introduction of Cost-benefit Anlaysis. Part IV: Applications to Highways Projects. University of California, Los Angeles. Available at: http://www.econ.ucla.edu/harberger/introCBpart4.pdf

[43] Ibid.

- since the trips are not currently made, the value of the trip to the individual is less than the cost of the trip in the absence of the all-weather road;
- however, since they do now make the trip on the all-weather road, the value of the trip is greater than the cost of the trip in the presence of the all-weather road;
- therefore, it is assumed that the value of the trip is the midpoint between the cost of the trip in the absence of the all-weather road and the cost of the trip in the presence of the all-weather road.

B. Input-Output Model Assumptions and Limitations

B. Input-Output Model Assumptions and Limitations

The economy is a highly complicated and dynamic system that is constantly changing as economic actors respond to a litany of signals across a number of markets over a series of time periods. Developing a model of such a complex system requires that several simplifying assumptions be made. These assumptions, in turn, affect how the analytical results can be interpreted.

- the infinite availability of resources. The IO model does not consider the availability or current use of resources necessary to build a given project. In reality, investment in a particular project may divert resources away from other uses and therefore result in the displacement of other economic activity. The estimates derived from the IO model should therefore not be interpreted as entirely net to the economy.

- scale invariant production relationships. The production relationships in the IO model are static and therefore do not reflect possible economies of scale as producers increase output to meet the additional demand resulting from the activity being analyzed. This may result in the overestimation of impacts.

- homogeneity in outputs. The output of a given industry is assumed to be constant across all producers. For example, the pulp and paper industry is assumed to produce a single product using a single representative production function. Differences across specific products and producers within a broader industry are not reflected in the model.

- expenditures and associated ripple effect occurs instantaneously. The IO model provides a snapshot of the economy and the aforementioned relationships at a single point in time. The dynamic and responsive nature of producers and consumers is not reflected in the model.

Although the Statistics Canada IO model has limitations, it is the most detailed representation of the Canadian economy available and its use is encouraged by a number of government and regulatory agencies across the country.

Appendix 5

Mackenzie Valley All-Weather Road, Economic Analysis
Terra Firma Consultants

Mackenzie Valley All-Weather Road Economic Analysis

Department of Transportation
Government of the Northwest Territories
2nd Floor, Lahm Ridge Tower
4501 Franklin Avenue
Yellowknife, NT X1A 2L9
SC 791942

September 16, 2009

Mackenzie Valley All-Weather Road Economic Analysis

Government of the Northwest Territories, Department of Transportation, Planning Division

EXECUTIVE SUMMARY

The Government of the Northwest Territories, Department of Transportation (DOT) retained Terra-Firma Consultants and Pacific Analytics Inc. to undertake an analysis of the economic effects of building a Mackenzie Valley All-Weather Road (AWR) from Wrigley to Tuktoyaktuk.

Four overall economic effects of building an AWR through the Mackenzie Valley to Inuvik in the Mackenzie Delta were assessed: 1) building and maintaining the AWR, 2) reduction in the cost of living, 3) increase in tourism activity, and 4) impacts on the Mackenzie Gas Pipeline (MGP) including natural-gas field exploration and development in the Mackenzie Valley.

The study uses two models: the NWT Input-Output Tables developed by Statistics Canada and a financial/economic model of the MGP developed by Pacific Analytics and used in earlier studies of the MGP that were submitted to the Joint Review Panel (JRP) and the National Energy Board (NEB). The Input-Output Tables analyze how the broader NWT and Canadian economies are affected by the AWR by calculating the spin-off (indirect and induced) impacts on the NWT and the rest of Canada (ROC). The financial/economic model is based on the detailed financial structure of the proposed MGP provided by Imperial Oil and analyzes how the AWR changes the MGP's internal finances (Cash Flows, Royalties, Income Taxes, Internal Rates of Return, etc.) and investment requirements based on various operating assumptions.

Assumptions for the MGP model were refined through interviews with oil and gas executives; business managers and owners in communities affected by the AWR; and air and ground transport companies servicing communities affected by the AWR. In addition, PROLOG Canada prepared a logistics analysis to determine if the MGP will derive any economic benefits from the existence of the AWR.

The results of the study strongly suggest that building the AWR is good for the residents of the Mackenzie Valley, the Canadian energy sector, and all governments in Canada. Specifically, the study concludes the following:

14,082 One-Time and 93 Long-Term Jobs Will Be Created

Building the AWR will create 7,785 one-time jobs in the NWT and 6,297 one-time jobs in the rest of Canada.

Building the AWR will create 7,785 one-time jobs in the NWT and 6,297 one-time jobs in the ROC. The AWR will create 78 long-term jobs in the NWT and another 15 in the ROC. Building the AWR will earn all governments over $200 million from activities in the NWT and an additional $70 million accruing to governments in the ROC.

AWR Maintenance Creates 161 Long-Term Jobs

Maintaining the AWR will create 161 long-term jobs: 128 in the NWT and 33 in the rest of Canada

Maintaining the AWR at $13 million a year results in total yearly benefits (direct plus indirect plus induced) of an additional $10 million in GDP, the creation of 128 permanent jobs, and an increase in GNWT revenues of $0.8 million. The (ROC) will also benefit with an additional $2.4 million in GDP, 33 additional permanent jobs, and just over $300,000 in additional tax revenues.

$1.3 Million a Year for Government to Reinvest

The AWR frees up about $1.3M a year for Government to spend elsewhere.

The economic downside of building the AWR is that it will replace the annual winter-road construction. This saves the GNWT money, but it also reduces the annual purchase of goods and services, as well as the number of jobs, thereby reducing economic activity in the NWT and the ROC. This study assumes that government savings resulting from not having to build annual winter-roads will be reinvested elsewhere into the NWT economy, but it does not identify exactly where this spending will be.

Improved Quality of Life

The NWT's quality of life indicators are significantly below national standards. Economic activity in the NWT is unevenly distributed: unemployment rates range from 5 percent in Yellowknife to almost 40 percent in smaller communities. In addition to these alarming employment statistics, population statistics show a declining population. Limited opportunities for employment and the high cost of living are factors contributing to this decline.

The AWR will increase community accessibility, quality of life, and resident populations.

The AWR will reduce transport costs in the Sahtu, Gwich'in and Beaufort-Delta regions and enable people to purchase more for the same amount of money, which will increase economic well-being. The decline in the population of smaller communities is often attributed to isolation, cost of housing, and availability of public and private service conveniences. The AWR will increase accessibility to the smaller communities, increase the standard of living in the Mackenzie Valley, and facilitate the transformation of the NWT's economy.

Transportation Cost Structures in the Mackenzie Valley Will Be Reduced

The results of the study confirm that transportation cost structures in the NWT will be reduced and that residents will enjoy higher standards of living based on their increased purchasing power.

> It will cost less to ship goods overland to Inuvik, Tuktoyaktuk, and communities along the Mackenzie Valley.

The AWR will reduce the cost of shipping goods to Inuvik, Tuktoyaktuk, and communities along the Mackenzie Valley served by the AWR. Lower prices for goods will mean that people will have money left over after buying the same basket of goods they bought before the AWR. That is, they will be able to buy more goods and services without having to make more money. The “additional disposable income”, by definition, will equal the savings in freight rates.

$15.7 Million More Dollars in Peoples’ Pockets Each Year

> . The AWR will put about $15.7 million more dollars in peoples’ pockets each year. Lower freight rates in NWT will make each dollar go further

Lowering freight rates in the NWT will make each dollar go further. The AWR will put about $15.7 million more dollars in peoples’ pockets each year, and that will have positive spin-off benefits for the rest of the NWT economy. People will be able to purchase more goods with the same amount of money as before the AWR, which will generate $5.5 million in GDP, create 41 permanent jobs, and increase government revenues by $1.1 million, of which $0.6 million will accrue to the GNWT.

Tourist Visitation Will Increase by 20 Percent Each Year

> $2 million increase in tourist expenditures, 10 new permanent jobs, and almost $100,000 in GNWT revenue.

Tourist visitation is expected to increase by 20 percent, or by about 2,500 – 2,700 new tourists each year. Based on historical average spending, a conservative increase in tourist expenditures of $2 million a year is expected. This translates into $550,000 more buying and selling in the NWT each year, 10 new permanent jobs each year, and almost $100,000 more in government revenues each year. The ROC will see a $200,000 increase in GDP, three more permanent jobs, and $25,000 in additional government revenues.

AWR Is a Significant Benefit to the Energy Sector's Financial Viability in the NWT

> Based on a 1.2 bcf/day capacity pipeline, the AWR will save the MGP about $1.2 billion in exploration and well-development costs.

The AWR will be of significant benefit to the energy sector's corporate financial viability (possibly increasing after-tax cash flows by $1 – $2 billion), despite our assumption that the building of the AWR will NOT affect in any material way the initial cost of building the Mackenzie Gas Project. There is also a substantial increase in GDP for the NWT, although because of the reduced investment costs of exploration and development, the GDP in the ROC actually falls. Similarly, the NWT will enjoy a clear increase in overall employment (person-years of employment), but the ROC will experience a decline in employment because the total demand for goods and services is lower.

The MGP Will Save $1.215 Billion over the 45 Years

Based on a 1.2 bcf/day capacity pipeline, the construction of the AWR affects the proposed MGP by reducing future exploration and well-development costs by an estimated $1.215 billion ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline. While the reduced exploration and well-development costs will result in less money being spent in the NWT and in the ROC, the increased financial returns for companies will increase the economic viability of many exploration projects and will therefore help promote economic development throughout the region.

Corporate after-tax returns to increase by almost $2 billion

MGP Project Economics Will improve by Between $1.1 and $2 Billion, and Government Revenues Will Decrease

The net or total effect of building the AWR on the base 1.2 bcf/day pipeline over the 45-year period will both improve private sector after-tax cash flows by almost $1.1 billion and the viability (Internal Rate of Return) of the MGP by almost 2 percent, as well as decrease total government revenues by an estimated $125 million, although the net fall in GNWT revenues will be only $30.9 million over the entire 45-year period.

The conclusion that the building of the AWR will actually reduce overall government revenues from the MGP project may at first appear counter-intuitive; however, the interpretation is that the AWR is serving to "support" the viability of the MGP by increasing after-tax cash flows and the Internal Rates of Return (IRR). Accordingly, while the AWR is not considered a benefit to the initial construction of the MGP, it does have a significant positive impact on its long-term success.

Improve private sector cash flows by $1.1 billion, the viability of the MGP by about 2 percent, and reduce government revenues by about $125 million

Rig Savings Will Reach $357 Million over the Life of the MGP

The AWR reduces costs on a 1.2 bcf/day pipeline by $1.084 billion, not including rig savings of $357 million.

While the AWR will result in reduced corporate investment costs by an estimated $1.215 billion ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline, the AWR could also result in exploration companies reducing their rig rental costs by being able to rent rigs over a shorter period. These factors are estimated to save companies $357 million ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline.

The Structure of the NWT Economy Will Change

Building the AWR will cause a structural change in the economy of the NWT as established patterns of economic activity change. Concurrently, however, new economic patterns and structures will emerge to take advantage of the lower costs and lower risks provided by the AWR.

For example, as Rod Maier of Chevron Canada (personal communication, June 16, 2009) states, an AWR can help spread the work over a longer period of time where spur roads off an AWR or a marine access from the AWR are feasible, thus reducing the cyclical intensity of activity and the associated inflationary pressures. Additionally, an AWR will allow for the mobilization of more equipment from southern contractors, increase competition between contractors, increase the potential for NWT resident companies to provide goods and services to the oil and gas industry, and reduce costs for industry. New hydrocarbon fields can be developed sooner and more efficiently, and can have a lower overall cost structure.

The AWR will improve the economics of working in the Mackenzie Valley and alter the economic structure of the NWT.

As the number of barriers to spending money in the NWT by businesses such as Chevron declines, more money will be spent in the NWT, and this will create more employment and increase the NWT's GDP. Ultimately, the AWR should lower cost structures, which will in turn both open up the NWT to a greater number of smaller oil and gas companies, as well as increase oil and gas activity in the NWT.

Positive Economic Returns for the Economy of the NWT

The AWR generates positive economic returns to the economy of the NWT.

Building the AWR will generate positive economic returns for the economy of the NWT. However, these estimates do not include other important economic effects that could not be quantified – the most important of these being the potential for NWT-based businesses to provide additional supplies and services to the oil and gas sector via the AWR.

Assertion of Canadian Sovereignty

The AWR is a comparatively low-cost assertion of Canadian sovereignty in Canada's Arctic without significant on-going expenses.

The Beaufort-Delta region is a territorial and national asset of strategic importance. It provides the only NWT and Canadian deep-sea port in the Western Arctic, and the development of oil and gas resources in Alaska may create additional and as yet unrealized opportunities, particularly if all-weather road access is available. The region is strategically located to assist shipping to/from Alaska, Asia, and the continental U.S. It could receive goods from Asia for trans-shipment south to the ROC. Arctic sovereignty concerns over the Northwest Passage could lead to the establishment and investment of an amplified Canadian presence. Potential partnerships exist with the U.S. and

Canada in the transport of oil and gas, and between the private and public sectors in the NWT in the development of infrastructure.

For comparison purposes, the cost of “[f]lying the flag in the Arctic could cost the Canadian military as much as $843 million annually, says a series of internal Defence Department cost estimates. The bill for operation and maintenance would be on top of the estimated $4.5-billion capital outlay for new light icebreakers, a deepwater port and a support base” (Brewster, 2009: and that is for the Eastern Arctic only). “From a cost perspective, it cannot be over-emphasized that the vastness, isolation and lack of existing infrastructure will lead to increased costs in all aspects of implementation and operations in the Arctic” (Brewster, 2009). With experts predicting that Arctic channels could be open to unimpeded summer navigation by 2015 (Brewster, 2009), Canada’s ability to exercise its sovereignty in the Western Arctic becomes more urgent.

AWR delivers a viable and economic assertion of Canadian sovereignty.

Jim Johnson MA, CFA
Pacific Analytics Inc.

Louie Azzolini MA, MBA, MCIP
Terra-Firma Consultants

Third Party Disclaimer

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1. Introduction

1.1. Approach

The purpose of this study, commissioned by the Department of Transportation (DOT), Government of the Northwest Territories (GNWT), is to estimate the economic effects of building the Mackenzie Valley All-Weather Road (AWR) from Wrigley to Tuktoyaktuk.

The outcome of the study flows from an analysis of the following:

1. the effects of building and maintaining the AWR, including the reduction in economic activity resulting from not having to build a winter-road each year;
2. the reduction in freight costs due to the year-round AWR resulting in lower consumer prices and increased standards of living in northern communities served by the AWR;
3. the effects on tourism stemming from the improved access provided by the AWR;
4. the impacts of the AWR on exploration and new gas-well development linked to the Mackenzie Gas Project (MGP); and finally
5. a qualitative assessment of the intangible impacts that the AWR may bring to the NWT.

The first three components are assessed in Section 2.2. In Section 2.3 the MGP impacts are examined. In that analysis a comparison between trucking and barging logistics of the MGP was prepared, and interviews with petroleum industry executives and retailers in Fort Good Hope, Norman Wells, Tulita, and Inuvik were held. The information derived from that analysis was included in a full financial model of the MGP that was developed and submitted to the MGP Joint Review Panel in 2007. The output of the financial model included:

1. financial information (e.g., cash flows, internal rates of return, royalties, and income taxes payable); and
2. economic outcomes (i.e., direct, indirect, and induced impacts) of the AWR on the MGP.

For the purposes of all the analyses, a 45-year life of the AWR was assumed, corresponding to the 45-year life of the MGP used by the Joint Review Panel assessment. The annual impacts of the AWR are discounted (at 5 percent) and summed over that 45-year period in order to calculate total impacts. It should be noted that because of the large effect that discounting has after 30 or so years, selecting an AWR life of 40 or 50 years would have no material effect on the outcome of the analysis.

An analysis was completed and interviews were coded and analysed for key themes regarding the strengths, weaknesses, opportunities, and threats (SWOT) of each NWT region affected by the AWR,

1.2. Context

The Federal Government has considered the vision of an all-weather highway through the Mackenzie Valley to the Arctic Coast to be a strategic priority for Canada since as far back as 1958. This vision has been restated in a number of GNWT strategic documents, including the *Department of Transportation's 2000 Highway Strategy, Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories*, and two funding proposals in pursuit of this vision.

In the 1960's and 1970's, there were a number of studies that the Federal Government undertook in support of constructing an all-weather highway through the valley. In 1977, however, with the increasing uncertainty regarding oil and gas development potential along with political, economic, and legal issues of the time, construction was halted. The Federal Government abandoned the route 18 kilometres south of Wrigley.

In the early 2000's, work on this highway was revived by the GNWT through a funding partnership with the Federal Government to construct permanent bridges at all stream crossings. These bridges, which will extend the winter-road window of operation and reduce environmental concerns at stream crossings, will ultimately serve the future all-weather highway.

Canada is on the brink of significant opportunities with the development of oil and gas discoveries in the Mackenzie Valley and Beaufort Delta. The potential for Arctic shipping is a reality for the near future. The significant natural gas and oil reserves in the Mackenzie Delta and Basin are key to the economic future and prosperity of Canada. Connecting Canada to the Arctic Coast would both facilitate Canada's development of these resources and safeguard against the associated challenges. While northern development offers significant opportunities for Canadians, it also poses significant risks. Canada's sovereignty, security, and environmental integrity are threatened by the economic, political, and environmental shifts ahead. These challenges, however, can be mitigated through the construction of an all-weather transportation corridor through the Mackenzie Valley to the Arctic Coast. It is crucial that this major corridor be connected to Canada through an all-weather surface transportation link.

Connecting Canada to the Arctic Coast is also crucial to the socioeconomic future of Canada. The completion of the Mackenzie Valley Highway to the Arctic Coast will provide residents of the Northwest Territories and all Canadians with enormous opportunities. Its completion is a cornerstone of the GNWT's plan for present and future economic development in the NWT. However, the benefits of completing the Mackenzie Valley Highway extend much further than the northern regions it would be connecting.
The benefits would extend coast to coast to coast. The highway is the final step in connecting Canada's three coasts and is critical for the future protection and prosperity of Canadians.

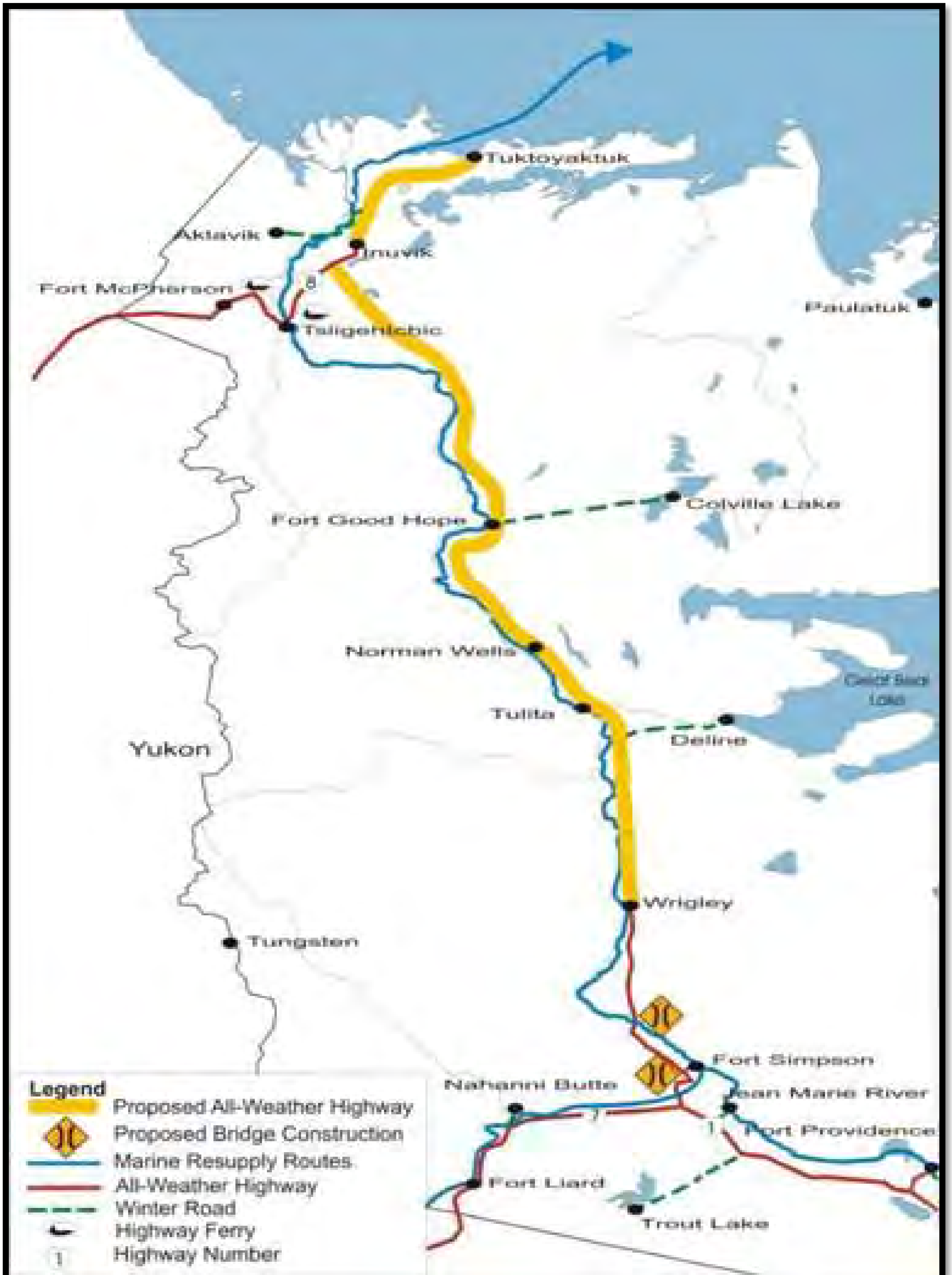

FIGURE 1 CURRENT NWT HIGHWAY SYSTEM

1.2.1. Strategic Regional Considerations

Each NWT region's strategic positioning with respect to the construction and operation of the AWR was assessed using a SWOT. Results indicate that the AWR will be a positive catalyst for renewable and non-renewable resource access; tourism; enhanced socioeconomic well-being; assertion of sovereignty; and climate change mitigation.

All regions have significant renewable and non-renewable resources. The AWR will reduce the time, cost, and attractiveness of investing in the NWT's renewable and non-renewable resource sectors.

All regions possess outstanding untapped tourism offerings. The AWR will improve tourism opportunities in the Northwest Territories, the Yukon Territory, and British Columbia. General touring is expected to increase about 20 percent within five years of the construction of the AWR, based on the current inventory of tourist offerings. The AWR will expand the NWT's tourism offering and likely increase tourist visitations.

The NWT continues to exhibit quality of life indicators that are significantly below national standards. Economic activity in the NWT is unevenly distributed with unemployment rates ranging from 5 percent in Yellowknife to almost 40 percent in smaller communities. In addition to these sobering employment facts, statistics show a population decline in smaller northern communities. Limited opportunities for employment and the high cost of living are factors contributing to this decline. The AWR will reduce transport costs in the Sahtu, Gwich'in and Beaufort-Delta regions and will enable people to purchase more for the same amount of money, hence increasing economic well-being. In addition, the alarming decline in the population of smaller communities is often attributable to isolation, cost of housing, and availability of public and private service conveniences. The AWR will reduce the isolation of smaller communities, reduce what it costs to live in the communities, and facilitate the creation of new jobs in the economy.

The Beaufort-Delta region is a territorial and national asset of strategic importance. It provides the only NWT and Canadian port in the Western Arctic, and the development of oil and gas resources in Alaska may create additional and as yet unrealized opportunities, particularly if all-weather road access is available. The region is also strategically located to assist shipping to/from Alaska, Asia, and the continental U.S. It could receive goods from Asia for transhipment south to the ROC. Arctic sovereignty concerns related to the Northwest Passage could lead to increased investment in Canadian presence. Potential partnerships exist between the U.S. and Canada in the transportation of oil and gas, and between the private and public sectors in the NWT in the development of infrastructure.

The cost of "[f]lying the flag in the Arctic could cost the Canadian military as much as $843 million annually, says a series of internal Defence Department cost estimates. The bill for operation and maintenance will be on top of the estimated $4.5-billion capital outlay for new light icebreakers, a deepwater port and a support base" (Brewster, 2009): and that is for the Eastern Arctic only. "From a cost perspective it cannot be over-emphasized that the vastness, isolation and lack of existing infrastructure will lead to increased costs in all aspects of implementation and operations in the Arctic," (Brewster, 2009). Moreover, with experts predicting that Arctic channels could be open to unimpeded summer navigation by 2015 (Brewster, 2009), Canada's ability to exercise its sovereignty in the Western Arctic becomes more urgent.

There is a critical need for a port connected to an AWR road link because if BP goes into development and production it will need a vastly improved harbour than currently *exists at Tuktoyaktuk to support the level of activity that will occur and the type of vessels that will be frequenting the Beaufort Sea.*

Bob Ball, BP Operations Manager, North American Arctic Exploration, (personal communication, June 16, 2009).

Extreme weather events; record temperatures and precipitation levels; thawing permafrost; and rising sea levels indicate that climate change is happening now and at a much faster rate than expected. Climate change will seriously affect northern regions, including transportation systems. The trend to warmer than normal temperatures has delayed the opening dates of ice bridges on the all-weather highways and reduced the operating window of the winter-road system (GNWT, 2007).

These impacts will require additional equipment, labour, and materials to maintain the integrity of the all-season transportation infrastructure (i.e., all-season roads and airports) resulting in maintenance costs over and above those currently being incurred. Based on the information collected from DOT staff, these effects currently cost DOT a minimum of $1,200,000 annually. Estimates of financial costs are difficult to provide given the current status of permafrost degradation modeling and available information. However, this cost is expected to rise in excess of $3,000,000 annually by 2055 assuming that permafrost degradation advances as indicated by the modeling (Dillon Consulting Limited, 2007).

2. The Economic Impacts of the All-Weather Road

2.1. Introduction

Four overall economic effects of building the AWR through the Mackenzie Valley to Inuvik in the Mackenzie Delta were assessed.[1] They are:

1. The construction and maintenance of the AWR: The actual building of the AWR will have three major impacts on the economy of the NWT.
   1.1. *Construction of the AWR:* Construction of the AWR will have a temporary (limited to the building period) impact on demand for supplies (e.g., gravel and fuel) and employment (and therefore wages), both of which will create additional spin-off activity in the economy. Once the AWR is built, there will be no additional economic stimulus from construction.
   1.2. *Annual maintenance of the AWR:* This component will generate much less activity in the economy than the construction activity; however, maintenance will need to be done every year, and therefore demand for supplies and maintenance jobs will be permanent fixtures in the economy.
   1.3. *Loss of annual winter-road construction:* This represents an annual cost savings to the government, but it also represents a reduction in economic activity since the supplies and employment associated with the winter-road building will no longer be required.
2. Reduction in the cost of living: With the AWR, it will cost less to transport goods to northern communities. With lower freight rates, people and businesses in communities will pay less for what they buy and will therefore have money left over (equal to the savings in freight rates) with which to buy more goods and services. Since people will be able to buy more with the same amount of money after the AWR is built, all things the same, this will lead to a higher standard of living and likely create additional local employment, too. This increase in consumer purchases and standard of living will have spin-off impacts on other parts of the economy throughout the NWT.

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[1] The economic impacts that will result from the building of the AWR have been calculated using the NWT Input-Output Tables developed by Statistics Canada. Three measures of economic impacts are calculated. The first are the ***direct impacts***. Direct impacts refer to the contribution to the economy made from specific economic activities related to the AWR ─ for example, actual AWR construction activities or the specific increase in tourism spending resulting from the existence of the AWR. Over and above these impacts are the ***indirect impacts***, which refer to the additional economic activity generated as the result of the purchases of material inputs. That is, when (say) the construction company building the AWR purchases goods and services (such as gravel, asphalt, or trucking services), those industries themselves generate activity in the economy through their own production process and through their own purchase of additional goods and services (e.g., the trucking industry would have to purchase greater quantities of diesel fuel, which would increase economic activity in the petroleum refining industry). On top of that, there are the ***induced impacts*** on the economy generated when the wages and salaries paid by the (say) construction company and (say) the trucking company are re-spent in the economy, generating economic activity in the retail sector, the recreation sector, the restaurant sector, and the like. Companies affected by this increase in local disposable income will themselves demand greater inputs and will hire additional staff, all of which serves to increase economic activity even further.

Direct, indirect, and induced impacts are determined separately for GDP (Gross Domestic Product – a standard measure of economic activity in the economy), for Labour Incomes, for Employment, and for Government Revenues. In order to calculate the direct, indirect, and induced impacts of an investment or an increase in spending, the investment or spending estimates (broken down by commodity type) are first entered into the NWT Input-Output Model. Then, since taxes do not add to economic activity, the appropriate taxes are removed. Third, the value of margins are reallocated (in a nutshell, the value of (say) gravel is made up of three price components: the value of the gravel at the mine site, the value of any wholesale and retail mark-ups, and the value of the transport or delivery costs to the construction site – see Appendix B for an in-depth explanation of IO modeling). Finally, the import content of each commodity is removed, since imported goods and services do not generate additional economic activity in the local economy. These impacts are calculated separately for impacts on the NWT economy and for impacts on the economies in the rest of Canada. Note that for ROC estimates, Statistics Canada does NOT calculate induced impacts and therefore the impacts highlighted in the Tables are "Direct + Indirect" only; as a consequence, the stated impacts are under-estimates.

It should be noted that the reduction in freight rates will likely have a negative impact on trucking and airline industry revenues, and transportation companies could earn less money due to this increase in freight-hauling productivity. This decline will be partially counterbalanced by an increase in purchases by northern residents and hence more trucking business. But more importantly, the increase in trucking productivity will have far-reaching positive impacts on a variety of economic activities in the NWT, impacts that are almost impossible to foresee and quantify, but that invariably occur with such investment in infrastructure.[2]

3 Increase in Tourism Activity: The creation of more economical access to northern areas will result in additional tourism activity. This increase will have a direct impact on local employment and incomes, and it will also have spin-off effects on the demand for supplies and other goods and services.

4. Impacts on the Mackenzie Gas Pipeline The AWR could have two potential impacts on the Mackenzie Pipeline Project. It could affect the initial cost of construction of the MGP; and it could affect future exploration and well-development costs.

4.1. *Construction of the MGP:* The cost structure of the MGP as proposed by the proponents (Imperial Oil et. al) was estimated based on the absence of an AWR. With an AWR, it is possible that the cost of building the MGP will decline. Reduced MGP construction costs would result in lower tolls for moving gas through the pipeline and would therefore increase gas field profitability. This increase in profitability would result in higher royalties and income taxes accruing to the GNWT. However, if investment costs are lower (due mainly to lower trucking costs), this would result in lower spin-off economic effects of the MGP and thus lower government revenues. While this reasoning is logical, an analysis by PROLOG (Section 4 beginning on page 33) suggests that the AWR will actually have no substantive effects on the construction costs of the MGP and that there will therefore be no spin-off effects.

4.2 *Impacts on natural gas field exploration and development in the Mackenzie Valley*: Apart from any effects on the construction phase of the MGP, the AWR could also reduce the cost of natural gas field drilling and well development in the Mackenzie Valley area. If this does happen, field profitability would increase, as would royalties and income taxes going to the GNWT. However, as with the MGP construction, a reduction in trucking costs for exploration and field development would result in less money spent in the NWT and therefore fewer spin-off dollars in the NWT economy. Whether the net effects are positive or negative for the economy of the NWT would depend on the exact nature of the exploration and well development costs, and this, in essence, will be the focus of this assessment.

> *An AWR would reasonably reduce logistics costs for a company in its development and production phase by 15 percent.*
>
> Gary Bunio, Vice President Operations & COO MGM Energy Corporation (personal communication, June 16, 2009).

[2] A number of examples can be cited, ranging from the economic spin-offs resulting from the building of the Trans-Canada Highway to the building of the Dempster Highway to the expansion of all-weather road capacity in the Peace River area of BC.

2.2. Economic Impacts of the AWR (Excluding Impacts on the MGP)

2.2.1. AWR Construction and Maintenance

Construction Impacts of the AWR

The total estimated cost of building the AWR including costs for engineering design is approximately $1.67 billion, of which $1.3 billion is for road building, $223 million is for bridge construction, and $178 million is for engineering. The GNWT Department of Transportation (DOT) provided these updated costs as of October 2008.[3] Table 1 summarizes the construction estimates for the AWR and includes both road and bridge requirements.

NWT benefits (direct plus indirect plus induced benefits) of building the AWR at a cost of $1.67 billion were calculated using the NWT Input-Output Model (see footnote 1) and include $956 million in additional GDP, the creation of 7,718 person-years of employment, and a $78 million increase of GNWT revenues. Building the AWR will also benefit the ROC because goods and services are purchased from other regions of the country. Benefits for ROC include $531 million in GDP, 6,281 more person-years of employment, and $67 million in new tax revenues for other governments (federal and provincial). See Appendix A for detailed results of these calculations.

Annual Maintenance of the AWR

Once built, the AWR requires an annual budget for its maintenance, which the GNWT DOT estimates will be $13 million a year. As a result of spending this money, the total yearly benefits (direct plus indirect plus induced) are an additional $10 million in GDP, the creation of 128 permanent jobs, and an increase in GNWT revenues of $0.8 million. ROC will also benefit with an additional $2.4 million in GDP, 33 additional permanent jobs, and just over $300,000 in additional tax revenues. These economic benefits of maintaining the AWR will continue year after year in contrast to the economic benefits of building the AWR, which will be a one-time event. See Appendix A for detailed results.

Loss of Annual Winter-Road Construction

The economic downside of building the AWR is that it will replace the annual winter-road construction. This saves the GNWT money, but it will also reduce the annual purchases of goods and services and jobs, thereby reducing economic activity in the NWT and ROC.

It costs the DOT $1.3 million every year to build the winter-road from Wrigley to Fort Good Hope. Spending this money adds (direct plus indirect plus induced) $0.8 million to the NWT GDP, creates six permanent jobs, and adds $152,000 to government revenues, of which $63,000 goes to the GNWT. In addition, ROC benefits from the winter-road by an additional $400,000 in GDP, five permanent jobs, and $55,000 in tax revenues. All these economic benefits will be lost after the AWR is built. Also, because the building of the winter-road normally happens every year, these winter-road benefits will be lost annually when the AWR is built.

2.2.2. Reduction in the Cost of Living

The AWR will reduce cost of shipping goods to Inuvik, Tuktoyaktuk, and communities along the Mackenzie Valley served by the AWR. With lower prices on goods, people will have money left over after

[3] It should be noted that final engineering specifications for the AWR are still far in the future, and therefore the estimate used in this study must be treated as preliminary and may be subject to significant changes as the road design is finalised.

buying the same basket of goods they bought before the AWR. They will be able to buy more goods and services without having to make more money and thus standards of living will increase. This additional disposable income, by definition, will be equal to the savings in freight rates.[4]

Currently, about 5,110 commercial transport trucks travel up the Dempster Highway each year, bringing goods into the NWT. The AWR would save about $3,070 a year per transport load, or about $15.7 million a year in total. The reduced cost of shipping goods north would result in lower prices for consumers. In other words, the AWR will put about $15.7 million more dollars in peoples' pockets each year, and that will have positive spin-off benefits on the rest of the NWT economy. The spin-off of people being able to purchase more goods with the same amount of money as before the AWR would generate $5.5 million in GDP, create 41 permanent jobs, and increase government revenues by $1.1 million, of which $0.6 million would accrue to the GNWT. ROC will experience an increase of $0.8 million in GDP, 11 more permanent jobs, and $88,000 in additional government revenues. This increase in consumer spending would occur annually and therefore would boost the economy year after year. Detailed results are in Appendix A.

> *An AWR would save the community about a half-million dollars a year, lower food prices by 20 – 30 per cent and reduce inventory costs and wastage.*
>
> Greg Turnbull, Tulita, Northern Store Resident Manager (per. com. April 10, 2009).

Another effect of better trucking infrastructure is that the delivery of food via the Federal Government-sponsored Food Mail programme would likely cease as food would be cheaper to purchase right in the communities. Consequently, there would be less need for food delivery via air cargo, and more trucking activity with an AWR. The bottom line would be an increase in GDP of $0.5 million, four additional permanent jobs, and an increase in Government Revenues of $77,000, of which $23,000 would go to the GNWT.

2.2.3. Tourism Impacts

Discussions with NWT Tourism officials suggest that the AWR would increase visitations by 20 percent, or 2,500 – 2,700 new tourists each year. Based on an historical average spending per person of $644 (excluding airfares) and prepaid package costs of $284 (some of which do not accrue to businesses in the NWT), a conservative increase in tourist expenditures of $2 million a year is expected. This translates into $550,000 more buying and selling in the NWT each year, 10 new permanent jobs, and almost $100,000 more in government revenues each year. ROC would experience a $200,000 increase in GDP, three more permanent jobs, and $25,000 in additional government revenues. Appendix A provides details of the analysis.

The AWR will also increase tourism numbers and result in longer stays in the NWT and across the North by creating a stunning loop up through the NWT and back down the Dempster Highway into the Yukon.

[4] The reduction in prices for consumer goods will flow partly to local individuals, resulting in additional disposable income. For local businesses that purchase (lower-priced) goods, the assumption is that lower input costs to businesses will lower business prices rather than raise profits. These lower business prices then flow to consumers, resulting in additional disposable income.

2.2.4. Total Economic Impacts (Excluding MGP Effects)

Building the AWR will provide on-going benefits to the economy for many years in the future. Economists convert the flow of benefits (and costs) over time into a single value. This is done by adding up all the economic plusses and minuses over the years (in this case, over the 45-year life of the AWR) and coming up with a total. However, a dollar today buys more than a dollar in the future because of inflation, so money made in the future is worth less. This study uses a 5 percent discount rate. This "Net Present Value" (NPV) is a way of comparing the value of money now with the value of money in the future.

Table 1 presents the total economic impacts, in 2009 dollars, of building the AWR. It highlights the positives (e.g., from construction and maintenance, reductions in cost of living, and increases in tourism) and the negatives (e.g., from not building the winter-road each year).

Table 1: NPV of Total Impacts Excluding MGP Effects ($2009; Discount Rate = 5%)

NPV TOTAL IMPACTS	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$2,142,000,861	$468,942,286	$443,966,589	**$3,054,908,736**	$1,242,402,573
Material Inputs	$1,133,778,175	$245,506,214	$290,044,702	**$1,669,328,091**	$650,782,592
GDP	$828,795,625	$220,147,073	$148,266,954	**$1,197,209,652**	$584,872,886
Employ (Initial Const.)	4,863	1,897	968	**7,785**	6,297
Employ (On-Going)	57	14	7	**78**	15
Wages & Salaries	$539,946,139	$127,541,706	$81,126,051	**$748,615,896**	$309,743,759
Benefits	$39,008,279	$9,672,477	$6,119,329	**$54,800,085**	$37,666,393
Total Gov't Revenues	$159,799,073	$33,638,569	$36,993,266	**$230,429,907**	$73,330,349
Federal	$97,197,692	$18,672,928	$15,518,653	**$131,390,273**	$40,846,174
Net Indirect Taxes	*$11,911,321*	*$2,429,966*	*$3,552,703*	***$17,894,990***	*$5,035,225*
Personal Income Taxes	*$85,332,364*	*$16,230,965*	*$11,934,954*	***$113,497,283***	*$35,818,448*
NWT	$62,600,363	$14,964,641	$21,476,630	**$99,041,634**	$32,489,619
Net Indirect Taxes	*$21,564,353*	*$8,191,358*	*$15,968,790*	***$45,724,501***	*$18,400,933*
Personal Income Taxes	*$41,051,358*	*$6,770,126*	*$5,493,648*	***$53,315,133***	*$14,095,968*

Source: NWT Input-Output Model
Note: Rest of Canada estimates are "Direct + Indirect" only; estimates exclude induced impacts and therefore are under-estimates.

Building the AWR will cost governments (Federal and Territorial) about $1.85 billion, and total government and non-government spending will reach $2.14 billion. The additional spending comes from increased tourism activity and increased trucking demand to accommodate additional spending by residents and businesses served by the AWR. When all economic spin-offs (direct, indirect, and induced impacts) are accounted for, this increase will create about $1.67 billion in net purchases of goods and services (material inputs) in the NWT and an additional $651 million (ROC). This results in a net increase in GDP in the NWT of $1.2 billion and an increase in GDP in the ROC of $585 million. Building the AWR will create 7,785 one-time jobs in the NWT and 6,297 one-time jobs in ROC. The AWR will create 78 long-term jobs in the NWT and another 15 in ROC. Building the AWR will earn all governments in Canada over $230 million from activities in the NWT and an additional $73 million accruing to governments in ROC. Therefore, the net cost to governments of building the AWR after accounting for these additional revenues could be as low as $1.55 billion ($1.85 billion - $230 million - $73 million). This excludes any benefits stemming from its effects on the MGP, which are examined next.

Limitations

In addition to increased tourism and trucking demand to accommodate additional spending by residents and businesses served by the AWR, the AWR will engender a number of catalytic effects for which no economic analysis has been undertaken. These effects are partially the result of increased economies of scale that the AWR will generate, particularly with regards to the MGP. In Newfoundland, for example, the development of Hibernia provided sufficient demand for a number of different types of supplies that prior to Hibernia had been sourced from outside the province.[5] At the same time, the reduced transport costs and improved transport links will act as a catalyst for import substitution and export potential beyond the MGP similar to what has occurred whenever transportation links improve (e.g., the Trans-Canada Highway). These catalytic effects can be summarised as follows:

1. Attracting new inward investment from outside the area (i.e., companies relocating to a given area).
2. Retaining existing companies in the area.
3. Promoting the import substitution and export success of companies located in the area by the provision of overland transport links to key markets.
4. Enhancing the competitiveness of the NWT economy and thereby reducing storage, warehousing, and medical travel costs.
5. Increasing opportunities for social and cultural interaction and development through reduced isolation, increased mobility, and expanded learning and training opportunities.

2.3. Impacts of the AWR on the Proposed Mackenzie Gas Pipeline

At the start of this study, there was a question as to whether constructing the AWR prior to the building of the MGP would reduce the overall investment costs of the MGP. The main argument for a reduction in investment costs was that the AWR would provide a more efficient trucking system and therefore reduce overall logistics costs. The argument against a substantive reduction in investment costs is that, much of the MGP construction will take place during the winter months when viable winter-roads are in place. Furthermore, there are potentially major advantages to using the existing barging operations to haul materials.

In order to answer the above question, the consulting firm PROLOG was commissioned to undertake a comparative analysis of the MGP with and without the AWR. The analysis by PROLOG (Section 4 beginning on page 33 of this study) found that having the AWR in place before building the MGP will have little or no impact on the costs of MGP construction since the MGP's bulk barging rates are about the same if not lower than trucking rates.

While the AWR may not change the initial construction costs of the MGP, the Gathering System, or the costs of development drilling and hook-ups of the three Anchor Fields[6], it will likely save the oil and gas

[5] One of the best examples coming out of Newfoundland is the supply of some specific office supplies, which has enabled several companies not only to provide these goods locally, but also, through the Internet, to develop a viable export product.

[6] The Mackenzie Gas Project (MGP) delivering natural gas from the NWT to Alberta is proposed by Imperial Oil, ConocoPhillips, Shell, ExxonMobil, and the Aboriginal Pipeline Group (APG). The three Anchor Fields (Niglintgak, Taglu, and Parsons Lake) are owned by Shell, Imperial Oil, and ConocoPhillips respectively.

The MGP will deliver dry natural gas from the Mackenzie Valley region (the Inuvik Gas Facility) down to Zama, located just south of the NWT/Alberta border, from where the gas will hook into the NOVA Gas Pipeline for delivery into the Alberta system.

industry 15 percent a year on all future field drilling and development. The savings result principally from reduced logistics costs.

> *Having access to an all-weather road provides Paramount Resources at least a 15 percent savings on its work in the Cameron Hills area. For example, the winter-road spur Paramount currently constructs into the Cameron Hills areas off the existing highway system costs Paramount $500 – $750K a year to build when needed. If there were no AWR, it would have to build a winter-road from possibly High Level at significantly greater cost.*
>
> Lloyd Doyle, COO, Northern Operating Unit, Paramount Resources Ltd. (personal communication, June 16, 2009).

2.3.1. Analysis of the Impacts of the AWR on the MGP

In its submission to the National Energy Board (NEB) and the Joint Review Panel (JRP), the proponents of the MGP proposed a pipeline with a daily capacity of 1.2 bcf/day, but included an alternative pipeline design with a daily capacity of 1.8 bcf/day (the design incorporated additional compressors along the pipeline, thereby increasing gas pressure). With an increase in capacity, additional gas would be needed to fill the pipeline (the 1.8 bcf/day scenario is estimated to require an increase in development wells from 435 wells under a 1.2 bcf/day scenario to 648 wells with a 1.8 bcf/day capacity pipeline).

The savings realized by the existence of the AWR (based on a reduction of 15 percent in exploration and development costs as suggested by discussions with exploration and production companies) were integrated into the MGP Financial Model[7], and two gas flow scenarios were examined to contrast against the Base Case gas flow of 1.2 bcf/day.

Associated condensates will be stripped at the Inuvik Gas Facility and moved to Norman Wells from where the condensateswill flow through the existing Enbridge Pipeline to Zama and from there into the Alberta system over the existing Rainbow Pipeline.

The main delivery Pipeline itself will function as a regulated utility earning a fixed rate of return on invested capital. The Gathering System consists of a number of pipeline laterals connecting the various fields to the Gas Plant, the Inuvik Gas Facility (comprising a Gas Plant/Compression Station and a Liquids Stabilisation Plant to separate the condensates), and a Liquids Line for delivering condensates to Norman Wells. Although not strictly regulated, according to the proponents, the Gathering System components will be operated as though they are regulated utilities, each earning a cost of service sufficient to earn a prescribed rate of return with unit tolls set at the cost of service divided by gas or condensate throughout. In contrast, the various natural gas fields will function as separate standard businesses, with their rates of return dependent on the following: their specific production profile; their unique capital investment and operating costs; Edmonton-based prices for natural gas and condensates; and the unit tolls charged by the Gathering System and main Pipeline.

[7] In 2005 a comprehensive financial model of the MGP was developed by Pacific Analytics Inc. with the objective to assess the financial implications (Cash Flows, Royalties, Income Taxes, Internal Rates of Return, etc.) of the project based on various assumptions regarding gas production over time; construction and development costs; gas prices; tax and royalty rates; and the like. A Base Case scenario was developed using information provided by Imperial Oil (updated in September 2007) and was presented to the Joint Review Panel. The present Financial Model maintains all the assumptions in that Base Case scenario, with the exception that an updated gas price forecast (from the same source used by Imperial Oil in the 2007 Base Case) is used; all other assumptions remain the same.

1. The first scenario assumes that the MGP gas flow remains as a 1.2 bcf/day pipeline over the 45-year production period, but that with the AWR, exploration and development costs for the appropriate wells within the total of 435[8] are reduced by the aforementioned 15 percent.

2. The second scenario assumes that additional compression is added to the MGP enabling a daily capacity to increase from 1.2 bcf/day to1.8 bcf/day (and, consequently, the number of development wells increases from a Base Case 435 wells to 648 wells. As above, the number of affected wells is lower than the total number of wells.[9]

3. A third scenario is one based on a 1.8 bcf/day capacity pipeline but that includes rig savings of approximately $1.22 million per well is also assessed.

Based on these scenarios, there are two effects that the AWR may have on the MGP. The first is the *financial impacts*: the reduction in exploration and well development costs will directly impact company returns, employment, and taxes.[10] The second impact is the *economic impacts,* which relate to the direct, indirect, and induced effects of the reduction in required corporate investment.

2.3.2. Financial Impacts

1.2 bcf/day capacity pipeline

Based on a 1.2 bcf/day capacity pipeline and a 15 percent reduction in overall logistics costs with the AWR, future exploration and well-development costs are reduced by an estimated $1.084 billion ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline. As displayed in Table 2, this reduction in investment by the oil and gas sector will result in the following financial impacts:

1. Reduced investment costs will lead directly to greater cash flows. It is estimated that after-tax cash flows going to corporations will increase by $1.08 billion over the 45-year period. This will have the effect of increasing the Internal Rate of Return (IRR) to corporations by roughly 2.0 percent.

2. Total revenues to governments will increase by some $80.5 million ($2009 dollars, discounted at 5 percent) due to the presence of the AWR, although, due to the vagaries of royalty legislation, the Federal Government will increase its revenues by $95.2 million, and the NWT will see its revenues drop by $14.7 million. It is expected that the Federal Government and GNWT will sign a royalty-

[8] Under the Base Case 1.2 bcf/day pipeline, 435 wells are forecast, but some of these, particularly those in the Beaufort Sea, will not be affected by the AWR. The total number of affected wells, then, is estimated at 325.

[9] Gilbert Lausten Jung Associates Ltd. (GLJ) developed the original 1.2 bcf/day production forecast submitted by the proponents of the NEB and Joint Review Panel. GLJ did not, however, provide a 1.8 bcf/day production scenario. For the purposes of this present analysis, we augmented GLJ's 1.2 bcf/day scenario with a 1.8 bcf/day production forecast produced by Sproule Associates. Table 20 includes two scenarios: a Base 1.8 bcf/day scenario, which excludes any AWR impacts, and a 1.8 bcf/day with the AWR. The difference between these two scenarios is the impact of the AWR, given that the AWR is not necessary for an expanded pipeline.

[10] The reduced exploration and well development costs factor into the financial results through a number of avenues. First, reduced costs directly lead to an increase in pre-tax cash flows and consequently the Internal Rate of Return (IRR) since expenses are now lower. Second, royalties increase because the "payout" date (the date at which the development company recovers the cost of field development and the date after which royalties kick in) is achieved earlier, and thus the royalties are larger and the discounted value of the stream of royalties over the 45-year period of production is higher. At the same time, royalties are a corporate tax write-off, and accordingly, despite the increase in cash flows, income taxes actually decline. Nevertheless, the aggregate level of taxes going to governments does increase.

sharing agreement, and therefore it is likely that the AWR will result in an increase in revenues flowing to the GNWT.

TABLE 2: FINANCIAL IMPACTS OF THE AWR ($2009 MILLIONS; DISCOUNT RATE = 5%)

	GLJ Base Case (1.2 Bcf/day)	With AWR (1.2 Bcf/day)	Base Case (1.8 Bcf/day)	With AWR (1.8 Bcf/day)	With AWR (1.8 Bcf/day) and Rig Savings
PRE-TAX CASH FLOWS	**$38,886.1**	**$40,043.1**	**$56,754.8**	**$58,648.6**	**$58,974.5**
Pre-Tax Tax IRR	**28.3%**	**30.2%**	**25.1%**	**27.3%**	**27.6%**
AFTER-TAX CASH FLOWS	**$24,124.3**	**$25,200.9**	**$31,649.8**	**$33,414.4**	**$33,618.5**
After-Tax IRR	**19.2%**	**20.8%**	**17.1%**	**19.0%**	**19.2%**
After-Tax IRR*	**20.6%**	**22.5%**	**17.8%**	**19.9%**	**20.2%**
TAXES	**$25,521.9**	**$25,602.4**	**$35,917.5**	**$36,046.6**	**$36,168.4**
Federal Royalties	$12,101.8	$12,216.9	$18,656.1	$18,838.0	$18,880.7
Field Income Taxes	$8,780.1	$8,745.5	$12,625.8	$12,573.1	$12,652.1
- to Canada	*$5,325.6*	*$5,304.6*	*$7,658.3*	*$7,626.3*	*$7,674.3*
- to NWT & Alb	*$3,454.5*	*$3,440.8*	*$4,967.5*	*$4,946.8*	*$4,977.9*
Pipeline Income Taxes	$4,640.0	$4,640.0	$4,635.6	$4,635.6	$4,635.6
- to Canada	*$2,622.3*	*$2,622.3*	*$2,619.6*	*$2,619.6*	*$2,619.6*
- to the NWT & Alb	*$2,017.7*	*$2,017.7*	*$2,015.9*	*$2,015.9*	*$2,015.9*

Source: MGP Financial Model

1.8 BCF/DAY CAPACITY PIPELINE

Based on a 1.8 bcf/day capacity pipeline and a 15 percent reduction in overall logistics costs with the AWR, future exploration and well development costs are reduced by an estimated $1.950 billion ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline, resulting in the following financial impacts:

1. Estimated after-tax cash flows going to corporations will increase by $1.765 billion over the 45-year period. This will have the effect of increasing the Internal Rate of Return (IRR) to corporations by roughly 2.1 percent.

2. Total revenues to governments will increase by $129.1 million over the 1.8 bcf/day pipeline without the AWR, of which $108.4 million will go to the Federal Government and another $20.7 million will accrue to the Government of the NWT. A royalty agreement with the Federal Government would result in even greater revenues flowing to the GNWT.

1.8 BCF/DAY CAPACITY PIPELINE WITH RIG SAVINGS

There is another consequence of building the AWR: without the AWR, drilling equipment (e.g., rigs and material) in the Colville Hills area will be stranded and will have to be stored over the summer period when the land is not suitable for the transport equipment and drill rig. With the AWR, however, drilling equipment could be dismantled and shipped southward where the rigs could be used for summer drilling in Alberta, as noted in the interviews. Accordingly, companies drilling in the Colville Hills area could reduce their MGP costs by using or renting out their equipment in Alberta.

Based on information provided by PROLOG, the rental value of a rig in Alberta is approximately $40,000 per drilling day. Using an average of 15 drilling days a month for a seven-month drilling season in Alberta, the gross rental value of a rig in Alberta would be approximately $4.2 million. The transport costs for moving the rig to/from Alberta are subtracted from this value.

Based on PROLOG's truck cost analysis, the cost for a flatbed truck is estimated at $2.50 per kilometre. Using a rough measure of 2,500 kilometres one-way from the Colville Hills area to northern Alberta, a two-way cost per truck load is $12,500. Adding a loading/off-loading cost of another $1,000 gives an estimated total cost per truckload of $13,500. Using an average of 40 loads per rig, the cost to transport a rig to/from Alberta is approximately $540,000. Consequently, the net rental value that a company drilling in the Colville Hills area could expect for its rig will be $4.2 million - $540,000 = $3.66 million per rig.

Finally, assuming a rig in the Colville Hills area could drill three wells over the (short) winter drilling season, the AWR will reduce average well development costs by $1.22 million. This reduction in the average cost of drilling and developing a well was integrated into the MGP Financial Model.

Comparing a 1.8 bcf/day capacity pipeline using the AWR with a 1.8 bcf/day capacity pipeline using the AWR plus rig savings shows that industry could save $357 million ($2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline by backhauling its rigs Being able to backhaul rigs into Alberta has the following financial effects on savings to industry:

1. Estimated after-tax cash flows going to industry will increase by $204 million over the 45-year period. This will have the effect of increasing the Internal Rate of Return (IRR) to corporations by roughly 0.3 percent.

2. Total revenues to governments will increase by $121.8 million over the 1.8 bcf/day pipeline with the AWR, of which $90.7 million will go to the Federal Government and another $31.1 million will accrue to the Government of NWT. A royalty agreement with the Federal Government would mean even greater revenues flowing to the GNWT.

2.3.3. Economic Impacts

The preceding financial analysis of the MGP provides details of the effects on the royalties and corporate income taxes due to the AWR. However, the economic activity related to the MGP (construction of the pipeline, expenditures on exploration and development, etc.) have their own direct, indirect, and induced effects on the NWT economy just as does activity related to the building of the AWR. However, in this case, because the AWR will reduce the cost of the required MGP infrastructure, the result will be a reduction in overall economic activity, in employment, and in government revenues.

The same three scenarios are examined:

1. the 1.2 bcf/day pipeline with the AWR in place contrasted against the original Base Case 1.2 bcf/day pipeline;

2. the 1.8 bcf/day pipeline with the AWR in place contrasted against an alternative 1.8 bcf/day pipeline; and

3. the 1.8 bcf/day pipeline with the AWR in place including rig savings contrasted against an alternative 1.8 bcf/day pipeline.

1.2 BCF/DAY CAPACITY PIPELINE

Based on a 1.2 bcf/day capacity pipeline, the construction of the AWR affects the MGP by reducing exploration and well development costs by an estimated $1.215 billion (2009 dollars, discount rate of 5 percent) over the 45-year operating period of the pipeline. In economic terms (as opposed to the financial effects on companies discussed earlier), the reduced exploration and well development costs result in less money being spent in the NWT and in the ROC. As displayed in Table 3, this reduction in spending by the oil and gas sector will result in the following:

1. Less buying and selling: A total reduction of $816 million ($18,651.3 – $19,467.3) in GDP over the 45-year period, with the ROC experiencing most of the decline ($518.3 million), and the NWT seeing a $297.7 million decline.[11]

2. Fewer person-years of employment: With less buying and selling it is estimated that over 45 years, there will be 16,589 fewer person-years of employment in NWT with the ROC having 12,702 fewer person-years of employment.

3. Lower government revenues: Governments will forgo $206 million in revenue; but since much of governments' revenues stemming from activity in the NWT actually accrue to the Federal Government, the NWT's portion of the decrease is about $16.2 million over 45 years.

1.8 BCF/DAY CAPACITY PIPELINE

Based on a 1.8 bcf/day pipeline, the reduced exploration and well development costs result in less money being spent in the NWT and in ROC. This reduction in spending by the oil and gas sector will result in the following:

1. Less buying and selling: Less buying and selling in the amount of $1.336 billion ($22,903.5 – $24,239.0) over the 45-year period will result in the NWT accumulating $487.1 million less in GDP.

2. Fewer person-years of employment: With less buying and selling, it is estimated that over 45 years, there will be 24,716 (5,790 in the NWT) fewer person-years of employment.

3. Lower government revenues: With less buying and selling and fewer person-years of employment, government revenues will decline by $337.3 million ($26.5 million in NWT revenues).

[11] Note: Unlike the non-MGP economic impact estimates, the estimates of economic impacts for the rest of Canada do include induced impacts and there is therefore no under-estimation.

Table 3: Economic Impacts of the AWR ($2009 Millions; Discount Rate = 5%)

	GLJ Base Case (1.2 Bcf/day)	With AWR (1.2 Bcf/day)	Base Case (1.8 Bcf/day)	With AWR (1.8 Bcf/day)	With AWR (1.8 Bcf/day) and Rig Savings
TOTAL INVESTMENT	**$27,093.3**	**$25,878.4**	**$34,109.7**	**$32,121.2**	**$31,779.0**
GROSS DOMESTIC PRODUCT (GDP)	**$19,467.3**	**$18,651.3**	**$24,239.0**	**$22,903.5**	**$22,673.6**
Rest of Canada	**$9,911.4**	**$9,393.1**	**$12,818.5**	**$11,970.1**	**$11,824.1**
NWT	**$9,555.9**	**$9,258.2**	**$11,420.5**	**$10,933.4**	**$10,849.5**
LABOUR INCOME	**$9,597.5**	**$9,121.5**	**$12,318.8**	**$11,539.8**	**$11,405.7**
Rest of Canada	**$6,428.0**	**$6,088.2**	**$8,331.4**	**$7,775.4**	**$7,679.7**
NWT	**$3,169.5**	**$3,033.3**	**$3,987.4**	**$3,764.4**	**$3,726.0**
EMPLOYMENT (jobs)	**312,446**	**295,857**	**391,284**	**366,568**	**361,684**
Rest of Canada	**234,030**	**221,328**	**293,969**	**275,045**	**271,305**
NWT	**78,416**	**74,529**	**97,314**	**91,524**	**90,380**
GOVERNMENT REVENUES	**$3,917.0**	**$3,710.9**	**$5,072.7**	**$4,735.4**	**$4,677.3**
Rest of Canada	**$2,694.6**	**$2,556.0**	**$3,476.4**	**$3,249.5**	**$3,210.4**
- Federal	*$1,743.7*	*$1,652.9*	*$2,254.1*	*$2,105.4*	*$2,079.9*
- Provincial	*$950.9*	*$903.1*	*$1,222.3*	*$1,144.0*	*$1,130.5*
NWT	**$1,222.3**	**$1,154.9**	**$1,596.3**	**$1,485.9**	**$1,466.9**
- Federal	*$908.8*	*$857.5*	*$1,191.1*	*$1,107.2*	*$1,092.7*
- Provincial/Territorial	*$313.5*	*$297.3*	*$405.2*	*$378.7*	*$374.2*

1.8 BCF/DAY CAPACITY PIPELINE WITH RIG SAVINGS

Savings on well drilling and development occur because rigs that were previously stranded in the North due to there not being an AWR will now be rentable in Alberta during the summer. These savings result in reduced investment costs (spending) in well exploration and development. Compared with the 1.8 bcf/day scenario that does not include backhauling rigs into Alberta, the result is:

1. Less buying and selling: Less buying and selling to the tune of $229.9 million ($22,673.6 – $22,903.5) over the 45-year period.

2. Fewer person-years of employment: With less buying and selling, it is estimated that over 45 years, there will be 4,884 (1,114 in the NWT) fewer person-years of employment.

3. Lower government revenues: With less buying and selling and fewer person-years of employment, government revenues will decline by $58.1 million, $4.5 million of which will be lost to the GNWT over the 45-year period.

2.3.4. TOTAL ECONOMIC IMPACTS ON THE MGP

Summing the financial impacts and the economic impacts on the MGP of building the AWR, the net or total effect on the Base 1.2 bcf/day pipeline over the 45-year period will improve private sector after-tax cash flows by almost $1.1 billion and the viability (Internal Rate of Return) of the MGP by almost 2 percent, and will decrease total government revenues by an estimated $125 million; however, the net fall in GNWT revenues will be only $30.9 million over the entire 45-year period.

For the Base 1.8 bcf/day pipeline, the net effect of building the AWR will improve private sector cash flows by almost $1.8 billion over the 45-year period and the viability (Internal Rate of Return) of the MGP by 2.1 percent, and will decrease total government revenues by an estimated $208 million. The net fall in GNWT revenues will be $47.2 million.

When rig savings are included, after-tax cash flows are $2.0 billion higher than under the Base 1.8 bcf/day scenario, the corporate IRR is 2.4 percent higher, and net government revenues decrease by $144.5 million ($20.6 million for GNWT revenues).

The conclusion that building the AWR will actually reduce overall government revenues from the MGP project may appear counter-intuitive at first; however, the interpretation is that the AWR is serving to "support" the viability of the MGP by increasing after-tax cash flows and the IRR. Accordingly, while the AWR is not considered a benefit to the initial construction of the MGP, it does have a significant positive impact on its long-term success.

3. Total Economic Impacts

Based on the preceding analysis, it is possible to calculate the total effects of the AWR on the economy of the NWT and ROC. Table 4 highlights the overall summation of the AWR construction and maintenance, the elimination of the winter-road, the effects of a lower cost of living, the additional tourism activity, the financial corporate tax effects on the MGP, and the economic impacts stemming from the MGP with the AWR in place.

Table 4: Total Economic Impact of Building the AWR ($Millions of $2009, discount Rate 5%)

NPV TOTAL IMPACTS Including MGP	MGP 1.2 Bcf/day	MGP 1.8 Bcf/day	MGP 1.8 Bcf /day and Rig Savings
Investment	$1,844.9		
After Tax Cash Flow	$1,076.5	$1,764.6	$1,968.7
Internal Rate of Return (IRR)	1.9%	2.1%	2.3%
Gross Domestic Product (GDP)	$966.1	$446.6	$216.7
Rest of Canada	*$66.6*	*-$263.5*	*-$409.5*
NWT	*$899.5*	*$710.1*	*$626.2*
Labour Income	$674.8	$371.8	$237.7
Rest of Canada	*$7.6*	*-$208.6*	*-$304.3*
NWT	*$667.2*	*$580.4*	*$542.0*
Employment (Person-Years)	1,684	-6,443	-11,327
Rest of Canada	*-5,721*	*-11,943*	*-15,683*
NWT	*7,405*	*5,502*	*4,358*
Government Revenues	$97.7	-$33.5	-$91.6
Rest of Canada Gov'ts	*$33.6*	*-$95.5*	*-$134.6*
NWT Gov't	*$64.0*	*$62.0*	*$43.0*

Depending on which version of the MGP is being considered, the AWR will be of significant benefit to corporate financial viability (possibly increasing after-tax cash flows by $1 – $2 billion) despite the fact we have assumed that the building of the AWR will NOT affect in any material way the initial cost of building the MGP. There is also a substantive increase in GDP for the NWT, although because of the reduced investment costs of exploration and development, GDP in ROC could actually fall. Similarly, the NWT will enjoy a substantive increase in overall employment (person-years of employment), but ROC could experience a decline in employment because the total demand for goods and services is lower with increased trucking productivity.

Depending on the final configuration of the MGP, overall government revenues could increase, but more likely, the building of the AWR will result in a small decrease in government revenues. Nevertheless, the GNWT will experience an increase in its revenues, and this may be expected to be even greater if there is an agreement with the Federal Government for sharing royalties.

The financial and economic effects outlined in this section of the study provide evidence that building the AWR will generate positive economic returns to the economy of the NWT. However, these estimates do not include other important economic effects that could not be quantified, the most important of these being the potential for NWT-based businesses to provide additional supplies and services to the oil and gas sector as a result of the AWR.

Building the AWR will cause a structural change in the economy of the NWT as established patterns of economic activity change. Concurrently, new economic patterns and structures will emerge to take advantage of the lower costs and lower risks provided by the AWR. For example, the AWR could help spread work over a longer period of time where spur roads off the AWR or marine access from the AWR are feasible, thus reducing the cyclical intensity of activity and the associated inflationary pressures (Rod Maier, Chevron Canada, personal communication, June 16, 2009). Additionally, the AWR will allow for the mobilization of more equipment from southern contractors; increase competition among contractors; increase the potential for NWT resident companies to provide goods and services to the oil and gas industry; and reduce costs for industry. In short, new hydrocarbon fields could be developed sooner and more efficiently, with a lower overall cost structure.

The AWR will also provide an alternative to using NTCL, and that will increase logistics competition and likely result in lower logistics costs – particularly if Chevron Canada did not have to front-load the cost of its equipment (rigs, etc.) and could simply truck it into place. Having an AWR will also do away with some of the redundancies in resources and equipment currently barged up because it could be trucked in if needed. Furthermore, having the AWR should allow for certain resources and equipment to be continuously available for use in various parts of the NWT (e.g., staged out of Inuvik), resulting in significant mobilization savings (i.e., not having to move it from Alberta to Inuvik every year). Currently, equipment standby charges are fairly high because rigs and equipment have to be barged into the NWT in the summer and are immobile until after freeze-up when overland access by winter-road is possible. Year-round access will also enable more efficient use of rigs and equipment. Chevron Canada could avoid having to pay stand-by costs for rigs and equipment when they are not in use, as the equipment could be de-mobilized to other projects in the North or western Canada.

As the number of barriers to spending money in the NWT by businesses declines, more money will be spent in the NWT, and this will create employment and increase the NWT's GDP. Ultimately, the AWR should, as Rod Maier explains, lower cost structures and in turn open up the NWT to a greater number of smaller oil and gas companies, and increase oil and gas activity in the NWT.

> *Having an AWR will provide a competitive alternative to NTCL and do away with some of the redundancies in resources and equipment currently barged up because it could be trucked in if needed. Furthermore, having an AWR should allow for certain resources and equipment to be permanently available in the region, e.g., Inuvik resulting in significant mobilization savings, i.e., not having to move it from Alberta to Inuvik every year. Currently, equipment standby charges are fairly high because of having to barge rigs and equipment into the NWT in the summer and not being able to use them until after freeze-up when overland access by winter-road is possible.*
>
> *Year-round access will also provide for more efficient use of rigs and equipment. That is, Chevron Canada could avoid having to pay stand-by costs for the rigs and*

equipment when they are not being used, as the equipment could be de-mobilized to other projects in the north or western Canada.

The top three areas where savings will result from having an AWR are: i) logistics, ii) construction, and iii) drilling and well-servicing. An AWR will provide industry with greater control of its logistics and planning functions and not be limited by third parties such as NTCL, local supplier/contractor availability, and standby costs will be dramatically reduced.

Rod Maier, Manager, Frontier Development, and Doug Connon, Mackenzie Delta Coordinator Chevron Canada Ltd. (personal communication, June 16, 2009).

While a complete analysis of the structural changes to the NWT economy resulting from the AWR is beyond the scope of this study, the results confirm that transportation cost structures in the NWT will be reduced and that residents will enjoy higher standards of living based on their increased purchasing power.

4. Trucking vs. Barging the Mackenzie Gas Project

PROLOG completed a series of studies on the impact of the MGP on the northern transportation system and local communities. Much of the data generated in this work form the basis of the economic analysis of trucking vs. barging the MGP. PROLOG worked closely with MGP planners, and its findings were generally verified as consistent with MGP logistics planning.

It is noted that MGP planners in their submissions to the National Energy Board's Joint Review Panel (JRP) assumed that main-line pipeline construction materials for the project route from (and including) Camsell Bend to the Mackenzie Delta anchor fields would be transported by barge to the various spread stockpile sites, all within a mile or two of the river. The MGP plan provides for trucks to service the pipeline south of Camsell Bend.

Appendix C describes the assumptions and limitations of the trucking vs. barging analysis; Appendix D provides the analysis; Appendix E shows what a typical MGP pipe trailer looks like; and Appendix F is a summary of the oil and gas industry interviews.

4.1. Methodology

The MGP logistics plan, as submitted to the JRP, assumes all commodities will arrive from the South by rail or truck to Hay River or directly to stockpile sites south of Camsell Bend by truck. PROLOG therefore assumes that this plan is common to both the truck and barge options as far north as Hay River/Enterprise for the purposes of this study and that the presence of the AWR down the Mackenzie River will not alter the cost of logistics south of these two points. Included are the volumes of freight required for construction of the three anchor fields, their gathering systems, and initial drilling operations.

4.2. Conclusions

It is clear from the analysis that oil and gas companies and other industries currently being serviced by barge under tariff rates could benefit directly from the presence of an AWR. On freight rate savings alone, almost $30 million could be accounted as a derived direct economic benefit from the presence of the AWR.

It is highly probable, however, that the MGP will negotiate a time charter arrangement for the fleet it requires over a three-year supply period.

Coopers Barging brings a measure of competition to the Mackenzie watershed. Coopers is a much smaller marine company than NTCL, backed by supply contracts it could lease equipment and manpower – a procedure common in the industry.

Even though NTCL is in the process of changing its business model due to declining traffic on the Mackenzie River, it will clearly not welcome the AWR and will likely be a willing party to the negotiation of charter contracts given that it has substantial barge capacity available at the time of writing.

Gravel

The eight or nine million tons of gravel to be mined and transported for pipeline access roads; camp areas; facility construction pads at gas plants and compressor stations; materials stockpile sites; etc. could provide an economic benefit to the MGP if the AWR could be used instead of specially constructed access roads otherwise required by the project.

A study is necessary to provide the associated economic benefits generated by the AWR. This should commence with a geotechnical survey (if one does not exist already) to identify the size and nature of all borrow pit locations adjacent to the AWR, and then distances from the granular sources to the required use points. The type and nature of the terrain that the access roads are constructed on have to be documented in order to produce a meaningful haul road construction estimate.

The MGP has validated or will be validating all known and existing borrow source sites adjacent to the river, and will be investigating new sites. Approximately 140 locations have been proven to date, with 60 or 70 expected to be used. Five or six will be major quarry operations with crushing equipment. Three of these are near Inuvik and others are near Norman Wells, Tulita (Fort Norman), and Little Chicago.

The Mackenzie Valley and adjacent area is a combination of permafrost, discontinuous permafrost, and muskeg. Large amounts of gravel will be required to construct roads through muskeg areas (assuming year-round operations) with sufficient strength to support the 12-cubic-metre (24-ton) capacity gravel trucks required.

If the average haul distance is 15 km and 60 pits are to be used by the MGP, and *if* it is assumed that one half of these could be facilitated by the AWR rather than new single-purpose haul roads planned by the MGP, a (very approximate) benefit of $200 million could be available using a (very rough) $500,000 per km capital cost estimate for the haul road.

Estimates for Seasonal Overland Roads (SOR) in the NWT– which are wider than haul roads and designed to handle higher operating speeds –are estimated to cost $800,000 – $1.2 million per km to construct. Haul roads are typically narrow, follow terrain contours, and feature relatively low-speed trucking operations, yet must support the very heavy gravel truck axle weights.

5. CORE GLOSSARY

Direct Impacts: equivalent to the level of direct value-added (or GDP) generated by an industry.

Gross Domestic Product (GDP or Value-Added): a measure of the total flow of goods and services produced by the economy and used for final domestic consumption, investment, and export (e.g., excluding immediate consumption). GDP can be calculated in three different ways, all of which yield the same results. The first method, applied in this report, estimates the value of net output of all industries minus the value of net material inputs used for immediate production (excluding indirect taxes). The second method sums the values of Wages and Salaries, Supplementary Labour Income (Benefits), Operating Surplus (Profits plus Depreciation plus Interest on Long-Term Debt), and Indirect Taxes for all industries. The third method sums the values for personal consumption, government expenditures, investment (including changes to inventories), and net exports. In addition to total GDP for the economy, GDP is also estimated for individual industrial sectors.

Indirect Impacts: the impacts resulting from the expenses (goods and services) of a firm or industry used in the production process. The purchase of goods or services increases the economic activity of the supplying firms and, in turn, the supplying firms themselves must purchase their own goods and services, which generates further economic activity in those supplying firms.

Induced Impacts: the impacts resulting from the wages and salaries paid by a firm or industry. When the wages and salaries are spent (minus taxes and savings) on goods and services, the economic activity of the firms supplying those goods and services increases. As well, the supplying firms themselves will pay additional wages and salaries to their own employees, which, when spent, generate more economic activity.

Input-Output Model: comprised of three tables or matrices: a **Make** matrix, a **Use** matrix, and a **Final Demand** matrix. The Make matrix lists all the different outputs produced by each industry. The Use matrix lists all the different purchases (material inputs) by each industry used in the production process as well as itemizing all taxes (explicit and implicit) paid by the industry (GST is not a company-level tax; rather, it is a tax paid by final consumers but channelled through the company). The Final Demand matrix lists all the various purchases by persons (including GST), by government, by industries for investment purposes, plus all net exports (exports minus imports) of each commodity (good or service). Mathematically re-arranging the tables enables one to determine how much additional production will be generated in the economy from an increase in demand for a commodity or series of commodities.

Intermediate Demand (or Material Inputs): a measure of all material inputs (goods and services) used in the production process excluding wages and benefits.

Internal Rate of Return (IRR): discount rate at which the present value of the future cash flows of an investment equals the cost of the investment. When the IRR is greater than the required return – called hurdle rate in capital budgeting – the investment is acceptable. The internal rate of return is the average rate earned by each and every dollar invested during the period. This rate is influenced by the timing and size of the cash inflows and outflows and the beginning and ending depreciated book or market value of the investment.

Payout Date: the date at which gas project revenues exceed project costs (capital investment and operating costs) and after which standard royalties apply.

Person-Year (PY) Employment: the total level of employment in a firm or industry when part-time positions are counted as a fraction of full-time positions. For example, four half-time positions equal two person-years of work.

Producer Prices: the value of a commodity (good or service) at the factory gate. It excludes all indirect taxes as well as wholesale, retail, and transportation costs (called "margins") associated with the final selling (purchaser) price.

Purchaser Prices: the price of a commodity (good or service) actually invoiced to the purchaser. It includes the factory-gate cost of the commodity plus any additional costs associated with indirect taxes, wholesale and retail margins, and costs associated with transporting the commodity from the factory gate to the final purchaser.

Royalty: a percentage interest in the value of production from a lease that is retained and paid to the mineral rights owner, in this case the Federal Government.

SWOT: abbreviation for Strengths, Weaknesses, Opportunities, and Threats.

Sunk Costs: costs incurred in the past and unaffected by any future action and thus irrelevant to decision-making. In economics and in business decision-making, sunk costs are costs that have already been incurred and that cannot be recovered to any significant degree. Sunk costs are sometimes contrasted with incremental costs, which are the costs that will change due to the proposed course of action. In microeconomic theory, only incremental costs are relevant to a decision. If sunk costs were to influence a decision, a proposal would not be assessed exclusively on its own merits. Note that sunk costs are still relevant for determining income taxes as they remain available for write-offs.

Value-Added: a term that is identical to GDP in concept, but that refers to a particular business or occasionally an industry sub-sector.

APPENDIX A-ECONOMIC IMPACT DETAILS

ECONOMIC IMPACTS OF AWR CONSTRUCTION

The estimate of total construction costs for the Mackenzie Valley All-Weather Road was supplied by the NWT Department of Transportation (DOT) based on updated costs as of October 2008.

TABLE A1: ALL-WEATHER ROAD CONSTRUCTION COSTS

	DOT Estimate (October 2008, $CDN)		
Mobilization 12 sites @ 6 years	84.0	$1,000,000	$84,000,000
Site clearing	5,920.0	$9,500	$56,240,000
Excavation - common	15,060,000.0	$16	$233,430,000
Excavation - rock	862,500.0	$36	$31,395,000
Excavate - fill	11,580,000.0	$8	$94,956,000
Excavate - waste	3,712,450.0	$7	$24,502,170
Channel excavation	9,960.0	$35	$348,600
Embankment construction	11,580,000.0	$29	$331,188,000
Sub-grade preparation	9,648,000.0	$4	$33,768,000
Load/haul and compact 50mm minus crushed granular	3,180,000.0	$23	$71,550,000
Excavate - gravel (100% crush, 60% blast)	3,180,000.0	$28	$89,835,000
Rip-rap	39,970.0	$20	$799,400
Ditch lining load, haul and place	21,010.0	$45	$945,450
Snow/ice removal	13,565.0	$0	$0
Supply and install CSP culverts	56,770.0	$1,875	$106,443,750
Supply and install CSPP culverts	9,396.0	$11,120	$104,483,520
Road sub-total			**$1,263,884,890**
Per km	**965.0**		**$1,309,725**
Install temporary bridges	13.0	$500,000	$6,500,000
Install short-span bridges	12.0	$2,000,000	$24,000,000
Large bridge - Great Bear			$57,500,000
Large bridge – Blackwater			$23,000,000
Large bridge - Hare River			$23,000,000
Bridge at Tieda Creek			$12,000,000
Bridge at Loon River			$12,000,000
Bridge at Shae Creek			$10,000,000
Bridge at Thunder River			$16,000,000
Bridge at Travailant River			$16,000,000
Bridge at Rengleng River			$23,000,000
Bridge sub-total			**$223,000,000**
Per km	**965.0**		**$231,088**
		Engineering @12%	**$178,426,187**
		TOTAL	**$1,665,311,077**

Source: NWT Department of Transportation

Table A1 highlights the construction estimates for the AWR including both road and bridge requirements. The total cost, with the additional costs for engineering design, comes to approximately $1.67 billion, of which $1.3 billion is for road building, $223 million is for bridge construction, and $178 million is for engineering. It should be noted, however, that final engineering specifications for the AWR are still way in the future; therefore, the estimate used in this study must be treated as preliminary and may be subject to significant changes as the road design is finalised.

The total length of the road is 965 kms, of which 820 kms is for the Wrigley to Dempster Highway portion and 145 kms is for the Inuvik to Tuktoyaktuk portion of the road. According to the NWT DOT, the road construction costs per kilometre are roughly the same over the two portions: accordingly, the Wrigley to Dempster road-construction costs are estimated at $1.1 billion vs. $190 million for the Inuvik to Tuktoyaktuk portion. Bridge costs apply only to the Wrigley to Dempster portion, while the engineering costs are allocated by the number of kilometres.

The final allocation of costs across the two road portions are highlighted in Table A2 below.

TABLE A 2: AWR TOTAL CONSTRUCTION COSTS BY ROAD PORTION

	Kms	Road Cost	Bridge Cost	Engineering Cost	Total Cost
TOTAL AWR COST	965	$1,263,884,890	$223,000,000	$178,426,187	**$1,665,311,077**
Wrigley to Dempster	820	$1,073,974,725	$223,000,000	$151,616,034	**$1,448,590,760**
Inuvik to Tuktoyaktuk	145	$189,910,165	$0	$26,810,152	**$216,720,317**

Source: NWT Department of Transportation

The economic effects flowing from this construction investment have been calculated using the NWT Input-Output Tables developed by Statistics Canada. Three measures of economic effects are calculated. The first is the ***direct impacts***, which refer to the contribution to the economy made from the actual AWR construction activities. Over-and-above these effects are the ***indirect impacts***, which refer to the additional economic activity generated as the result of the purchase of material inputs. That is, when the construction industry purchases goods and services (such as gravel, diesel, or trucking services), those industries themselves generate activity in the economy through their own purchase of goods and services (e.g., the trucking industry will have to purchase greater quantities of diesel fuel). On top of that, there are the ***induced impacts*** that are created when the wages and salaries paid by the construction industry and (say) the trucking industry are re-spent in the economy, generating economic activity in the retail sector, perhaps the restaurant sector, and the like.

The estimation of the economic effects of the construction of the AWR has been undertaken separately for each portion of the highway. The Wrigley to Dempster Highway portion of the AWR has an investment definitionally equal to 'Output') of $1.449 billion.

As displayed in Table A3, this investment results in an increase in NWT GDP of $525 and will generate direct employment of 4,230 person-years of employment over the entire construction period. The estimated wages stemming from this investment will be approximately $408 million. The revenues accruing to governments will reach roughly $113 million, of which $71 million will go to the Federal Government and of which $41 million will go to the GNWT. These government revenues are the result of increases in indirect taxes (e.g., fuel taxes) and personal income taxes.

TABLE A 3: ECONOMIC IMPACTS OF WRIGLEY TO DEMPSTER HIGHWAY AWR CONSTRUCTION[12]

AWR: Wrigley to Dempster Highway	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$1,448,590,760	$334,365,810	$305,058,795	**$2,088,015,365**	$988,361,167
Material Inputs	$876,654,152	$179,993,350	$202,253,980	**$1,258,901,482**	$525,656,327
GDP	$571,936,608	$154,372,460	$102,804,816	**$829,113,884**	$462,704,840
Employment (FTE)	4,230.1	1,615.7	832.8	**6,678.6**	5,474.1
Wages & Salaries	$380,078,220	$88,780,347	$56,222,046	**$525,080,613**	$243,945,854
Benefits	$27,790,924	$6,600,005	$4,179,597	**$38,570,526**	$29,841,424
Total Gov't Revenues	$112,899,865	$23,483,438	$25,818,680	**$162,201,983**	$58,065,970
Federal	$71,486,264	$13,276,481	$10,804,310	**$95,567,055**	$32,403,980
Net Indirect Taxes	*$8,766,600*	*$1,726,713*	*$2,549,743*	***$13,043,056***	*$4,105,380*
Personal Income Taxes	*$62,719,664*	*$11,549,768*	*$8,254,567*	***$82,523,999***	*$28,298,600*
NWT/Provincial	$41,413,601	$10,206,957	$15,014,370	**$66,634,928**	$25,661,990
Net Indirect Taxes	*$10,604,849*	*$5,319,267*	*$11,218,870*	***$27,142,986***	*$14,531,210*
Personal Income Taxes	*$30,808,752*	*$4,887,690*	*$3,795,500*	***$39,491,942***	*$11,130,780*

Source: NWT Input-Output Model

The $877 million in purchases of material input (ranging from gravel to diesel fuel to trucking services, but excluding any direct wage payments) have an ***indirect impact*** on the NWT economy. Once all imports are removed (since imports have almost no impact on local economies), the additional spending in the NWT economy is estimated at $334 million (Output), which results in an indirect increase in GDP of $154 million, additional employment of 1,616 jobs, and $23 million in government revenues ($13 million to the Federal Government and $11 million accruing to the GNWT).

As mentioned earlier, the additional wages and salaries paid to workers less taxes and savings result in additional spending on consumer goods and services. These ***induced impacts*** generate $103 million in GDP, 833 additional jobs, and total government revenues of $26 million ($11 million to the Federal Government and $15 million to the GNWT). The total impacts on the NWT economy stemming from the original investment of $1.449 billion for the Wrigley to Dempster Highway portion of the AWR is an increase in GDP of $829 million, an addition of 6,679 full-time equivalent jobs, and an increase in government revenues of $162 million (of which the GNWT will receive $67 million).

Impacts on ROC have also been calculated using Statistic Canada's Inter-Provincial I/O Impact tables (excluding any induced impacts, as Statistics Canada does not measure induced impacts). ROC GDP will increase by some $526 million as a result on the Wrigley to Dempster AWR construction, generating 5,474 direct and indirect jobs, and resulting in over $58 million in government revenues.

The economic effects stemming from the Inuvik to Tuktoyaktuk portion of the AWR construction are smaller, based on an estimated investment of $217 million for that portion of the AWR. As displayed in Table A4, the direct impact on GDP is estimated at $86 million, the number of jobs at 633, and government

[12] Definitions are as follows. Output: investment and/or construction costs; Material Inputs: the cost of all material expenses excluding wages and benefits; GDP (or Gross Domestic Product): equal to Output minus Material Inputs, alternatively, equal to the sum of wages and benefits, depreciation, interest costs, and profits; Employment: equals jobs but may differ slightly from full-time depending on industry; Wages and Salaries: wages excluding benefits (e.g. holiday pay, extended health, pension); Benefits: includes holiday pay, extended health, pension, etc.; Indirect Taxes: includes gasoline taxes, federal excise taxes and duties, air transport taxes, lottery and liquor taxes, etc.; Personal Income Taxes: taxes assessed on wages and benefits.

revenues at $18 million. Indirect impacts reach $25 million in GDP, generating 268 jobs and $4 million in government revenues. Induced impacts are estimated at $16 million, 128 jobs, and $4 million in additional government revenues. Overall, therefore, the total contribution to NWT GDP from the Inuvik to Tuktoyaktuk construction is estimated at $127 million with 1,029 jobs being created, and governments receiving $25 million in additional revenues (of which the GNWT will receive $11 million). The direct and indirect impacts on ROC are $69 million in GDP, 807 jobs, and $8.5 million in government revenues.

TABLE A 4: ECONOMIC IMPACTS OF INUVIK TO TUKTOYAKTUK AWR CONSTRUCTION

AWR: Inuvik to Tuktoyaktuk	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$216,720,320	$52,958,145	$46,964,906	**$316,643,371**	$148,005,474
Material Inputs	$130,295,520	$27,961,349	$31,137,740	**$189,394,609**	$79,462,567
GDP	$86,424,797	$24,996,796	$15,827,175	**$127,248,768**	$68,542,907
Employment (FTE)	632.7	267.7	128.2	**1,028.6**	807.5
Wages & Salaries	$57,929,157	$14,247,555	$8,668,571	**$80,845,283**	$35,543,190
Benefits	$4,077,825	$1,036,253	$630,481	**$5,744,559**	$4,381,687
Total Gov't Revenues	$17,648,080	$3,790,336	$3,979,508	**$25,417,924**	$8,536,550
Federal	$11,137,439	$2,112,526	$1,666,253	**$14,916,218**	$4,729,440
Net Indirect Taxes	*$1,518,915*	*$300,442*	*$392,577*	***$2,211,934***	*$621,300*
Personal Income Taxes	*$9,618,524*	*$1,812,084*	*$1,273,676*	***$12,704,284***	*$4,108,140*
NWT/Provincial	$6,510,641	$1,677,810	$2,313,255	**$10,501,706**	$3,807,110
Net Indirect Taxes	*$1,770,894*	*$924,281*	*$1,727,340*	***$4,422,515***	*$2,191,240*
Personal Income Taxes	*$4,739,747*	*$753,529*	*$585,915*	***$6,079,191***	*$1,615,870*

Source: NWT Input-Output Model

ANNUAL MAINTENANCE COSTS OF THE AWR

Once the AWR is completed, it will be necessary to provide an annual budget for its maintenance. Again, the NWT DOT provided estimates of these maintenance costs, apportioned for the Wrigley to Dempster Highway portion and the Inuvik to Tuktoyaktuk portion of the AWR by the number of kilometres.

Table A5 and Table A6 highlight the estimated annual economic effects associated with the maintenance budget for each portion of the AWR. Total economic impacts are estimated at $8 million and $1.5 million in GDP, for a total maintenance impact on GDP of $10 million. The employment effects are estimated at 109 and 19 jobs for a total of 128 total jobs associated with maintenance, and $1.3 million and $230,000 in government revenues for a total of $1.5 million from all maintenance activities. ROC impacts are respectively $2 million and $366,000 in GDP, 28 and five direct and indirect jobs, and $260,000 and $47,000 in government revenues.

TABLE A 5: ANNUAL ECONOMIC IMPACTS OF WRIGLEY TO DEMPSTER HIGHWAY AWR MAINTENANCE

AWR Maint. Wrigley to Dempster Hwy.	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$11,070,000	$3,218,983	$3,226,481	**$17,515,464**	$4,030,340
Material Inputs	$5,373,518	$1,562,535	$2,139,160	**$9,075,213**	$1,955,489
GDP	$5,696,482	$1,656,448	$1,087,324	**$8,440,254**	$2,074,852
Employment (FTE)	77.2	22.4	8.8	**108.4**	28.0
Wages & Salaries	$3,511,764	$1,021,166	$588,349	**$5,121,279**	$1,138,057
Benefits	$301,392	$87,640	$50,494	**$439,526**	$138,187
Total Gov't Revenues	$893,558	$259,834	$259,587	**$1,412,979**	$263,210
Federal	$466,425	$135,630	$110,790	**$712,845**	$145,170
Net Indirect Taxes	*$56,599*	*$16,458*	*$24,868*	***$97,925***	*$16,820*
Personal Income Taxes	*$409,826*	*$119,172*	*$85,922*	***$614,920***	*$128,350*
NWT/Provincial	$427,133	$124,204	$148,797	**$700,134**	$118,040
Net Indirect Taxes	*$265,935*	*$77,330*	*$109,421*	***$452,686***	*$67,550*
Personal Income Taxes	*$161,198*	*$46,874*	*$39,376*	***$247,448***	*$50,490*

Source: NWT Input-Output Model

TABLE A 6: ANNUAL ECONOMIC IMPACTS OF INUVIK TO TUKTOYAKTUK AWR MAINTENANCE

AWR Maint. Inuvik to Tuktoyaktuk	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$1,957,500	$569,210	$570,537	**$3,097,247**	$712,682
Material Inputs	$950,195	$276,302	$378,270	**$1,604,767**	$345,788
GDP	$1,007,305	$292,908	$192,272	**$1,492,485**	$366,895
Employment (FTE)	13.6	4.0	1.6	**19.2**	4.9
Wages & Salaries	$620,983	$180,572	$104,037	**$905,592**	$201,242
Benefits	$53,295	$15,497	$8,930	**$77,722**	$24,435
Total Gov't Revenues	$158,006	$45,946	$45,903	**$249,855**	$46,550
Federal	$82,477	$23,983	$19,591	**$126,051**	$25,680
Net Indirect Taxes	*$10,008*	*$2,910*	*$4,397*	***$17,315***	*$2,980*
Personal Income Taxes	*$72,469*	*$21,073*	*$15,194*	***$108,736***	*$22,700*
NWT/Provincial	$75,529	$21,963	$26,312	**$123,804**	$20,870
Net Indirect Taxes	*$47,025*	*$13,674*	*$19,349*	***$80,048***	*$11,940*
Personal Income Taxes	*$28,504*	*$8,289*	*$6,963*	***$43,756***	*$8,930*

Source: NWT Input-Output Model

Unlike the economic effects of the AWR construction phase, which are one-time impacts, these maintenance effects are annual impacts and will therefore continue to impact the economy year after year. In order to convert these annual impacts into a single impact value, the standard treatment is to convert the profile of annual impacts (in this case, over the 45-year life of the AWR) into a discounted value (discounted at a 5 percent discount rate).

Table A7 and Table A8 each displays the same information as Table A5 and Table A6, except the data are in the form of a Net Present Value (NPV) over a 45-year period (discounted at 5 percent). Over this period, the (discounted) increase in GDP due to maintenance activities are estimated at $150 million (Wrigley to Dempster) and $27 million (for the Inuvik to Tuktoyaktuk portion) for a total of $177 million in GDP. The NPVs of government revenues are estimated at $25 million and $4 million for a total maintenance NPV impact in government revenues of $29 million. Note: the concept of NPV employment is not valid and therefore no estimate is provided.

TABLE A 7: NPV OF MAINTENANCE IMPACTS FOR WRIGLEY TO DEMPSTER HIGHWAY PORTION

NVP Wrigley to Dempster Maint.	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$196,759,000	$57,214,000	$57,348,000	**$311,321,000**	**$71,635,533**
Material Inputs	$95,509,000	$27,773,000	$38,021,000	**$161,303,000**	**$34,756,890**
GDP	$101,250,000	$29,442,000	$19,326,000	**$150,018,000**	**$36,878,643**
Employment (FTE)	0	0	0		**0**
Wages & Salaries	$62,418,000	$18,150,000	$10,457,000	**$91,026,000**	**$20,227,917**
Benefits	$5,357,000	$1,558,000	$897,000	**$7,812,000**	**$2,456,090**
Total Gov't Revenues	$15,882,000	$4,618,000	$4,614,000	**$25,114,000**	**$4,678,241**
Federal	$8,290,000	$2,411,000	$1,969,000	**$12,670,000**	**$2,580,230**
Net Indirect Taxes	$1,006,000	$293,000	$442,000	***$1,741,000***	***$299,041***
Personal Income Taxes	*$7,285,000*	*$2,118,000*	*$1,527,000*	***$10,930,000***	***$2,281,379***
NWT	$7,592,000	$2,208,000	$2,645,000	**$12,444,000**	**$2,098,012**
Net Indirect Taxes	*$4,727,000*	*$1,374,000*	*$1,945,000*	***$8,046,000***	***$1,200,628***
Personal Income Taxes	*$2,865,000*	*$833,000*	*$700,000*	***$4,398,000***	***$897,381***

Source: NWT Input-Output Model

TABLE A 8: NPV MAINTENANCE IMPACTS FOR INUVIK TO TUKTOYAKTUK PORTION

NVP Inuvik to Tuktoyaktuk Maint.	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$34,793,000	$10,117,000	$10,141,000	**$55,051,000**	$12,667,335
Material Inputs	$16,889,000	$4,911,000	$6,723,000	**$28,523,000**	$6,146,001
GDP	$17,904,000	$5,206,000	$3,418,000	**$26,528,000**	$6,521,324
Employment (FTE)	0	0	0		0
Wages & Salaries	$11,037,000	$3,209,000	$1,849,000	**$16,096,000**	$3,576,874
Benefits	$947,000	$275,000	$159,000	**$1,381,000**	$434,181
Total Gov't Revenues	$2,808,000	$817,000	$816,000	**$4,441,000**	$827,394
Federal	$1,466,000	$426,000	$348,000	**$2,240,000**	$456,349
Net Indirect Taxes	*$178,000*	*$52,000*	*$78,000*	***$308,000***	$53,008
Personal Income Taxes	*$1,288,000*	*$375,000*	*$270,000*	***$1,933,000***	*$403,538*
NWT	$1,343,000	$390,000	$468,000	**$2,201,000**	$371,029
Net Indirect Taxes	*$836,000*	*$243,000*	*$344,000*	***$1,423,000***	*$212,255*
Personal Income Taxes	*$507,000*	*$147,000*	*$124,000*	***$778,000***	*$158,779*

Source: NWT Input-Output Model

ELIMINATION OF TEMPORARY WINTER-ROAD REQUIREMENTS

The building of the AWR will have an additional impact on the economy. Once the AWR is in place, there will be no need for the temporary winter-road to be built. This will result in annual savings to the GNWT, but it also means that the associated annual purchases of goods and services and hiring of labour will be eliminated, thereby reducing economic activity in the NWT.

Table A9 below highlight this reduction in economic activity for the Wrigley to Fort Good Hope portion of the Winter Road. With a direct reduction in investment of approximately $1.3 million for the Wrigley to Fort Good Hope portion of the winter-road, the total associated negative annual economic impact on GDP is estimated at $763,000, six jobs, and $152,000 in government revenues, of which the Federal Government will experience a reduction of $89,000 in revenues and the GNWT will incur a reduction of $63,000 in tax revenues. Again, in order to convert these annual effects into a representative total value, an NPV value of impacts needs to be calculated using a discount rate of 5 percent over the 45-year life of the AWR. These NPV data are displayed in Table A11..

Table A 9: Reduction in Economic Impacts from Wrigley to Fort Good Hope Winter-Road

Winter: Wrigley to Fort Good Hope	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$1,285,000	$318,358	$281,826	**$1,885,184**	$866,274
Material Inputs	$768,224	$167,843	$186,850	**$1,122,917**	$464,681
GDP	$516,776	$150,515	$94,977	**$762,268**	$401,593
Employment (FTE)	3.8	1.6	0.8	**6.2**	4.7
Wages & Salaries	$346,670	$86,196	$51,996	**$484,862**	$208,586
Benefits	$25,589	$6,311	$3,806	**$35,706**	$25,703
Total Gov't Revenues	$105,084	$22,873	$23,867	**$151,824**	$50,040
Federal	$66,329	$12,765	$9,993	**$89,087**	$27,730
Net Indirect Taxes	*$8,847*	*$1,805*	*$2,354*	***$13,006***	*$3,630*
Personal Income Taxes	*$57,482*	*$10,960*	*$7,639*	***$76,081***	*$24,100*
NWT/Provincial	$38,755	$10,108	$13,874	**$62,737**	$22,310
Net Indirect Taxes	*$10,449*	*$5,552*	*$10,360*	***$26,361***	*$12,830*
Personal Income Taxes	*$28,306*	*$4,556*	*$3,514*	***$36,376***	*$9,480*

Source: NWT Input-Output Model

The equivalent economic effects stemming from the Inuvik to Tuktoyaktuk portion of the winter-road are displayed in Table A10. With savings to government of $129,000 each year (equal to Output – what the cost of the winter-road will be without the AWR), this results in a reduction in economic activity of $73,000 in GDP, the loss of 0.6 full-time equivalent jobs, and a reduction in government revenues of approximately $15,000. The equivalent NPV values for this portion of the winter-road are displayed in Table A12.

Table A 10: Reduction in Economic Impacts from Inuvik to Tuktoyaktuk Winter-Road

Winter: Inuvik to Tuktoyaktuk	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$128,650	$29,988	$26,758	**$185,396**	$91,619
Material Inputs	$78,790	$15,916	$17,740	**$112,446**	$49,326
GDP	$49,860	$14,073	$9,018	**$72,951**	$42,293
Employment (FTE)	0.4	0.1	0.1	**0.6**	0.5
Wages & Salaries	$33,326	$7,886	$4,947	**$46,159**	$21,818
Benefits	$1,951	$560	$351	**$2,862**	$2,693
Total Gov't Revenues	$10,329	$2,119	$2,273	**$14,721**	$5,260
Federal	$6,514	$1,175	$952	**$8,641**	$2,920
Net Indirect Taxes	*$954*	*$170*	*$224*	***$1,348***	*$390*
Personal Income Taxes	*$5,560*	*$1,005*	*$728*	***$7,293***	*$2,530*
NWT/Provincial	$3,815	$944	$1,321	**$6,080**	$2,340
Net Indirect Taxes	*$1,068*	*$525*	*$986*	***$2,579***	*$1,350*
Personal Income Taxes	*$2,747*	*$419*	*$335*	***$3,501***	*$990*

Source: NWT Input-Output Model

Note: The value of $0 in some cells does NOT indicate there is no impact; rather, impact is less than $500 and therefore is rounded downward to $0.

Table A 11 NPV Impacts for the Wrigley to Fort Good Hope Portion of the Winter-Road

NVP Winter: Wrigley to Fort Good Hope	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$22,839,000	$5,658,000	$5,009,000	**$33,507,000**	$15,397,030
Material Inputs	$13,655,000	$2,983,000	$3,321,000	**$19,959,000**	$8,259,357
GDP	$9,185,000	$2,675,000	$1,688,000	**$13,549,000**	$7,138,142
Employment (FTE)					
Wages & Salaries	$6,162,000	$1,532,000	$924,000	**$8,618,000**	$3,707,431
Benefits	$455,000	$112,000	$68,000	**$635,000**	$457,107
Total Gov't Revenues	$1,868,000	$407,000	$424,000	**$2,699,000**	$889,569
Federal	$1,179,000	$227,000	$178,000	**$1,583,000**	$492,738
Net Indirect Taxes	$157,000	$32,000	$42,000	***$231,000***	$64,473
Personal Income Taxes	*$1,021,000*	*$195,000*	*$136,000*	***$1,352,000***	*$428,270*
NWT	$689,000	$180,000	$247,000	**$1,115,000**	$396,507
Net Indirect Taxes	*$186,000*	*$99,000*	*$184,000*	***$469,000***	*$228,264*
Personal Income Taxes	*$503,000*	*$81,000*	*$63,000*	***$647,000***	*$168,616*

Source: NWT Input-Output Model

Table A 12: NPV Impacts for the Inuvik to Tuktoyaktuk Portion of the Winter-Road

NPV Winter: Inuvik to Tuktoyaktuk	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$2,207,000	$515,000	$459,000	**$3,181,000**	$1,571,982
Material Inputs	$1,352,000	$273,000	$304,000	**$1,929,000**	$846,187
GDP	$856,000	$242,000	$155,000	**$1,252,000**	$725,833
Employment (FTE)					
Wages & Salaries	$572,000	$135,000	$85,000	**$792,000**	$374,360
Benefits	$33,000	$10,000	$6,000	**$49,000**	$46,113
Total Gov't Revenues	$178,000	$36,000	$39,000	**$253,000**	$90,400
Federal	$112,000	$20,000	$16,000	**$148,000**	$50,013
Net Indirect Taxes	*$16,000*	*$3,000*	*$4,000*	***$23,000***	$6,654
Personal Income Taxes	*$95,000*	*$17,000*	*$12,000*	***$125,000***	*$43,363*
NWT	$65,000	$16,000	$23,000	**$104,000**	$40,026
Net Indirect Taxes	*$18,000*	*$9,000*	*$17,000*	***$44,000***	*$23,032*
Personal Income Taxes	*$47,000*	*$7,000*	*$6,000*	***$60,000***	*$16,967*

Source: NWT Input-Output Model

Consumer Surplus Impacts

One of the major rationales behind the building of the AWR is the belief that with the construction of the AWR, freight costs northward to Inuvik and Tuktoyaktuk will decrease and will result in lower prices for goods trucked into the various northern communities. Lower prices will mean that consumers, after buying the same basket of goods and services, will enjoy a "surplus" that will be available to be spent on additional goods and services. The "surplus", by definition, will be equal to the savings in freight rates.[13]

Table A 13: Economic Impacts due to Increase in Consumer Surplus

Consumer Surplus	NWT				REST OF CANADA
	Direct	**Indirect**	**Induced**	**TOTAL**	**Dir. + Indir.**
Output	$15,687,700	$1,109,503	$1,748,382	**$18,545,585**	$1,597,562
Material Inputs	$1,930,207	$526,503	$1,159,180	**$3,615,890**	$829,360
GDP	$4,288,410	$583,000	$589,204	**$5,460,614**	$768,202
Employment (FTE)	30.0	6.3	4.8	**41.1**	11.2
Wages & Salaries	$2,352,988	$298,938	$323,447	**$2,975,373**	$434,380
Benefits	$82,266	$21,007	$22,732	**$126,005**	$49,377
Total Gov't Revenues	$874,983	$85,134	$147,502	**$1,107,619**	$87,880
Federal	$428,239	$43,854	$62,027	**$534,120**	$48,300
Net Indirect Taxes	*$58,933*	*$8,613*	*$14,448*	***$81,994***	*$190*
Personal Income Taxes	*$369,306*	*$35,241*	*$47,579*	***$452,126***	*$48,110*
NWT/Provincial	$446,744	$41,280	$85,475	**$573,499**	$39,580
Net Indirect Taxes	*$270,145*	*$27,419*	*$63,572*	***$361,136***	*$20,660*
Personal Income Taxes	*$176,599*	*$13,861*	*$21,903*	***$212,363***	*$18,920*

Source: NWT Input-Output Model

[13] The reduction in prices for consumer goods will flow both partly to local individuals resulting in a "surplus" available to be spent. For local businesses purchasing (lower-priced) goods, the assumption is that lower input costs to businesses will lower business prices rather than increase profits. These lower business prices then flow to consumers resulting in an additional "surplus".

While the reduction in freight rates will increase the purchasing power of individuals in northern communities and therefore improve standards of living, the purchase of these additional goods and services will also have spin-off (indirect and induced) effects on the rest of the NWT economy.

As described earlier in this study, the savings in freight rates (which will flow into reduced prices) have been estimated by taking the number of freight-carrying vehicles travelling to the northern parts of the NWT and multiplying the number of freight-carrying vehicles, the estimated savings per truck. With the number of commercial trucks travelling to the north of the NWT estimated at 5,110 and the savings per truckload due to the AWR estimated at $3,070, the annual saving in freight is estimated at roughly $16 million.

Table A13 highlights the direct, indirect, and induced effects that this $15.7 million in annual freight savings will generate. While the actual increase in spending is estimated at $15.7 million, many of these goods and services will be imported from outside the NWT, resulting in much lower impacts on the NWT economy. Overall, the savings in freight rates will increase GDP by $5.5 million, generate 41 jobs, and contribute roughly $1.1 million to government coffers (of which $577,000 will accrue to the GNWT).

In addition to changes in freight rates with the building of the AWR, it is expected that most of the Food Mail programme will not be required, and that necessary food will be transported by truck. As a result, there will be a decrease in air-cargo traffic and an increase in truck transport. The net impacts of these changes are highlighted in Table A14. Including direct, indirect, and induced impacts, GDP due to the elimination of the Food Mail programme will increase by $0.5 million; there will be an additional four jobs created; and government revenues will increase by $77,000 of which $23,000 will accrue to the GNWT.

TABLE A 14: ECONOMIC IMPACTS OF CHANGES TO FOOD MAIL DELIVERIES

Food Mail	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$0	-$72,000	$117,030	**$44,940**	-$457,174
Material Inputs	-$373,000	-$152,000	$77,590	**-$447,330**	-$198,984
GDP	$373,000	$80,000	$39,440	**$492,270**	-$258,190
Employment (FTE)	3	1	0	**4**	-4
Wages & Salaries	$140,000	$23,000	$25,330	**$188,620**	-$168,922
Benefits	-$2,000	-$2,000	-$2,150	**-$6,000**	-$21,997
Total Gov't Revenues	$56,000	$10,000	$10,850	**$76,580**	-$38,570
Federal	$40,000	$9,000	$4,910	**$53,090**	-$20,670
Net Indirect Taxes	*$24,000*	*$7,000*	*$920*	***$30,720***	*-$1,810*
Personal Income Taxes	*$16,000*	*$2,000*	*$3,990*	***$22,370***	*-$18,860*
NWT	$16,000	$1,000	$5,940	**$23,490**	-$17,900
Net Indirect Taxes	*$10,000*	*$0*	*$4,030*	***$14,350***	*-$10,480*
Personal Income Taxes	*$6,000*	*$1,000*	*$1,910*	***$9,140***	*-$7,420*

Table A15 describes the effects of the AWR on Net Consumer Surplus.

The effect is a positive impact on the economy as a whole: GDP increases by some $4.1 million in the NWT, and there is a net gain of 37 jobs and an increase in GNWT revenues of $550,000.

TABLE A 15: ECONOMIC IMPACTS DUE TO INCREASE IN NET CONSUMER SURPLUS

Net Consumer Surplus	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$15,687,700	$1,181,503	$1,631,352	**$18,500,645**	$2,054,735
Material Inputs	$2,303,207	$678,503	$1,081,590	**$4,063,220**	$1,028,344
GDP	$3,915,410	$503,000	$549,764	**$4,968,344**	$1,026,392
Employment (FTE)	27	6	4	**37**	16
Wages & Salaries	$2,212,988	$275,938	$298,117	**$2,786,753**	$603,302
Benefits	$84,266	$23,007	$24,882	**$132,005**	$71,374
Total Gov't Revenues	$818,983	$75,134	$136,652	**$1,031,039**	$126,450
Federal	$388,239	$34,854	$57,117	**$481,030**	$68,970
Net Indirect Taxes	*$34,933*	*$1,613*	*$13,528*	***$51,274***	*$2,000*
Personal Income Taxes	*$353,306*	*$33,241*	*$43,589*	***$429,756***	*$66,970*
NWT	$430,744	$40,280	$79,535	**$550,009**	$57,480
Net Indirect Taxes	*$260,145*	*$27,419*	*$59,542*	***$346,786***	*$31,140*
Personal Income Taxes	*$170,599*	*$12,861*	*$19,993*	***$203,223***	*$26,340*

Source: NWT Input-Output Model

Table A16 provides the equivalent impact values summed over 45 years (discounted at 5 percent).

TABLE A 16: NPV OF NET CONSUMER SURPLUS

NPV Net Con. Surplus	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$235,866,000	$16,681,000	$26,287,000	$278,834,000	$30,761,220
Material Inputs	$21,853,000	$5,961,000	$13,124,000	$40,937,000	$9,592,602
GDP	$54,654,000	$7,430,000	$7,509,000	$69,593,000	$14,422,042
Employment (FTE)					
Wages & Salaries	$31,106,000	$3,952,000	$4,276,000	$39,334,000	$8,497,869
Benefits	$978,000	$250,000	$270,000	$1,498,000	$817,051
Total Gov't Revenues	$11,500,000	$1,119,000	$1,939,000	$14,557,000	$1,784,635
Federal	$5,533,000	$567,000	$801,000	$6,901,000	$994,384
Net Indirect Taxes	*$446,000*	*$65,000*	*$109,000*	*$621,000*	*$27,965*
Personal Income Taxes	*$5,130,000*	*$489,000*	*$661,000*	*$6,280,000*	*$973,502*
NWT	$5,964,000	$551,000	$1,141,000	$7,656,000	$795,038
Net Indirect Taxes	*$3,459,000*	*$351,000*	*$814,000*	*$4,624,000*	*$412,581*
Personal Income Taxes	*$2,521,000*	*$198,000*	*$313,000*	*$3,032,000*	*$390,376*

Source: NWT Input-Output Model

TOURISM IMPACTS

It is difficult to determine in a cogent, analytical manner the number of additional tourists who will likely visit the NWT due to the building of the AWR and the opening up of better transport links to the northern areas of the territory. Nevertheless, discussions with NWT Tourism officials have suggested that the AWR could result in an increase of 20 percent in visitation, equal to roughly 2,500 – 2,700 new tourists each year. Based on historical average spending per person of $644 (excluding airfares) plus prepaid package costs of $284 (some of which will not accrue to businesses in the NWT), we have estimated a conservative total increase in tourist expenditures of $2 million.

Table A17 below highlights the effects stemming from this addition to tourism activity. Overall, GDP will increase by $555,000 generating 10 new jobs and resulting in almost $100,000 in additional government revenues.

TABLE A 17: ECONOMIC IMPACTS DUE TO INCREASE IN TOURISM

Tourism	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$2,000,000	$220,255	$211,837	**$2,432,092**	$462,784
Material Inputs	$442,013	$126,028	$140,450	**$708,491**	$249,067
GDP	$388,561	$94,227	$71,390	**$554,178**	$213,716
Employment (FTE)	8.1	1.2	0.6	**9.8**	3.1
Wages & Salaries	$239,642	$50,694	$38,608	**$328,944**	$118,537
Benefits	$20,134	$4,383	$3,336	**$27,853**	$13,937
Total Gov't Revenues	$64,514	$14,789	$16,845	**$96,148**	$24,330
Federal	$33,578	$7,399	$7,234	**$48,211**	$13,090
Net Indirect Taxes	*$9,845*	*$1,622*	*$1,597*	***$13,064***	*-$20*
Personal Income Taxes	*$23,733*	*$5,777*	*$5,637*	***$35,147***	*$13,110*
NWT/Provincial	$30,936	$7,390	$9,611	**$47,937**	$11,240
Net Indirect Taxes	*$21,601*	*$5,118*	*$7,028*	***$33,747***	*$6,080*
Personal Income Taxes	*$9,335*	*$2,272*	*$2,583*	***$14,190***	*$5,160*

Source: NWT Input-Output Model

Since this tourism spending will occur each year, it is necessary to determine the Net Present Value (NPV) of the impacts. Table A18 displays these results: an increase in GDP of $9.5 million and an increase in government revenues of $1.7 million, of which $823,000 will accrue to the NWT.

TABLE A 18: NPV OF ECONOMIC IMPACTS DUE TO INCREASE IN TOURISM

NVP Tourism	NWT				REST OF CANADA
	Direct	Indirect	Induced	TOTAL	Dir. + Indir.
Output	$34,317,781	$3,779,331	$3,634,888	$41,732,000	$7,940,856
Material Inputs	$7,584,503	$2,162,515	$2,409,982	$12,157,000	$4,273,749
GDP	$6,667,220	$1,616,817	$1,224,963	$9,509,000	$3,667,105
Employment (FTE)					0
Wages & Salaries	$4,111,762	$869,804	$662,434	$5,644,000	$2,033,846
Benefits	$345,530	$75,219	$57,251	$478,000	$239,179
Total Gov't Revenues	$1,107,128	$253,795	$289,078	$1,650,000	$417,528
Federal	$575,989	$126,921	$124,090	$827,000	$224,543
Net Indirect Taxes	*$168,806*	*$27,811*	*$27,383*	$224,000	-$343
Personal Income Taxes	*$407,176*	*$99,113*	*$96,711*	*$603,000*	*$224,922*
NWT	$531,121	$126,874	$165,005	$823,000	$192,972
Net Indirect Taxes	*$370,610*	*$87,810*	*$120,580*	*$579,000*	*$104,315*
Personal Income Taxes	*$159,859*	*$38,907*	*$44,233*	*$243,000*	*$88,364*

Source: NWT Input-Output Model

APPENDIX B-AN INPUT-OUTPUT PRIMER

National Accounting (also termed Economic Accounting) assumes a company undertakes two steps in its production process. First, it purchases material inputs from other industries and second, it transforms those material inputs into finished goods (or services) ready for resale. Take as an example a construction company constructing a pipeline. The construction company may buy steel pipe from the steel manufacturing sector. Using other material inputs (e.g., electricity and fuel oil), it transforms the steel pipe into a completed pipeline, which, in turn, is "sold" to the owners of the pipeline at a selling price (equal to the investment cost) higher than the cost of its inputs. The difference between the selling price (investment cost) and the material input cost is the "mark-up" or "value-added". This value-added is used to pay for the labour, any taxes levied by governments, the depreciation of equipment, and any interest costs the construction company may have, and will also generate, the owner hopes, a profit.

National Accounting asserts that the value that the construction sector adds to the economy (hence, the term "value-added") is equal not to the total revenues of the construction sector (equivalently, the investment cost), but only to this "mark-up" value. That is, the value of an industry to an economy is the difference between the value of its output (effectively, total operating revenues) and the cost of its material inputs. In this way, the construction industry does not claim the value of the steel pipe inputs it uses, which should rightly be accounted for by the steel industry. As a result, there is no double counting when measuring the value of the entire economy.

The value-added of the construction industry building the pipeline will be equal to the revenue received (equal to the invested capital) minus all of its material costs for goods or services (material inputs), or:

Value-Added = Revenue (or Capital Invested) - Material Inputs

Another way of defining value-added is that it is the sum of an industry's payments for labour, for indirect taxes, for depreciation and interest costs, and for profit:

Value Added = Labour + Indirect Taxes + Depreciation + Interest Costs + Profit

The resulting value-added of any firm (or industry) is available to be shared among labour (wages, salaries, and benefits), indirect taxes, and "operating surplus." The operating surplus itself is shared between payments for the use of physical capital (depreciation), payments for the use of monetary capital (interest costs), and payments (profits) to the owner(s) of the enterprise. Value-added is an industry's contribution to, or ***direct impact*** on, the economy. The sum of value-added of all industries is termed the country's Gross Domestic Product (GDP).

An important distinction needs to be made between Financial Accounting and National Accounting. Under financial accounting, an industry that has a high value-added (i.e., contributes a lot to the economy) can be unprofitable if, for example, its payments to labour or for interest costs are too high. Alternatively, low value-adding industries can be very profitable to their owners, depending on their usage of labour and their capital structure.

Economists have standardised the measure of the flows of commodities between industries and the inter-relationships of inputs and outputs among industries through the concept of Input-Output (I/O) analysis. The **MAKE** matrix identifies the various types of output the sector produces (the construction industry produces "construction" services). The **USE** matrix highlights all the various types of inputs used to produce that output (the construction industry uses a variety of inputs including steel pipe, fuel oil, office supplies, etc.).[14] By mathematically manipulating these matrices, it is possible to determine by how much the supply of each commodity will increase when the output of an industry increases by one dollar.

The GDP-to-Output ratio is a measure of the direct contribution to the economy *per dollar of output*. Clearly, an industry that requires a lower dollar value of inputs to produce a given dollar of output is a higher value-adding industry. One must note, however, that a higher GDP-to-Output ratio does *not* imply that the industry is more important to the economy. It merely states that for every dollar of output, the impact on the economy is greater. Obviously, when examining an industry's importance to an economy, one must also take into account the total output of the industry. There is, however, another important characteristic of an industry that must be examined if one is to determine the importance of a sector to the local economy: its ***linkages*** to other industries.

When inputs such as steel pipe are purchased by the construction sector, the industries supplying those goods and services (in this case, the steel industry) increase their own economic activity. This increased activity itself creates demand for other products. The steel industry, for example, may need more iron ore. Iron ore producers themselves may need more chemicals and fuel oil. The demand for extra chemicals and fuel oil will, in turn, stimulate activity in the chemical and hydrocarbon industries. The increased activity in the chemical industry will create greater demand for its own inputs, perhaps some other primary chemicals. And so it continues down the chain of industries. The sum effects of all this additional economic activity are known as ***indirect impacts***.

Such indirect impacts (also known as "multiplier effects" or "spin-offs") on the economy clearly are important. They should not be ignored (as they usually are with financial accounting) if we are to measure the true benefits of an industry or an investment to an economy. An interesting observation is that while it is true that high value-adding industries have low indirect impacts, those industries with relatively lower direct impacts have relatively higher indirect impacts. This is because, by definition, low value-adding industries consume more inputs per dollar of output and thus have a greater impact on their supplying industries. It should be noted, however, that the level of indirect impacts is highly influenced by the type of goods and services demanded and by the propensity of the companies (or the economy) to import those particular goods and services. The higher the propensity to import the required goods and services, the lower will be the effects on the local economy. Indeed, an industry that imports all its inputs will have virtually no indirect impact on the economy, save the small level of distributive activity (wholesale, retail, and transportation margins) that the imports may generate.

Increased industrial activity or investment has a third effect on the economy. When additional wages and salaries are paid out, those dollars (appropriately adjusted for taxes and savings) are available to be re-spent on consumer goods and services. Take, for example, an additional $1 million in wages resulting in, say, an increase of $750,000 in disposable income. Depending on the spending patterns, this may result in extra consumer spending of, say, $500,000 in the retail sector (the remaining being spent in the entertainment sector, restaurant sector, etc.). This will increase the economic activity of the manufacturers and other suppliers of consumer goods to the retail sector who, in turn, will increase their own employment and their own wage payments. The sum effects of this additional activity due to increased wages are known as ***induced impacts***. Again, it should be clear that, like indirect impacts, induced impacts are highly influenced by the economy's propensity to import as well as by the economy's taxation and savings rates, the level of wages paid to employees, and the level of capacity at which the economy is operating.

The following question arises: given that there are many levels of indirect and induced spending that affect many different firms and industrial sectors, how can we estimate these impacts on the economy? Fortunately, economists have developed a method to estimate these impacts by using the same input-output tables to which we already have been introduced.[15] However, since the base information is coming from

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[14] Output is closely associated with industry revenues, but there are important differences. Likewise, inputs are highly related to industry expenses. But, again, the differences are important. For a summary of these differences, see the next sub-section: *Technical Differences*.

[15] For a detailed discussion of the underlying mathematics of Input-Output analysis, see ***Input-Output Analysis: Foundations and Extension***, Ronald E. Miller and Peter D. Blair, Prentice Hall, 1985

financial statement data directly provided by operators, it is critical to understand how financial statement data are re-structured to meet National Accounting standards. These differences are discussed below.

Technical Differences

Although the National Accounting (Input-Output) measurement of the value and impacts of an industry begins with the same set of data as the financial results of the industry, a number of adjustments are required in order to conform to strict National Accounting standards. To avoid possible confusion, these technical differences between Financial Accounting and National Accounting should be understood, although not all the differences relate to the construction industry or to other industries involved in the MGP. The intent here is not to provide a comprehensive or definitive discussion of these differences, however, but rather to provide a cursory overview. For a more in-depth discussion of the differences and of the methodology underlying National Accounting, the interested reader is referred to the National Accounting compendium published by the UN.[16]

The following outlines the major differences:

1. The first and perhaps most important difference is that National Accounting measures <u>all</u> non-tax related revenues and expenses related to production, even those not itemized on the corporate income statement. Hence, gratuities paid to staff are included as output. This increases output but not material inputs, and therefore it increases the estimate of GDP (Output – Input) by precisely the amount of gratuities. Using our other definition of GDP (GDP = indirect taxes + wages, salaries and benefits + operating surplus), we see that the increase in GDP is reflected in an increase in wages and salaries equal to the reported gratuities.

2. Another (usually) off-budget item is an estimate of the value of imputed room and board provided to employees. On the Output side there is an increase in lodging revenues and, since the provision of room and board is a value to the employee, it is considered equivalent to a wage, and thus contributes to overall GDP equal to the value of the imputed room and board. Statistics Canada has standard values that it uses to assess the value of this room and board.

3. At the same time, National Accounting omits revenues not directly related to the production process. Generally, these incomes are limited to interest and dividend earnings, but include non-operating revenues related to rental incomes, commissions, and the like.

4. A third difference is that under National Accounting, the value of each input in the USE matrix is stated in "producer" prices. That is, all wholesale, retail, and transportation costs included in the "purchaser" price of a commodity are removed, as are all commodity taxes, indirect taxes, and import duties. These "distributive and tax margins", as they are called, are explicitly recognized in the USE matrix as separate line items. For the construction industry, the purchase cost of steel pipe will be equal to the "producer" cost of steel pipe (the cost at the manufacturer's plant gate) plus the cost of transporting the pipe to the NWT (the "transportation" margin) plus any retail/wholesale mark-ups plus any indirect taxes. The reader should understand that this does not in any way reduce the total cost of inputs to the industry; it simply re-assigns the costs to different input categories.

5. A fourth difference lies in the treatment of merchandise sales. National Accounting treats the purchase of merchandise as partly a purchase from the manufacturer of the good (equal to the cost price of the good less distributive and tax margins) and partly a purchase from the retailer (equal to the mark-up for the good). Consequently, in an input-output table for a sector selling some retail goods, there is no recognition of the cost of the merchandise on the input (USE) side, and only the mark-up value is recognized on the output (MAKE) side. The cost of the merchandise is captured in the manufacturing sector as output.

[16] *<u>System of National Accounts</u>*, Statistical Papers Series F No 2 Rev. 4, New York, 1993

6. Related to this unusual approach to merchandise sales is the treatment of “service margins.” When a firm purchases a product (such as liquor, beer, or wine) and re-sells it with a mark-up without any fundamental change to it, National Accounting recognizes only the mark-up or “service margin” as output. It then treats the purchase cost of the product (less distributive and tax margins) as an output to the original producer of the good. The main instance that affects most industries (besides retail sales) is alcohol sales. In this case, only the service margins are recognized as output, and the costs are assigned to the alcohol manufacturing sectors (beer, wine, and liquor distillers).

APPENDIX C-ASSUMPTIONS OF TRUCKING VS. BARGING THE MGP

TRUCKING

Pipe hauls are carried out with self-steering dolly trailers (see Appendix E on page 72) and they are while legal under current permissible vehicle weight laws in NWT, they are longer than permitted. Therefore, PROLOG has assumed pilot cars will be required as is customary for over-length loads. Modules will weigh over the permissible vehicle weight limits but will likely be within overall length allowances and conducted during the winter months when the AWR is frozen.

It is assumed that **fuel** will be trucked in conventional Super B Train equipment, as is customary in the NWT.

It is assumed that **construction equipment** (yellow iron) **and drilling equipment and supplies** will be moved on low-boy trailers and/or flat-deck trailers. **Camp Buildings** will be moved on conventional flat-deck trailers and **modules** by specially constructed trailers designed to match module dimensions. Flat-deck trailers may also be used for compressor station components.

TABLE A 19: TRUCKING SYSTEM DESCRIPTION

Commodity	Vehicle Type	Payload	Avg. Speed	Running Cost/Hr.	Materials Handling Costs
Pipe	Tractor & Pipe Dolly	25 tons	60 km/hr	$263	$10 per ton - each end
Fuel	Super B Train	40 tons	70 km/hr	$192	load/unload - 1.5 hrs @ $63/hr.
Equipment	Tractor/Low-Boy	28 tons	70 km/hr	$175	$10 per ton - each end
Camp Buildings	Tractor/Flat-Deck	24 tons	70 km/hr	$175	$10 per ton - each end
Modules	Tractor/Special Trailers	60 tons	45 km/hr	$175	$10 per ton - each end
Drill Rigs/Supplies	Tractor/Flat Deck	30 tons	70 km/hr	$346	$10 per ton - each end

For the truck case, pipe and fuel (the commodities entering the NWT from the South by rail) are considered shipments originating in Hay River. Equipment, camps, and modules are typically truck-mounted at their factories or southern distribution points and assumed to originate in Enterprise (the origin of Highway No.1). All logistics costs south of Hay River and Enterprise are common to both scenarios, whether or not the AWR exists.

The following table shows commodity origins and AWR distances to the planned MGP river stockpile sites. Included are the estimated distances from the stockpile site to the closest new AWR alignment:

TABLE A 20: TRUCKING O/D DISTANCE ASSUMPTIONS (KMS)

Destination	Origin	
	Hay River	Enterprise
Camsell Bend	518	475
Trail River	543	500
Ochre River	674	631

Destination	Origin	
	Hay River	Enterprise
Blackwater	747	704
Fort Norman	43	
Norman Wells	988	945
Fort Good Hope	1,135	1,092
Little Chicago	1,261	1,218
Inuvik	1,497	1,454
Swimming Point	1,571	1,528
Camp Farewell	1,651	1,608
Lucas Point	1,576	1,533

Tug and barge operating cost data are provided by a PROLOG consultant with 36 years experience with Northern Transportation Company Ltd. (NTCL), much of it in marketing and implementing logistics programs for the oil and gas industry active in the North, and for Arctic communities. He maintains a close relationship with senior NTCL officials.

Trucking and materials handling operating cost data are derived from the hands-on experience of PROLOG consultants and discussions with such companies as Trimac Transportation, Ventures West, Matco, Tli Cho Landtran, and Atco Structures; from personnel at ports and stevedoring companies; from energy and mining companies; and from consulting engineering firms – all highly experienced in northern operations.

BARGING

Two forms of rates are generally available from marine transportation companies:

> **Tariff rates** are available for periodic shippers, usually for seasonal deliveries, to points along the river. Tariffs are established by commodity groups for regional destinations throughout the Arctic. Rates increase in proportion to the distance from bases at Hay River (NTCL) and/or Fort Simpson (Coopers Barging).
>
> **Time Charter rates** are available for customers willing to commit large volumes of freight over extended periods of time. It is highly probable that the two- or (more likely) three-year supply program for the MGP will involve the time-chartering of tugs and barges from both major operators on the river. Some freight required by contractors and service companies no doubt will move under tariff rates, but the amount should be minimal.

Both tariff and time charter freight rates were developed for this analysis as a basis for comparing each with a trucking option.

TRUCKING

Typically, trucking freight rates in the North are developed on an hourly basis for specific hauls based on round-trip times, with additional consideration for loading and unloading the products. Mileage-based rates are generally developed for movements over the high volume and extensive southern highway system where traffic disruptions are less frequent and weather conditions less onerous.

Rates provided here are consistent with known rates for current bulk and full-load contract hauls in the NWT and Yukon. Included are a 10 percent administration fee and a 10 percent margin.

The following table describes the comparative results obtained in the analysis.

TABLE A 21: COMPARATIVE IMPACTS - TRUCK VS. BARGE MGP ($CDN)

			Cost Barge	
	Tonnage (Short Tons)	Cost Truck (Hourly Basis)	Tariff	Time Charter
Camsell Bend	43,475	5,374,833	4,583,015	3,444,800
Ochre River	59,680	8,914,874	9,299,060	3,744,000
Trail River	9,621	937,581	1,189,024	960,420
Blackwater River	9,819	1,302,313	1,759,335	864,000
Little Smith Creek	78,089	13,895,565	16,797,011	6,582,360
Norman Wells	76,666	16,215,214	16,254,117	7,469,060
Fort Good Hope	92,604	22,494,244	23,501,294	10,277,800
Little Chicago	168,090	42,377,830	46,494,740	20,781,400
Inuvik	100,608	27,874,189	30,601,780	14,252,160
Swimming Point	33,830	10,997,232	9,437,870	5,284,600
Camp Farewell	40,678	10,111,435	13,654,230	6,306,760
Bar C	63,560	11,500,504	22,513,690	9,472,600
Lucas Point	50,590	12,813,428	18,862,840	8,644,000
Totals	**827,310**	**$184,809,242**	**$214,948,006**	**$98,083,960**

BARGING

PROLOG assumes all materials will be shipped to river stockpile sites from Hay River, as most high volume commodity movements are currently planned in the MGP logistics submission to the JRP. MGP has some shipments from Fort Simpson in its plan, but the volumes are small and involve construction equipment only.

PROLOG assumes that a standard barge train consists of a 4,500 hp tug, six barges – four 1500 Series units (1,500-ton capacity), and two 1000 Series barges (1,000-ton capacity). This configuration provides excellent performance on the river and reflects NTCL's fleet mix.

The commodity-based NTCL tariff rates are based on travel distances from Hay River to a series of "tariff regions" blanketing NTCL's overall market area in the Mackenzie watershed and Western Arctic. The time charter rate is based on a daily charge of $48,000, $30,000 of which covers the cost of maintaining a tug on the Mackenzie system, and a balance of $18,000 for the six barges.

An Alaskan stevedoring company recently quoted PROLOG a figure of $10 per ton for loading and off-loading barges (same as truck) in the "tariff" case, except for fuel. The cost to off-load fuel is included in the tariff because barge-mounted pumps and hoses are used to transfer fuel to shore manifolds.

The destinations in all cases are the pipeline spread stockpile site locations identified in the MGP Logistics Plan. Swimming Point, Camp Farewell, and Lucas Point are the three Mackenzie Delta sites serving the three anchor field locations. Barging trip times are based on the following "average" return trip intervals:

TABLE A 22: TRAVEL TIME FROM HAY RIVER TO MGP STOCKPILE SITE LOCATIONS

Barge Travel Time From Hay River, NWT to MGP Stockpile Site Locations	
Camsell Bend	8 days
Trail River	8 Days
Ochre River	9 Days
Blackwater	9 Days
Little Smith Creek	9 Days
Fort Norman	10 Days
orman Wells	10 Days
Little Chicago	14 Days
Inuvik	15 Days
Swimming Point	16 Days
Camp Farewell	17 Days
Lucas Point	16 Days

LIMITATIONS

PROLOG's analysis of the economics of barging vs. trucking with the MGP considers only the transportation costs of moving construction materials to stockpile sites. Other benefits not within the scope of the analysis include:

1. Certainty of access and the impact on contingency planning
2. Opportunity cost of stockpiling material and equipment
3. Gravel pit development
4. Gravel quantities
5. Crew changes
6. Camp resupply
7. Emergency procedures

While it was not possible to assign a value to any of these potential investment savings or even to determine whether there would be any savings, it is safe to conclude that the AWR can only be a positive factor in the overall cost structure of the MGP. Since the financial impacts identified in this report can only be larger if the AWR reduces the investment costs of the MGP, it is also safe to say that with the AWR in place, the economic viability of the MGP and the long-run economic returns of future exploration and development would themselves only improve with the construction of the AWR.

APPENDIX D-AWR BARGE AND TRUCK IMPACTS

TABLE A 23: DEH CHO REGION MACKENZIE RIVER MGP STOCKPILE SITES

Deh Cho Region Mackenzie River MGP Stockpile Sites				BARGE					NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER				
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Pipe	Camsell Bend	31,890	1 to 5	6,400	8	5	40	100	3,189,000	48,000	1,920,000	637,800	2,557,800
Fuel	Camsell Bend	5,635	6	5,635	8	1	8	89	501,515	48,000	384,000		384,000
Camps	Camsell Bend	5,950	7	5,950	8	1	8	150	892,500	48,000	384,000	119,000	503,000
	Total	43,475				Total at Tariff Rates			$4,583,015				
										Total at Time Charter Rate			$3,444,800
Pipe	Ochre R.	36,000	1 to 6	6,000	9	6	54	161	5,796,000	48,000	2,592,000	720,000	3,312,000
Pipe	Ochre R.	5,300	7	5,300	9	1	9	161	853,300	48,000	432,000	106,000	538,000
Fuel	Ochre R.	12,540	8 & 9	6,270	9	2	18	98	1,228,920	48,000	864,000		864,000
Camp	Ochre R.	5,840	10	5,840	9	1	9	239	1,395,760	48,000	432,000	116,800	548,800
	Total	59,680				Total at Tariff Rates			$9,273,980				
										Total at Time Charter Rate			$3,744,000
Fuel	Trail River	4,166	1	4,166				89	370,774				
Camp	Trail River	771	1	771	8	1	8	150	115,650	48,000	384,000	15,420	399,420
Equip.	Trail River	1,984	2	1,984				150	297,600			39,680	39,680
Modules	Trail River	2,700	2	2,700	8	1	8	150	405,000	48,000	384,000	54,000	438,000
	Total	9,621				Total at Tariff Rates			$1,189,024				
										Total at Time Charter			$877,100

Deh Cho Region Mackenzie River MGP Stockpile Sites				BARGE					NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER				
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
											Rate		
Fuel	Blackwater	4,166	1	4,166				98	408,268				
Equip.	Blackwater	1,983	1	1,983	9	1	9	239	473,937	48,000	432,000	39,660	471,660
Camp	Blackwater	770	2	770				239	184,030			15,400	15,400
Modules	Blackwater	2,900	2	2,900	9	1	9	239	693,100	48,000	432,000	58,000	432,000
	Total	9,819				Total at Tariff Rates			$1,759,335				
											Total at Time Charter Rate		$919,060
	Total	122,595				Total Region at Tariff Rates			$16,805,354				
										Total Region at Time Charter Rate			$8,984,960

NOTES:

1. These two rate levels are for transportation of the primary construction materials for the MGP to the major stockpile sites – by barge from Hay River.
2. Equipment includes 4,500 hp tugs, and 1,500 and 1,000 Series barges. Up to seven barges can be included in a barge train.
3. A “typical” barge train is made up of a 4,500 hp tug ($30,000 per day); 4 x 1500 series barges ($3,500 per day each); and two 1000 series barges ($2,000 per day each).

TABLE A 24: SAHTU REGION MACKENZIE RIVER MGP STOCKPILE SITES

Sahtu Region Mackenzie River MGP Stockpile Sites					BARGE					NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Pipe	Little Smith Cr.	50,688	1 to 8	6,336	9	8	64	219	11,100,672	48,000	3,072,000	1,013,760	4,085,760
Fuel	Little Smith Cr.	10,571	9 and 10	5,286	9	2	18	109	1,152,239	48,000	864,000		864,000
Equipment	Little Smith Cr.	11,000	11 and 12	5,500	9	2	18	270	2,970,000	48,000	864,000	220,000	1,084,000
Camps	Little Smith Cr.	5,830	13	5,830	9	1	9	270	1,574,100	48,000	432,000	116,600	548,600
	Total	78,089					Total at Tariff Rates		$16,797,011		Total at Time Charter Rate		$6,582,360
Pipe	Norman Wells	44,800	1 to7	6,400	10	7	70	220	9,856,000	48,000	3,360,000	896,000	4,256,000
Pipe	Norman Wells	3,200	8	3,200	10			220	704,000			64,000	64,000
Fuel	Norman Wells	2,413	8	2,413	10	1	10	109	263,017	48,000	480,000		480,000
Fuel	Norman Wells	12,800	9 and 10	6,400	10	2	20	109	1,395,200	48,000	960,000		960,000
Equipment	Norman Wells	1,980	11	1,980	10			300	594,000			39,600	39,600
Camps		3,000	11	3,000	10	1	10	300	900,000	48,000	480,000	60,000	540,000
Camps	Norman Wells	4,020	12	4,020	10	1	10	300	1,206,000	48,000	480,000	80,400	560,400
Camps		2,000	13	2,000	10			300	600,000			40,000	40,000
Modules	Norman Wells	2,453	13	2,453	10	1	10	300	735,900	48,000	480,000	49,060	529,060
	Total	76,666					Total at Tariff Rates		$16,254,117		Total at Time Charter Rate		$7,469,060

Sahtu Region Mackenzie River MGP Stockpile Sites					BARGE					NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Pipe	Fort Good Hope	57,600	1 to 9	6,400	12	9	108	237	13,651,200	48,000	5,184,000	1,152,000	6,336,000
Pipe	Fort Good Hope	1,300	10	1,300	12			237	308,100			26,000	26,000
Fuel	Fort Good Hope	5,100	10	5,100	12	1	12	131	668,100	48,000	576,000		576,000
Fuel	Fort Good Hope	5,614	11	5,614	12			131	735,434				
Equipment	Fort Good Hope	786	11	786	12	1	12	354	278,244	48,000	576,000	15,720	591,720
Equipment	Fort Good Hope	12,000	12 and 13	6,000	12	2	24	354	4,248,000	48,000	1,152,000	240,000	1,392,000
Equipment	Fort Good Hope	2,064	14	2,064	12			354	730,656			41,280	41,280
Camps	Fort Good Hope	4,140	14	4,140	12	1	12	354	1,465,560	48,000	576,000	82,800	658,800
Camps	Fort Good Hope	4,000	15	4,000	12	1	12	354	1,416,000	48,000	576,000	80,000	656,000
	Total	92,604					Total at Tariff Rates		$23,501,294		Total at Time Charter Rate		$10,277,800
Pipe	Little Chicago	44,800	1 to 7	6,400	14	7	98	272	12,185,600	48,000	4,704,000	896,000	5,600,000
Pipe	Little Chicago	1,550	8	1,550	14			272	421,600			31,000	31,000
Fuel	Little Chicago	4,850	8	4,850	14	1	14	175	848,750	48,000	672,000		672,000
Fuel	Little Chicago	6,400	9	6,400	14	1	14	175	1,120,000	48,000	672,000		672,000
Fuel	Little Chicago	3,180	10	3,180	14			175	556,500				
Equipment	Little	2,600	10	2,600	14	1	14	407	1,058,200	48,000	672,000	52,000	724,000

Sahtu Region Mackenzie River MGP Stockpile Sites					BARGE					NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
	Chicago												
Equipment	Little Chicago	1,360	11	1,360	14			407	553,520			27,200	27,200
Camps	Little Chicago	770	11	770	14			407	313,390			15,400	15,400
Modules	Little Chicago	3,450	11	3,450	14	1	14	407	1,404,150	48,000	672,000	69,000	741,000
	Total	68,960					Total at Tariff Rates		$18,461,710		Total at Time Charter Rate		$8,482,600
Total Region (Tons)		316,319				Total Region at Tariff Rates			$75,014,132	Total Region at Time Charter Rate			$32,811,820

TABLE A25: INUVIK/BEAUFORT REGION - MACKENZIE RIVER MGP STOCKPILE SITES

Inuvik/Beaufort Region - Mackenzie River MGP Stockpile Sites				BARGE						NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Pipe (1)	Little Chicago	51,200	1 to 8	6,400	14	8	112	272	13,926,400	48,000	5,376,000	1,024,000	6,400,000
Pipe	Little Chicago	2,560	9	2,560	14			272	696,320			51,200	51,200
Fuel	Little Chicago	3,840	9	3,840	14	1	14	175	672,000	48,000	672,000		672,000
Fuel	Little Chicago	17,950	10 to 12	5,983	14	3	42	175	3,141,250	48,000	2,016,000		2,016,000
Equip.	Little Chicago	6,000	13	6,000	14	1	14	407	2,442,000	48,000	672,000	120,000	792,000
Equip.	Little Chicago	2,290	14	2,290	14			407	932,030			45,800	45,800
Camps	Little	4,000	14	4,000	14	1	14	407	1,628,000	48,000	672,000	80,000	752,000

Inuvik/Beaufort Region - Mackenzie River MGP Stockpile Sites				BARGE						NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
	Chicago												
Camps	Little Chicago	5,645	15	5,645	14	1	14	407	2,297,515	48,000	672,000	112,900	784,900
Camps	Little Chicago	5,645	16	5,645	14	1	14	407	2,297,515	48,000	672,000	112,900	784,900
	Total	99,130					Total at Tariff Rates		$28,033,030		Total at Time Charter Rate		$12,298,800
Pipe	Inuvik	43,780	1 to 7	6,254	15	7	105	272	11,908,160	48,000	5,040,000	875,600	5,915,600
Fuel	Inuvik	19,118	8 to 10	6,373	15	3	45	175	3,345,650	48,000	2,160,000		2,160,000
Equip.	Inuvik	17,270	11 to 13	5,756	15	3	45	407	7,028,890	48,000	2,160,000	345,400	2,505,400
Camps	Inuvik	6,000	14	6,000	15	1	15	407	2,442,000	48,000	720,000	120,000	840,000
Camps	Inuvik	3,470	15	3,470	15			407	1,412,290			69,400	69,400
Modules	Inuvik	2,530	15	2,530	15	1	15	407	1,029,710	48,000	720,000	50,600	770,600
Modules	Inuvik	4,220	16	4,220	15	1	15	407	1,717,540	48,000	720,000	84,400	804,400
Modules	Inuvik	4,220	17	4,220	15	1	15	407	1,717,540	48,000	720,000	84,400	804,400
	Total	100,608					Total at Tariff Rates		$30,601,780	Total at Time Charter Rate			$13,869,800
Pipe	Swimming Pt.	19,200	1 to 3	6,400	16	3	48	300	5,760,000	48,000	2,304,000	384,000	2,688,000
Pipe	Swimming Pt.	1,220	4	1,220	16			300	366,000			24,400	24,400
Fuel	Swimming Pt.	5,180	4	5,180	16	1	16	175	906,500	48,000	768,000		768,000
Fuel	Swimming Pt.	4,070	5	4,070	16	1	16	175	712,250	48,000	768,000		768,000

Inuvik/Beaufort Region - Mackenzie River MGP Stockpile Sites				BARGE						NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Camps	Swimming Pt.	4,160	6	4,160	16	1	16	407	1,693,120	48,000	768,000	83,200	851,200
	Total	33,830					Total at Tariff Rates		$9,437,870		Total at Time Charter Rate		$5,099,600
						Total Region at Tariff Rates			$68,072,680	Total Region at Time Charter Rate			$31,268,200

Note:1. Little Chicago is the stockpile site for construction spreads in both the Sahtu and Beaufort regions.

TABLE A 26: MACKENZIE DELTA ANCHOR PRODUCTION PAD SITES (1) - MGP

Mackenzie Delta Anchor Production Pad Sites (1) – MGP				BARGE						NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
Pipe	Camp Farewell	1,980	1	1,980	17			335	663,300			39,600	39,600
Fuel	Camp Farewell	4,420	1	4,420	17	1	17	220	972,400	48,000	816,000		816,000
Fuel	Camp Farewell	6,520	2	6,520	17	1	17	220	1,434,400	48,000	816,000		816,000
Equip.	Camp Farewell	1,980	3	1,980	17			503	995,940			39,600	39,600
Camps	Camp Farewell	2,430	3	2,430	17			503	1,222,290			48,600	48,600
Modules	Camp Farewell	2,000	3	2,000	17	1	17	503	1,006,000	48,000	816,000	40,000	856,000
Modules	Camp Farewell	1,240	4	1,240	17			503	623,720			24,800	24,800
Rigs Supplies	Camp Farewell	3,608	4	3,608	17	1	17	335	1,208,680	48,000	816,000	72,160	888,160
Rigs Supplies	Camp Farewell	16,500	5 to 7	5,500	17	3	51	335	5,527,500	48,000	2,448,000	330,000	2,778,000
	Total	40,678					Total at Tariff Rates		$13,654,230		Total at Time Charter Rate		$6,306,760
Fuel	Bar C	19,200	1 to 3	6,400	18	3	54	220	4,224,000	48,000	2,592,000		2,592,000
Fuel	Bar C	2,730	4	2,730	18			220	600,600				
Equip.	Bar C	2,070	4	2,070	18			503	1,041,210			41,400	41,400
Camps	Bar C	1,300	4	1,300	18	1	18	503	653,900	48,000	864,000	26,000	890,000
	Bar C	1,130	5	1,130	18			503	568,390			22,600	22,600
Modules	Bar C	5,080	5	5,080	18	1	18	503	2,555,240	48,000	864,000	101,600	965,600
	Bar C	12,700	6 and	6,350	18	2	36	503	6,388,100	48,000	1,728,000	254,000	1,982,000

Mackenzie Delta Anchor Production Pad Sites (1) – MGP				BARGE						NOTE: ALL SHIPMENTS ORIGINATE IN HAY RIVER			
Product	Destination	Volume (Short Tons)	Trip No.	Tons Per Trip (2)	Sailing Time (Days)	No. of Sailings	Total Days	Tariff Rate ($/Ton)	Total Cost (Tariff - $)	Charter Rate/Day ($)	Charter Trip Cost ($)	Load Unload ($10/Ton)	Total Cost Charter - ($)
			7										
Rigs/ Supplies	Bar C	19,350	8 to 10	6,450	18	3	54	335	6,482,250	48,000	2,592,000	387,000	2,979,000
	Total	63,560					Total at Tariff Rates		$22,513,690		Total at Time Charter Rate		$9,472,600
Fuel	Lucas Point	6,400	1	6,400	18	1	18	220	1,408,000	48,000	864,000		864,000
Fuel		440	2	440	18			220	96,800				
Equip.	Lucas Point	2,920	2	2,920	18			503	1,468,760			58,400	58,400
Camps	Lucas Point	2,890	2	2,890	18	1	18	503	1,453,670	48,000	864,000	57,800	921,800
Modules	Lucas Point	10,970	3 and 4	5,485	18	2	36	503	5,517,910	48,000	1,728,000	219,400	1,947,400
Rigs Supplies	Lucas Point	26,620	5 to 9	5,324	18	5	90	335	8,917,700	48,000	4,320,000	532,400	4,852,400
							Total at Tariff Rates		$18,862,840		Total at Time Charter Rate		$8,644,000
						Total Region at Tariff Rates			$55,030,760	Total Region at Time Charter Rate			$24,423,360

Note: 1. Camp Farewell is the stockpile site for Shell's Niglintgak anchor field; Bac C serves IOL'as Taglu field; and Lucas Point serves ConocoPhillips Parsons Lake field.

Table A 27: Mackenzie Highway AWR Impacts on the MGP – Deh Cho Region

	Deh Cho Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load Unload Cost/ Trip ($) (2)	Total Cost Per Trip ($)	Total For Year ($)
Year 1												
Pipe	28,990	Hay River	Camsell Bend	Pipe Dolly	35	518	17.3	263	4,541	700	5,241	4,341,156
Fuel	5,330	Hay River	Camsell Bend	Super B	40	518	14.8	192	2,842	95	2,937	391,302
Equipment				Flat/Lowboy	28							
Camps (5)	5,400	Enterprise	Camsell Bend	Flat Deck	24	475	13.6	175	2,375	480	2,855	642,375
Modules				Special	60 (3)							
									Total Deh Cho Region - Year 1 (4)			5,374,833
Year 2												
Pipe	37,480	Hay River	Ochre River	Pipe Dolly	35	670	22.3	263	5,874	700	6,574	7,039,458
Fuel	11,380	Hay River	Ochre River	Super B	40	670	19.1	192	3,675	95	3,770	1,072,687
Fuel	3,780	Hay River	Blackwater	Super B	40	747	21.3	192	4,098	95	4,193	396,222
Fuel	3,780	Hay River	Trail River	Super B	40	544	15.5	192	2,984	95	3,079	290,987
Equipment	1,800	Enterprise	Blackwater	Flat/Lowboy	28	704	20.1	175	3,520	560	4,080	262,286
Equipment	1,800	Enterprise	Trail River	Flat/Lowboy	28	500	14.3	175	2,500	560	3,060	196,714
Camps	5,300	Enterprise	Ochre River	Flat Deck	24	631	18.0	175	3,155	480	3,635	802,729
Camps	700	Enterprise	Blackwater	Flat Deck	24	704	20.1	175	3,520	480	4,000	116,667
Camps	700	Enterprise	Trail River	Flat Deck	24	500	14.3	175	2,500	480	2,980	86,917
Modules	2,630	Enterprise	Blackwater	Special	60	704	31.3	346	10,826	1200	12,026	527,138
Modules	2,450	Enterprise	Trail River	Special	60	500	22.2	346	7,689	1200	8,889	362,963
Total	111,520								Total Deh Cho Region - Year 2 (4)			11,154,767

	Deh Cho Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load Unload Cost/ Trip ($) (2)	Total Cost Per Trip ($)	Total For Year ($)
									Total Deh Cho Region - Years 1&2			$16,529,600

Notes:

1. Pipe – Assume 60 km.hr; fuel 70 km/hr; equipment, camps, and drilling supplies 70 km/hr; modules 45 km/hr. Speeds impacted by ferries.
2. Allow $10/ton for pipe, equipment, camps, and modules – at each end. Fuel – allow 1.5 hrs @ $63/hr (fixed costs only).
3. 12-ton module load permitted from South to Hay River. Assume load split to 60 tons from Hay River to site.
4. Note this excludes the Deh Cho area stockpile sites that can only be serviced by truck, i.e., McGill Station, Trout River.
5. Camp volumes include miscellaneous supplies, spare parts, and some consumables.

Table A 28: Mackenzie Highway AWR Impacts on the MGP – Sahtu Settlement Region

	Sahtu Settlement Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load/ Unload Cost/Trip ($) (2)	Total Cost Per Trip ($)	Total For Year ($)
Year 1												
Pipe	53,550	Hay River	Ft. Good Hope	Pipe Dolly	35	1,130	37.7	263	9,906	700	10,606	16,227,690
Pipe	46,080	Hay River	Little Smith R	Pipe Dolly	35	811	27.0	263	7,110	700	7,810	10,282,116
Fuel	9,740	Hay River	Ft. Good Hope	Super B	40	1,130	32.3	192	6,199	95	6,294	1,532,554
	9,610	Hay River	Little Smith R	Super B	40	811	23.2	192	4,449	95	4,544	1,091,675
Equipment	13,500	Enterprise	Ft. Good Hope	Flat/ Lowboy	28	1,092	31.2	175	5,460	560	6,020	2,902,500
Equipment	10,000	Enterprise	Little Smith R	Flat/ Lowboy	28	773	22.1	175	3,865	560	4,425	1,580,357
Camps	7,400	Enterprise	Ft. Good Hope	Flat Deck	24	1,092	31.2	175	5,460	480	5,940	1,831,500
Camps	5,200	Enterprise	Little Smith R	Flat Deck	24	773	22.1	175	3,865	480	4,345	941,417
									Total Sahtu Region - Year 1			$36,389,809
Year 2												
Pipe	43,630	Hay River	Norman Wells	Pipe Dolly	35	983	32.8	263	8,618	700	9,318	11,615,095
Pipe	42,140	Hay River	Little Chicago	Pipe Dolly	35	1,250	41.7	263	10,958	700	11,658	14,036,633
Fuel	13,830	Hay River	Norman Wells	Super B	40	983	28.1	192	5,392	95	5,487	1,897,288
Fuel	13,130	Hay River	Little Chicago	Super B	40	1,210	34.6	192	6,638	95	6,733	2,210,013
Equipment	1,800	Enterprise	Norman Wells	Flat/ Lowboy	28	945	27.0	175	4,725	560	5,285	339,750
Equipment	1,800	Enterprise	Little Chicago	Flat/ Lowboy	28	1,218	34.8	175	6,090	560	6,650	427,500
Camps	8,200	Enterprise	Norman Wells	Flat Deck	24	945	27.0	175	4,725	480	5,205	1,778,375
Camps	700	Enterprise	Little Chicago	Flat Deck	24	1,218	34.8	175	6,090	480	6,570	191,625

	Sahtu Settlement Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load/ Unload Cost/Trip ($) (2)	Total Cost Per Trip ($)	Total For Year ($)
Modules	2,230	Enterprise	Norman Wells	Special	60	945	42.0	346	14,532	1200	15,732	584,706
Camps	3,140	Enterprise	Little Chicago	Special	60	1,218	54.1	346	18,730	1200	19,930	1,043,010
									Total Sahtu Region - Year 2			$34,123,997
									Total Sahtu Region - Years 1&2			$70,513,806

TABLE A 29: MACKENZIE HIGHWAY AWR IMPACTS ON THE MGP – BEAUFORT DELTA REGION

	Beaufort Delta Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load Unload Cost/ Trip ($)(2)	Total Cost Per Trip ($)	Total For Year ($)
Year 1												
Pipe	39,800	Hay River	Inuvik	Pipe Dolly	35	1,494	49.8	263	13,097	700	13,797	15,689,615
Pipe	48,810	Hay River	Little Chicago	Pipe Dolly	35	1,210	40.3	263	10,608	700	11,308	15,769,349
Fuel	11,180	Hay River	Inuvik	Super B	40	1,494	42.7	192	8,196	95	8,291	2,317,239
Fuel	19,810	Hay River	Little Chicago	Super B	40	1,210	34.6	192	6,638	95	6,733	3,334,377
Equipment	13,900	Enterprise	Inuvik	Flat/Lowboy	28	1,454	41.5	175	7,270	560	7,830	3,887,036
Equipment	13,900	Enterprise	Little Chicago	Flat/Lowboy	28	1,218	34.8	175	6,090	560	6,650	3,301,250
Camps	6,940	Enterprise	Inuvik	Flat Deck	24	1,454	41.5	175	7,270	480	7,750	2,241,042
Camps	7,540	Enterprise	Little Chicago	Flat Deck	24	1,218	34.8	175	6,090	480	6,570	2,064,075
									Total Beaufort Delta Region - Year 1			$48,603,982
Year 2												
Pipe	18,560	Hay River	Swimming Pt.	Pipe Dolly	35	1,570	52.3	263	13,764	700	14,464	7,669,876
Pipe	1,800	Hay River	Camp Farewell	Pipe Dolly	35	1,650	55.0	263	14,465	700	15,165	779,914
Fuel	9,410	Hay River	Swimming Pt.	Super B	40	1,570	44.9	192	8,613	95	8,708	2,048,456
Fuel	9,950	Hay River	Camp Farewell	Super B	40	1,650	47.1	192	9,051	95	9,146	2,275,174
Fuel	19,940	Hay River	Bar C/Taglu	Super B	40	1,638	46.8	192	8,986	95	9,081	4,526,679
Fuel	16,170	Hay River	Lucas Pt./Tuk	Super B	40	1,575	45.0	192	8,640	95	8,735	3,531,124
Fuel	6,220	Hay River	Inuvik	Super B	40	1,494	42.7	192	8,196	95	8,291	1,289,197
Equipment	1,800	Enterprise	Camp Farewell	Flat/Lowboy	28	1,608	45.9	175	8,040	560	8,600	552,857
Equipment	1,800	Enterprise	Bar C/Taglu	Flat/Lowboy	28	1,596	45.6	175	7,980	560	8,540	549,000
Equipment	2,600	Enterprise	Lucas Pt./Tuk	Flat/Lowboy	28	1,533	43.8	175	7,665	560	8,225	763,750
Equipment	1,800	Enterprise	Inuvik	Flat/Lowboy	28	1,454	41.5	175	7,270	560	7,830	503,357
Camps	3,780	Enterprise	Swimming Pt.	Flat Deck	24	1,528	43.7	175	7,640	480	8,120	1,278,900

	Beaufort Delta Region				Mackenzie River MGP Stockpile Sites							
Product	Volume (Tons)	Origin	Destination	Vehicle Type	Payload (Tons)	Distance (Kms)	Trip Run Time Hrs (1)	Running Cost/Hr.	Total Run Cost ($)	Load Unload Cost/ Trip ($)(2)	Total Cost Per Trip ($)	Total For Year ($)
Camps	2,210	Enterprise	Camp Farewell	Flat Deck	24	1,608	45.9	175	8,040	480	8,520	784,550
Camps	2,210	Enterprise	Bar C/Taglu.	Flat Deck	24	1,596	45.6	175	7,980	480	8,460	779,025
Camps	2,630	Enterprise	Lucas Pt./Tuk.	Flat Deck	24	1,533	43.8	175	7,665	480	8,145	892,556
Camps	1,670	Enterprise	Inuvik	Flat Deck	24	1,454	41.5	175	7,270	480	7,750	539,271
Modules	2,950	Enterprise	Camp Farewell	Special	60	1,608	45.9	175	8,040	1200	9,240	454,300
Modules	4,020	Enterprise	Bar C/Taglu.	Special	60	1,596	45.6	175	7,980	1200	9,180	615,060
Modules	6,490	Enterprise	Lucas Pt./Tuk.	Special	60	1,533	43.8	175	7,665	1200	8,865	958,898
Modules	9,970	Enterprise	Inuvik	Special	60	1,454	41.5	175	7,270	1200	8,470	1,407,432
Drill Rigs	18,280	Enterprise	Camp Farewell	Flat Deck	30	1,608	45.9	175	8,040	600	8,640	5,264,640
Supplies	17,590	Enterprise	Bar C/Taglu.	Flat Deck	30	1,596	45.6	175	7,980	600	8,580	5,030,740
Supplies	24,200	Enterprise	Lucas Pt./Tuk.	Flat Deck	30	1,533	43.8	175	7,665	600	8,265	6,667,100
								Total Beaufort Delta Region - Year 1				$49,161,856
								Total Beaufort Delta Region - Years 1 & 2				$97,765,837

APPENDIX E-TYPICAL MGP PIPE TRAILER

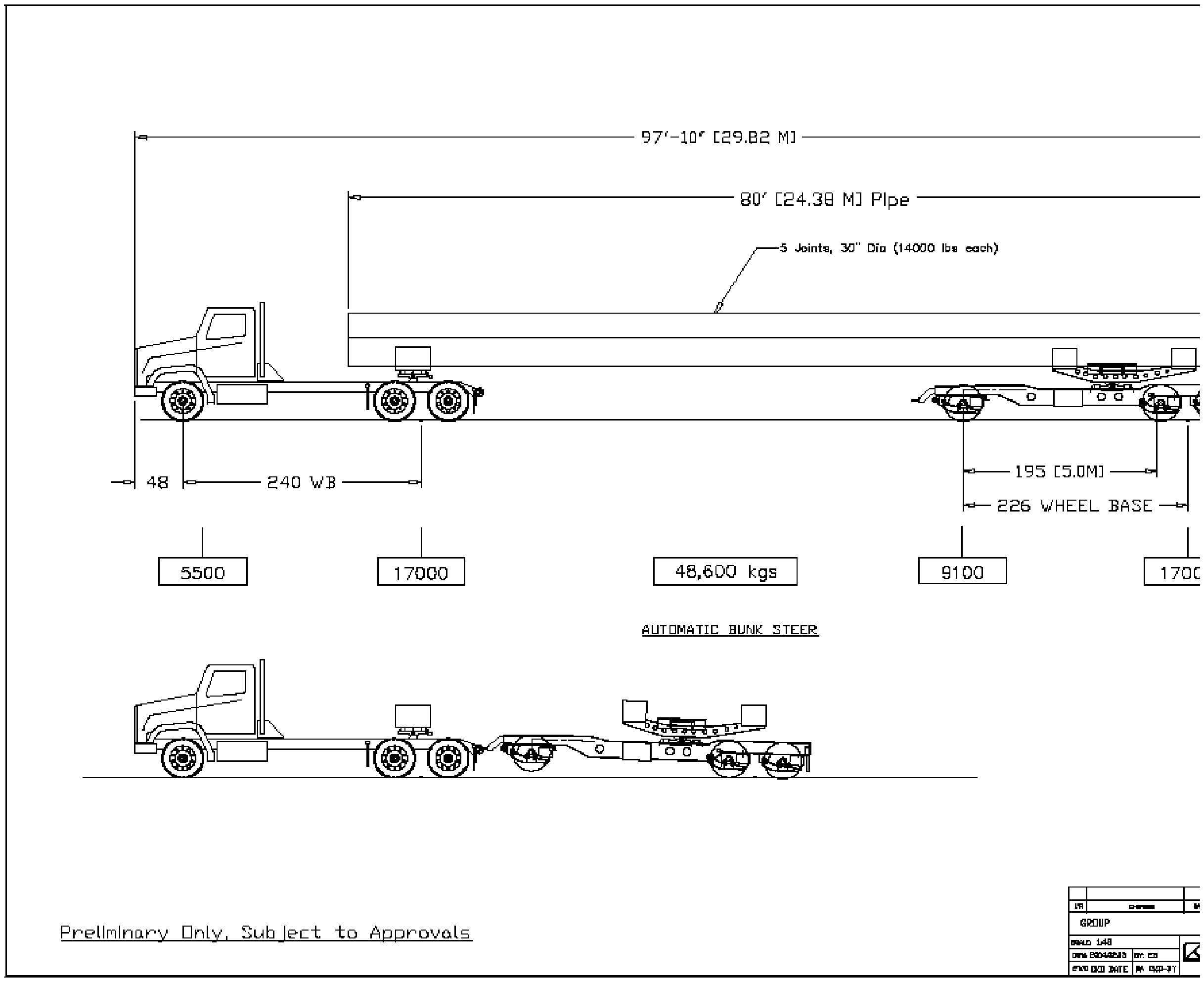

FIGURE 2 - MGP PIPE TRAILER

APPENDIX F-OIL AND GAS INDUSTRY INTERVIEWS

Bob Ball, BP Operations Manager, North American Arctic Exploration, (personal communication, June 16, 2009).

Intuitively, an AWR should reduce the cost of constructing the Mackenzie Gas Pipeline (MGP) and other oil and gas operations in the area. BP has a significant off-shore presence and a limited on-shore presence. The off-shore tracts are currently the focus of BP's exploration activities. The typical exploration cycle begins with seismic work followed by exploration drilling, and concludes with the development and then production of hydrocarbon resources, if found. Based on this cycle, BP would not not expect to undertake any drilling on its new lease until at least 2013, and if hydrocarbon resources of sufficient quantity are discovered, production would occur many years beyond that.

For BP's on-shore leases, an AWR would probably not make that big of an impact except for in logistics and its associated costs. Current constraints include the Fort McPherson and Tsiigehtchic crossings during the shoulder seasons (spring and fall) when neither ferry nor ice-road crossing is possible. The AWR from Inuvik to Tuktoyaktuk would not make much of a difference for our onshore activities, and could actually be a disadvantage depending on the location of the AWR and if the government ice roads were no longer supported.

BP's off-shore is a stand-alone operation in that it requires minimal on-land support other than the provision of consumables and fuel from supply bases. Off-shore work is similar throughout the world, and there is a true and tried method of doing the work that for the most part does not need to rely on AWR access. It would be nice to have a supply base nearby, and a port on the Arctic Ocean linked to a road connected to the North American road system during exploration, but it is not necessary and would not significantly affect the cost of off-shore seismic programs.

BP's seismic program in the Beaufort Sea includes two supply ships and a seismic vessel. The supply ships will obtain their supplies from Tuktoyaktuk, supplies that will have already mobilized to Tuktoyaktuk by barge. Helicopters transport crew changes between the ships and Tuktoyaktuk. A port harbour connected by an AWR would be advantageous, but may not make a big difference in cost to the seismic and exploration drilling work. BP's greatest constraint is the off-shore operational time in that it needs open water between June and September, and the movement of ships/barges through Point Barrow Alaska where the ice breaks up later than the Beaufort Sea area.

If sufficient hydrocarbon resources are discovered (Sic. economic), BP could enter into a field development phase. If oil is found, it could be loaded onto tankers and shipped for refinement. If gas is found, the AWR should reduce operating costs and provide efficiencies for the construction of gas transport infrastructure and eliminate the shoulder season (spring/fall) overland transportation constraint.

BP has not evaluated the impact of an AWR on their operations, but a 15 percent savings from having an AWR seems to be a reasonable estimate.

There is a need for a port connected to an AWR road link for a number of reasons including: i) if BP goes into development and production, it will need a vastly improved connected harbour than currently exists at Tuktoyaktuk to support the level of activity that will occur and the type of vessels that will be frequenting the Beaufort Sea and ii) national sovereignty and security.

Gary Bunio, Vice President Operations & COO MGM Energy Corporation (personal communication, June 16, 2009).

Scheduling is the key driver in an exploration/development program. With that in mind, the key question is how will the AWR affect scheduling (as it will probably not affect project scope)? The AWR will allow rig transfer inside the NWT and allow additional timing flexibility that will not otherwise exist. Currently, MGM's operating window begins on about December 1, and concludes early to mid-April, and requires equipment redundancy to accommodate unforeseen events that might require shipping in equipment at exorbitant cost. Therefore, an AWR will reduce scheduling risk and costs.

For development and production, MGM will undertake summer exploration/production work in the Mackenzie Delta using helicopter supported drill rigs that are built onto piles. This provides MGM at least an additional 2-month operating window keeping in mind this method applies to production wells, not exploration wells.

Currently, logistics costs comprise between 25 percent – 40 percent of exploration and production costs (in the Delta it is between 40 percent – 50 percent of exploration/production cost) with the key factor driving logistics costs being the distance from an exploration/production well and support infrastructure and services. That is why exploration around Norman Wells and Inuvik is less expensive. An AWR will not eliminate or reduce the need to carry redundant equipment during exploration and therefore will not affect exploration costs too much. However, if a company is in its development and production phase, the AWR will reasonably reduce logistics costs by 15 percent.

A constraint in the Mackenzie Delta is the April 10 – June 15 window when break-up makes winter-roads and ice bridges impassable. In the development phase of a gas field, having a shorter overland/winter-road route (spur roads) off an AWR can save a company a few days (shorter winter-roads/ice roads) and reduce redundancy costs. It is important to keep in mind that oil/gas companies will spend money to the point that scheduling risks are eliminated. If too much money is needed, the project won't proceed.

Not having an AWR results in freeze-up and break-up logistics constraints. That is, right after freeze-up, there is an influx of labour, materials, supplies, etc. into communities and drilling areas. Conversely, at the end of a season, there is a rush to relocate equipment, etc. This results in seasonal spikes in demand and associated cost increases for companies and communities. These cyclical spikes in demand not only draw away from needed community resources, but in some instances also increase the community costs for those resources by as much as 25 percent. An AWR will dampen the spikes in demand, reduce demand driven cost increases to communities and oil and gas companies, and allow for a more efficient use of all resources.

The NWT needs to build an AWR north of Wrigley as soon as possible because there is no means of economic transportation other than barging with its inherent limitations and seasonality. In the long-term, an AWR is vital to the social and economic evolution of the NWT.

Lloyd Doyle, COO, Northern Operating Unit, Paramount Resources Ltd. (personal communication, June 16, 2009).

Having access to an all-weather road provides Paramount Resources at least a 15 percent savings on its work in the Cameron Hills area. For example, the winter-road Paramount constructs into the Cameron Hills areas off the existing NWT highway system costs Paramount $500 – $750K to build. If there was no AWR Paramount would have to build a winter-road from possibly High Level at significantly greater cost. By way of another example, when Paramount was undertaking exploration work in the Colville

Lake area, its costs could have been significantly reduced if there had been an AWR. An AWR will also reduce Paramount's carrying charges for equipment it cannot use and enable the equipment to be redeployed elsewhere in the NWT or elsewhere. In short, having an AWR provides significant cost savings annually by i) avoiding lengthy winter-road construction and ii) avoiding the carrying charges for equipment and rigs stranded until freeze-up.

Rod Maier, Manager, Frontier Development, and Doug Connon, Mackenzie Delta Coordinator Chevron Canada Ltd. (personal communication, June 16, 2009).

Chevron Canada operates in the outer reaches of the Mackenzie Delta; and being a delta, there will still be the need for over-river winter-roads and barges to access specific areas for exploration and production purposes. Therefore, there will not be direct AWR access to each drill site/production facility, and year-round logistics via an AWR will still not be available; albeit the length of winter-roads necessary could be reduced. However, given the proposed routing of the AWR from Inuvik to Tuktoyaktuk, the AWR will not profoundly reduce Chevron's logistics costs in the Delta area.

Because of the seasonality of the work in the NWT (being dependent on winter-roads), there are significant seasonal fluctuations on the draw of human and local service resources, particularly during start of the season and end of the work season. The result is increased competition for scarce resources (particularly people and equipment) and inflationary pressures on budgets. An AWR could help spread the work out over a longer period of time where spur roads off an AWR or marine access from the AWR were feasible, thus reducing the cyclical intensity of activity and the associated inflationary pressures. Additionally, an AWR will allow for the mobilization of more equipment from southern contractors, increase competition among contractors, and reduce costs for industry. In short, new hydrocarbon fields could be developed sooner, more efficiently, and with a lower overall cost structure.

An AWR will provide an alternative to using NTCL, and that will increase logistics competition and likely result in lower logistics costs, particularly if Chevron Canada did not have to front-load the cost of its equipment (rigs, etc.) and could simply truck it into place. Having an AWR will also do away with some of the redundancies in resources and equipment currently barged up because it could be trucked in if needed. Furthermore, having the AWR should allow for certain resources and equipment to be permanently available in the region – e.g., Inuvik – resulting in significant mobilization savings, i.e., not having to move it from Alberta to Inuvik every year. Currently, equipment standby charges are fairly high because of having to barge rigs and equipment into the NWT in the summer and not being able to use them until after freeze-up when overland access by winter-road is possible.

Year-round access will also provide for more efficient use of rigs and equipment. That is, Chevron Canada could avoid having to pay stand-by costs for the rigs and equipment when they are not being used, as the equipment could be demobilized to other projects in the North or western Canada. There will still be some restrictions in the Delta, as logistics will still rely on seasonal transportation to/from the Delta to the AWR staging point in Inuvik. The benefit may be more profound farther down the Mackenzie Valley where the geography was more amenable to year-round access using spur roads off an AWR.

The top three areas where savings will result from having an AWR are: i) logistics, ii) construction, and iii) drilling and well-servicing. The AWR will provide industry with greater control of its logistics and planning functions and not be limited by third parties such as NTCL, and local supplier/contractor availability, and standby costs will be dramatically reduced.

From a broader socioeconomic perspective, having an AWR may provide residents of the Mackenzie Valley and the Delta more opportunities to interact and engage with others in the NWT and abroad. This will broaden their understanding and views regarding oil and gas development, and possibly increase their comfort with the oil and gas sector. From a global competitive standpoint, cost structure is overriding, and an AWR could reduce the cost structure of working in the Mackenzie Delta and the Mackenzie Valley. Lowering the cost structure will in turn open up the NWT to a greater number of smaller oil and gas companies, and increase oil and gas activity in the NWT. Fundamentally, it is not just about building a road. It is about supporting a vital sector of the NWT and Canadian economy that can probably run for the next 50 to 60 years. The hydrocarbon potential has been shown to exist; now AWR road access is needed to fulfill that long-term potential.

Confidential Interviewee and Company (personal communication, June 16, 2009).

Rigs: There are different types of rigs, and each type has its own unique logistics and operational requirements. The Arctic Class rigs are capable of handling 2 – 3 lengths of drill pipe at a time and can drill down 2,500 – 5,500m. The design of the Arctic Class rigs makes them optimal for the harsh northern climate and terrain.

The process that ultimately leads to the use of drilling rigs involves the following steps:

i. Obtain access to possible oil and gas through an open bidding process as per *Canada Oil and Gas Operations Act* (COGOA) based on work bid commitments. Highest work bid wins. Only lands that are put up for the bidding process are eligible (that is, not all lands in the NWT are open to hydrocarbon exploration at any one time), and these lands are pre-approved for hydrocarbon exploration and possibly production by the landowners.
ii. The successful firm undertakes seismic work to find/delineate a potential hydrocarbon resource. This takes at least one winter season, as land seismic work is not allowed in the summer in the Delta.
iii. The successful firm (upon finding a hydrocarbon resource) obtains authorizations and negotiates benefits agreements (Government, landowners) to undertake drilling. This can take upwards of one year.
iv. Concurrent to point iii above, the successful firm sources equipment to undertake exploration drilling. If authorizations do not come through in time, the successful firm could end up paying for equipment it cannot use in the field. That is, if the equipment has been barged northward and frozen into place in anticipation of winter drilling activity and authorizations do not come through in time, the successful company still has to pay for rental of the rig.
v. Once authorizations are secured, there is a 30 – 90 day operating window in which to drill and back-haul the rig on a winter-road to the nearest all-weather road.

For example, a typical drilling season will begin in September when a rig is barged and left to freeze in place. Then, as soon as winter-road travel is possible (ranges from mid-December to mid-January), crews are dispatched to set-up the camp and drill rig. This can happen anywhere from mid-December to mid-January depending on environmental conditions. Then, if the rig has to be moved to another drilling location, another winter-road has to be constructed, and the rig dismantled, moved, and reconstructed.

The AWR will make the overall rig deployment process somewhat less planning intensive, but the need for overland winter-road access remains a constraint. Currently in the Inuvialuit Settlement region, only minimal overland winter-road travel is allowed, and in the Sahtu Settlement area, only minimal frozen-water road travel is allowed (such as ice bridges). In places like Fort Liard where there is an AWR nearby and no community objections to constructing all-season access roads off the main highway system, drilling can happen year-round. If a general set of land-use guidelines were prepared that enabled permanent overland access, where possible, the full benefits of the AWR could be achieved. Furthermore, without such guidelines in place, it will not be economically possible to drill enough exploration and production wells to bring the MGP up to 1.8 bcf/day production.

The barging window of operations is from about June 15 to September 15, depending on climatic conditions. It takes between 6 – 8 days to set up a rig and its support infrastructure. Then, depending on the drilling depth (deep in the Inuvialuit Settlement region and certain places in the Sahtu Settlement area) a 3,500m well can take an entire drilling season. Shallower drilling such as in the Colville Lake area can result in up to three wells being drilled per winter operating season before the rig is transported by ice-road to the nearest AWR. In the Inuvialuit case, this is Inuvik.

A 15 percent costs savings associated with having an AWR in place is reasonable because presumably shorter winter-road spurs are necessary.

In summary, the true benefits of building an AWR can only be achieved if all-season spur roads can be built off the AWR, something not currently allowed in the NWT except in the Fort Liard area. And, while there will be logistics/planning cost savings in the order of 15 percent, these cost savings will not be linear because winter-road spurs will still need to be constructed under the current regulatory regime.

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Appendix 6

Mackenzie Valley All-Weather Road, Opportunity Assessment
Meyers, Norris, Penny LLP

MACKENZIE VALLEY ALL-WEATHER ROAD OPPORTUNITY ASSESSMENT

PREPARED FOR BARRIE ROBB, VICE PRESIDENT
MACKENZIE ABORIGINAL CORPORATION

OCTOBER 12, 2007

PREPARED BY MEYERS NORRIS PENNY LLP
SUITE 300, 622 – 5TH AVENUE SW
CALGARY, ALBERTA T2P 0M6

MEYERS NORRIS PENNY LLP

AUTHORS

ROBERT BALDAUF, BA
PRACTICE LEAD, MANAGEMENT CONSULTING
MEYERS NORRIS PENNY LLP
SUITE 300, 622 – 5TH AVENUE SW
CALGARY, ALBERTA T2P 0M6
OFFICE: (403) 537.7604 FAX: (403) 269.1438
EMAIL: ROBERT.BALDAUF@MNP.CA

CLAYTON NORRIS, CAFM, MBA
DIRECTOR, ABORIGINAL SERVICES
MEYERS NORRIS PENNY LLP
SUITE 300, 622 – 5TH AVENUE SW
CALGARY, ALBERTA T2P 0M6
OFFICE: (403) 537.7665 FAX: (403) 269.1438
EMAIL: CLAYTON.NORRIS@MNP.CA

ANDREA MONDOR, MBA
MANAGER, MANAGEMENT CONSULTING
MEYERS NORRIS PENNY LLP
SUITE 400, 10104-103 AVENUE
EDMONTON, ALBERTA T5J 0H8
OFFICE: (780) 453.5375 FAX: (780) 453.5375
EMAIL: ANDREA.MONDOR@MNP.CA

LIZ SCARRATT, BSC
CONSULTANT, MANAGEMENT CONSULTING
MEYERS NORRIS PENNY LLP
SUITE 300, 622 – 5TH AVENUE SW
CALGARY, ALBERTA T2P 0M6
OFFICE: (403) 537.8414 FAX: (403) 269.1438
Email: Liz.Scarratt@MNP.ca

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1. EXECUTIVE SUMMARY

For almost 70 years, there has been discussion among public policy makers, industry representatives, residents of Canada's Northern communities and others about the opportunities presented by construction of an all-weather road in the Arctic, and more specifically in the Mackenzie Valley region. Initially, it was felt that the primary opportunity was the ability to link remote communities in the region. However, interest in establishing an all-weather road in the region has recently resurfaced, to act as a catalyst to support the exploration and production of natural resources, to support other economic development initiatives in the region and to support the assertion of Canadian Arctic Sovereignty.

Meyers Norris Penny (MNP) was engaged to provide an independent assessment of the economic impacts associated with an all-weather road in the region. Information used to prepare the assessment was gathered from oil and gas exploration and production firms currently conducting exploration activities in the Mackenzie Valley. The impact and opportunities relative to these organizations was felt to be a relevant proxy for the potential impact and opportunities for the broader regional and territorial economy.

Our economic impact estimates are based on the fundamental assumption that a distribution system will be present in the region to allow gas resources to be shipped from the region. Our findings support the assertion that the presence of an all-weather road in the region makes further investment in resource exploration and production more attractive, which in turn will improve the viability of the distribution system.

The primary economic impact of all-weather road access to oil and gas exploration and production firms in the region are the substantial reduction of exploration and production cost premiums currently being borne by the industry, and the extension of the drilling season made possible by eliminating the need for the annual construction of a temporary regional access road each winter.

The seasonal extension is the more significant, as it is a permanent outcome. The extension of the drilling season from 90 to 129 days allows for a fundamental and permanent increase in the rate at which the natural resource base may be developed, relative to the current state, thereby allowing for the release of the full economic benefit associated with the development of the resource base over a shorter period of time.

The estimated rate of increase in the release of the economic benefit is approximately 43%, relative to the current situation where an all-weather road is not present in the region. With an all-weather road present, the economic benefit associated with the drilling and subsequent production from 500 wells expected over a 25 year period would accrue in approximately 17.5 years.

The impact of this permanent increase in the rate of release of economic benefit due to the presence of an all-weather road in the region yields a potential additional gain of $3.4 Billion to government at the end of 25 years. This net gain has the present value equivalent of approximately $1 Billion at 5% annual growth.

In addition to this significant increase in the rate at which economic benefit will flow with an all-weather road in place, the following additional economic impacts are also expected:

- An estimated reduction of 15% on the per unit cost of exploration and production well drilling, resulting in an average $2.25M reduction in costs per well drilled. The total estimated cost savings to industry are $1.25 Billion, predicated on the drilling of 500 new wells.
- The permanent extension of the exploration season will allow an additional $70 Million in wages to be released into the regional economy, driven by the ability of industry to drill these 500 wells in the time it previously took to drill 350 and the consequential need for incremental labor hours to do so.

The estimation of impacts and benefits cited are based on currently available cost information and cost structures for exploration wells in the Mackenzie Valley. Although not specifically within the scope of this report, it is anticipated that the presence of an all-weather road in the region would also have positive beneficial impacts on other economic development initiatives and communities in the region.

Commodity prices and worldwide demand for natural resources have increased substantially over the past ten years giving rise to new levels of opportunity to nations and organizations with the ability to supply these resources. With respect to natural resource exploration and development in Northern Canada, the inherent economic cost premiums in time and money for development and exploration activities is a central issue. The presence of an all-weather road in the Mackenzie Valley region would serve to materially reduce these premiums, thereby stimulating investment in the region and generating significant positive financial and other benefits for the region and for Canadians.

2. INTRODUCTION AND BACKGROUND

2.1 CANADA'S NORTHWEST TERRITORIES

More than 1.3 million square kilometers in size and home to approximately 42,000 Canadians[1], the Northwest Territories (NWT) is a vast, remote and sparsely populated region. Largely due to the severity of regional climatic and geophysical conditions and its distance to markets, the NWT's natural resource development potential remains minimally explored and largely untapped. That being said, there are natural resource types that have been significantly assessed and exploited; during the period of 2002 to 2006, an estimated $4.5 billion was invested in mining and oil and gas extraction in the NWT.[2] During approximately the same period, mineral and oil shipments were valued at $10.6 billion, 75% [$8.0 billion] of which were the shipment of diamonds.[3]

NWT's natural gas proven reserves are approximately 313 billion cubic feet, with an estimated 75 trillion cubic feet cited in literature as being ultimately recoverable.[4] Recoverable oil sources are estimated at 12 billion barrels. [5] Significant potential also exists for development of copper, zinc and other mineral extraction.[6]

Appendix C provides an overview of the geographical relationship between these types of resources in the NWT and specifically the Mackenzie Valley region

A number of factors have limited the NWT from further developing these types of natural resources. A key limiting factor has been the high cost of developing the necessary infrastructure needed to economically support exploration and production of gas and oil resources. Driven by the region's remoteness and climatic extremes, the investment required to develop roads, ports, power grids and fuel delivery systems has not had a corresponding return that satisfies the requirements of those entities able to do so.

A second factor that impeded development up to the mid-90's was the Federally mandated moratorium on the issuance of exploration rights for oil and gas from 1977 to 1994, pending the settlement of Aboriginal land claims. This moratorium hindered exploration in the region, serving to limit understanding of the existing geology and to impede the estimation of the extent of region's natural resource potential during that period.

In general, there exist inherent cost inefficiencies in the development of the natural resource base in the NWT. Some are a result of the process by which development is supported and undertaken, with many legislative and regulatory checks and balances built in. Others are a function of the isolated location of the NWT, far from markets and the major population centers and infrastructure of the South. Any initiatives or activities that serve to reduce or mitigate these cost inefficiencies should have a positive impact on the value of the resource in a competitive environment and will therefore serve to stimulate investment and development in the region.

2.2 ACCESS TO THE MACKENZIE VALLEY REGION

Alternatives exist in the Mackenzie Valley Region other than all-weather road access. Firms do obtain access for exploration to varying degrees in the region. That being said, current access to and within the Mackenzie Valley region for the movement of materials and labour typically requires a multi-modal approach. Current modes of transportation in the region include rail, barge, air and truck. The freight weight and size, seasonal availability, urgency of transport, and cost are all factors which influence the selection of transport. Making a decision on which mode of transportation to use requires due consideration of four key factors of access, timing, price and speed, as summarized in Exhibit 2-1 below:

EXHIBIT 2-1: Transport Modes - Considerations

	Access	Timing	Price	Speed
Rail	Limited to terminus at Hay River	Year round- potential intermodal off loading delay	Low	Slow/Medium
Barge	Seasonal to barge landing sites only	Seasonal limitation	Low	Slow
Air (Aircraft, Helicopter)	Year round - fixed wing limited to landing strip	Year round	High	High
Truck	Limited in valley to Wrigley	Limited seasonal access	Medium	Medium/High

As noted above, there is no one "most viable, efficient or effective" transportation mode in the region; combinations of modes are required and these significantly increase the overall cost of transportation for all but the simplest of items.

RAIL

Rail transportation is available via the CN-owned Mackenzie Northern Railway, which has its terminus in Hay River. Mostly carrying fuel stock, goods are off-loaded at the terminus onto barges or trucks for travel to the final destination. Compared to the other modes, rail is relatively inexpensive but this benefit is offset by the very limited penetration of the mode in the region, a slower relative delivery time, terminal congestion and if the material is required beyond Hay River, the timing constraints of the associated barging or trucking mode.

BARGE

The main southern barge terminal is located in Hay River, NWT. Mackenzie River barges operate from Hay River and Fort Simpson. Barging is the most cost-efficient mode of transport, however it is restricted to summer operations from June until October, and it can take 10-14 days for goods to travel up the Mackenzie River.

Adding to the challenge of barging from a timing perspective, a recent report entitled *Northern Transportation Impacts of the Mackenzie Gas Project* concluded "the combination of baseline and project traffic may exceed historical tug and barge fleet capacity of a third of a million tonnes per season and that pending strategic adjustments, the barge system cannot assure completion of all project material movements and still meet baseline community re-supply requirements".

The report also suggested several contingency plans for organizations involved in the region, such as, "reduce barging where all-weather trucking alternatives are available along the Mackenzie Highway to Wrigley and via the Dempster Highway to the Mackenzie Delta."

AIR

Several commercial and charter airlines service the NWT. Fixed wing aircraft service the communities and industry as required, and helicopters are used to transport materials to remote areas lacking sufficient landing areas. Air transport is by far the most expensive mode of transportation, yet for certain types of cargo provides the quickest delivery. However, flights are often delayed due to extreme weather and to date there has not been a mode of air transport effective at delivering the extreme payloads associated with exploration and resource development equipment.

TRUCK

Trucking is often the final delivery mode to the communities and project areas, as goods may be transported by rail or barge and then transferred to truck for final delivery. Direct shipments by truck are available from Alberta to the southern portion of the NWT or the Dempster Highway through the Yukon for the Mackenzie Delta.

EXHIBIT 2-2: Current State of Highway System in Northwest Territories

Currently there is all-weather road access to Wrigley, but access is dependent on ferry crossings. Vehicle access beyond Wrigley is dependent on winter ice roads. The construction of ice roads and winter roads connect communities North of Wrigley from January to March. At present, the communities of Norman Wells, Deline, Tulita, and Fort Good Hope must rely upon a winter ice road to transport goods, equipment and supplies for a very limited time each year. For the remainder of the year, the only access to the area is by air or barge via the Mackenzie River. Further downstream, the communities of Tsiigehtchic and Inuvik can be accessed by an all-weather road, however the Dempster Highway through the Yukon is the most direct route. Aklavik and Tuktoyuktuk are accessed by winter road and air. This climate -dependent infrastructure leads to significantly higher prices for both residents and industry.

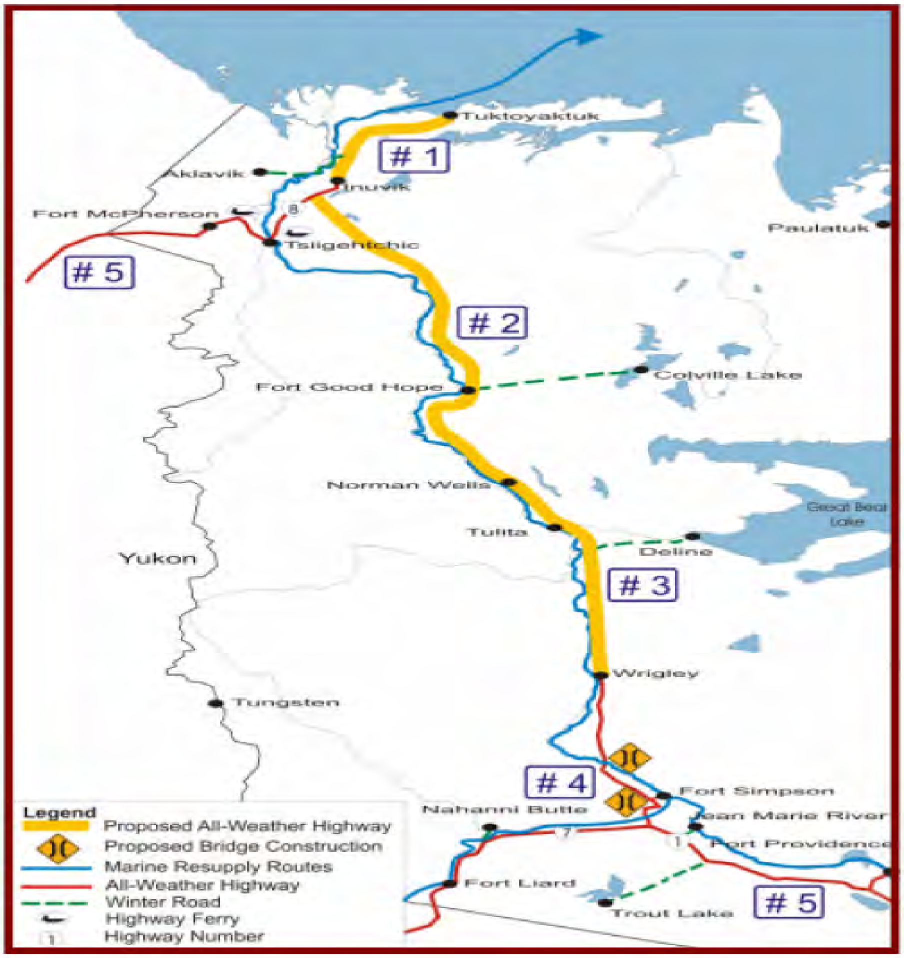
Trucking costs are moderate compared to the other modes and speed for delivery is medium/high depending on weather and road conditions. Timing associated with trucking is actually quite good, but as has been noted, there are distinct periods during the year (spring thaw and fall freeze up) when ground transportation simply cannot pass rivers and streams without fixed bridging, no matter if there is a road available on either side to utilize.

Technological improvements have improved ice road construction techniques and have moderated the influence of climate, however climate change will still have an impact. Over the past forty years, average temperature within the Mackenzie River basin has increased by 1.5 °C, and scientists predict that temperatures within the region will increase by at least 5 °C by the end of this century.[7] This fluctuation in average temperature serves to increase the uncertainty with respect to the length of the drilling season in any given year, contributing to the sustainment of exploration cost premiums in the region.

The interaction between the high resource potential and low infrastructure development is problematic for many companies in the E&P industry. While the NWT was ranked 4th out of 64 locations worldwide surveyed by the Fraser Institute (2004/2005 Survey of Mining Companies) in terms of mineral potential, it was ranked last in terms of quality of infrastructure; 41% of mining companies indicated the quality of infrastructure was a strong deterrent to investment, with 4% indicating they would not pursue exploration due to this factor.

The Mackenzie Valley remains one of the most remote areas in Canada. The region has experienced limited exploration, yet estimates of proven and potential natural resources are significant. Realization of the full potential of the region has been limited due to legislated access constraints, severe environmental conditions and the lack of cost effective methods of transportation. A potential solution proposed to offset the exploration and production cost premiums associated with access and climatic constraints is to construct an all-weather road from Wrigley to Tuktoyuktuk.

EXHIBIT 2-3: Proposed Highway System in the Mackenzie Valley Region, Northwest Territories



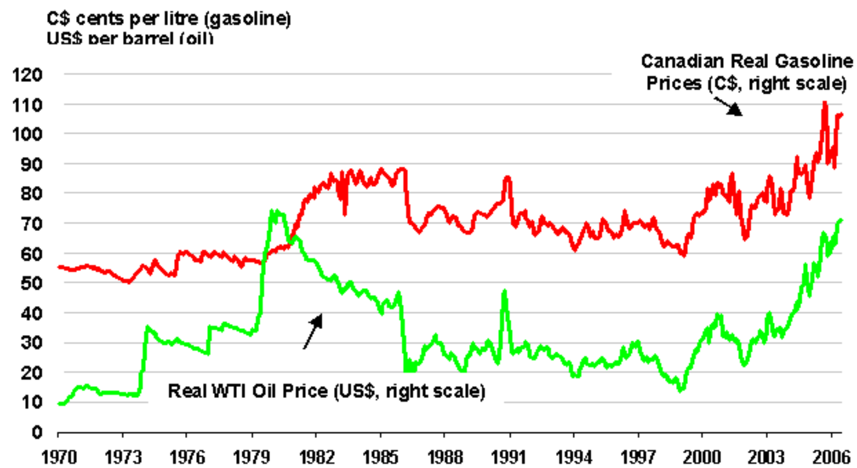
The proposed all-weather road would connect Wrigley to Tuktoyuktuk through the communities of Tulita, Norman Wells, Fort Good Hope and Inuvik. The purpose of the remainder of this report is to:

- Assess the opportunity costs that a of lack of all-season access to the Mackenzie Valley Region has had on regional natural resource development, and to
- Estimate development opportunities which could result from potential access to remote exploration and production sites in the Mackenzie Valley Region.

3. DEVELOPMENT POTENTIAL OF THE MACKENZIE VALLEY

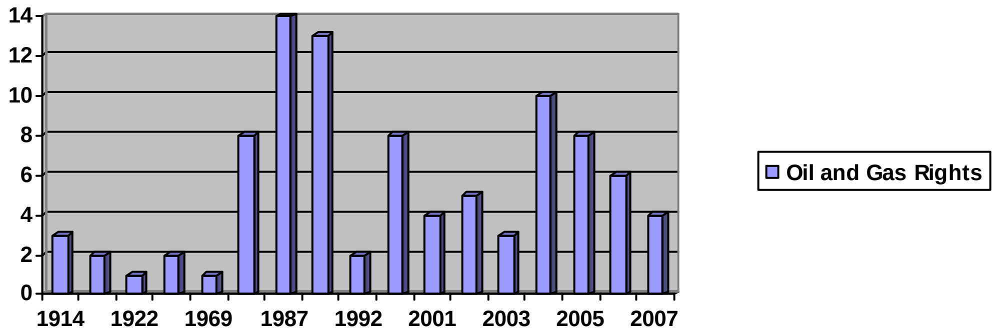
Over the past several years, inflation-adjusted commodity prices and the worldwide demand for energy and mineral resources have significantly increased. The IMF estimates that worldwide demand for oil grew by 1.5% annually from 1993 to 2001 and 2.2% annually for the period of 2002-2005. Prices for oil and gas also rose rapidly in this period (Exhibit 3.1).

EXHIBIT 3-1: Gasoline and Oil Prices (Adjusted for Inflation)[8]



With this twin increase in price and demand, the economics of global oil and gas development changed and enhanced interest in increasing capacity. The rise of gas prices since the late 1990's encouraged the exploration cycle, and stimulated renewed interest in resource exploration throughout the North. The resource-rich fields within the NWT present opportunities for the production of oil and gas in several areas. However, the acquisition of oil and gas rights held within the Mackenzie Valley region has been sporadic, and has decreased during times of regulatory uncertainty (Exhibit 3-2).

EXHIBIT 3-2: Exploration Activity in the Northwest Territories



9

Historical data on rights acquisition depicts upward trends in the period following the announcement, development and pursuit of regulatory approval for the Mackenzie Gas Pipeline. Industry appears to have been preparing for the eventual construction of a pipeline in the Mackenzie Valley. In 2000 when the project was being proposed, exploration activity substantially increased. However uncertainty in the regulatory process and the economic models proposed served to stall any further expansion of exploration activity.

Historical exploration activity within the Northwest Territories, with the pattern of ramping up in expectation of access to market and ramping down upon increasing uncertainty over market access, is depicted in Exhibit 3-3:

EXHIBIT 3-3: Exploration Activity – Number of Wells Drilled, Northwest Territories[10]

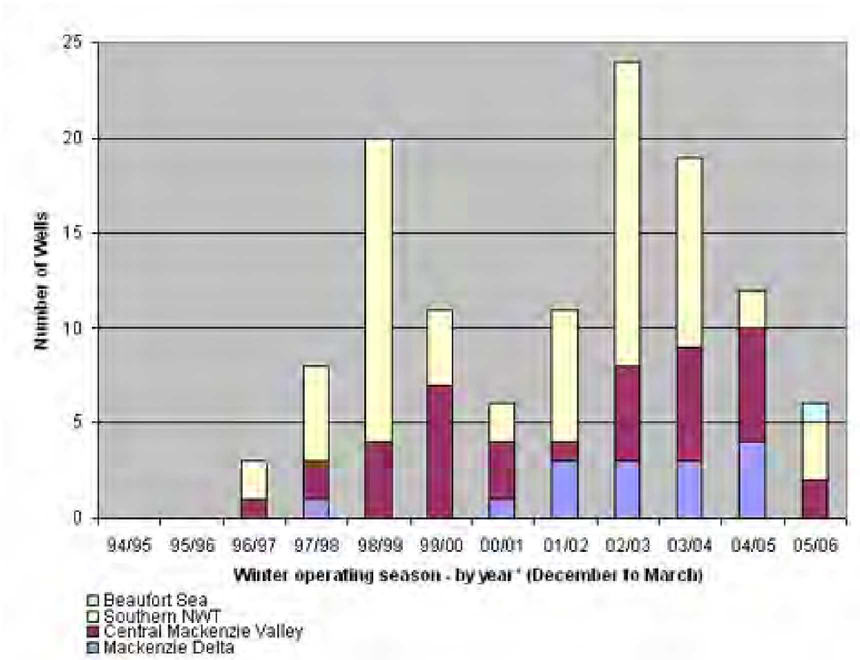


Exhibit 3-4 details the pattern of activity with well completions for the period of 1997 to 2006.

EXHIBIT 3-4: Exploration Activity – Number of Wells Drilled, Northwest Territories

Selected Statistics, Northwest Territories

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Well Completions January - July											
Oil	0	0	0	0	0	3	0	0	0	0	0
Gas	0	2	2	1	2	2	5	2	0	3	0
Dry	2	3	3	8	2	3	3	1	1	0	0
Total Well Completions	2	5	5	9	4	8	8	3	1	3	0
Horizontal Wells Drilled January - July	1	3	0	0	0	0	0	0	0	0	0
Directional Wells Drilled January - July	0	0	3	4	2	0	1	0	0	0	0

Selected Statistics, Northern Canada (Territories)

	1999	2000	2001	2002	2003	2004	2005	2006
Crude Oil and Equivalent Production, Thousand Cubic Meters Per Day	4.2	3.9	3.9	4.0	3.8	3.6	3.2	3.2
Well Licenses	28.0	16.0	12.0	18.0	32.0	15.0	15.0	5.0
Surveys of Active Geophysical Crews In Canada, Average	3.0	4.0	8.0	8.0	2.0	1.0	2.0	1.0
Active Drilling Rigs, Average	3.0	1.0	1.0	1.0	3.0	3.0	2.0	0.0
Service Rig Activity Surveys, Average	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: "Oil & Gas Statistics Quarterly, Second Quarter 2007", Nickle's Energy Group

All the exhibits above illustrate the same pattern; the acquisition of mineral rights or the drilling of exploratory wells for natural resources in the North has been significant to date, but has tailed off over the past several years. Uncertainty over the availability of a production delivery system (i.e., pipeline) may be one reason for this decline in activity; a second relates to the inherent cost inefficiencies of exploration in the region due to limited development infrastructure.

The Mackenzie Valley region contains significant non-renewable resource potential, including oil, gas, copper and zinc. A resource map has been included for reference in Appendix C. An estimate of current resource potential and associated government royalty and tax rates (in $billions) is provided in Exhibit 3-5:

EXHIBIT 3-5: Potential Resources and Revenues, NWT[11]

Commodity	Projected Resources	Gross Revenue	Federal Royalties	Federal Taxes	Northwest Territories Taxes
Existing Projects					
Natural Gas	1 Tcf	$2.70	$0.60	$0.50	$0.20
Oil	0.107 Billion bbls	$3.40	$0.80	$0.30	$0.10
New Projects					
Natural Gas	14.9 Tcf	$33.80	$6.10	$5.40	$2.50
Possible Projects					
Natural Gas	47.4 Tcf	$107.50	$19.40	$17.50	$8.00
Oil	1.65 billion barrels	$39.40	$9.50	$7.60	$3.70
Totals		**$186.80**	**$36.40**	**$31.30**	**$14.50**

A number of natural gas fields have been discovered in the Mackenzie Valley, including fields at Taglu, Parsons Lake, Niglintgak and other locations. While relatively small in total volume to date, further exploration is expected to significantly increase proven resources in the area. Based on the above, it would appear that at least 15 Tcf and up to 60 Tcf of natural gas resources are present for future development in the region.

It would seem that organizations present in the region are now waiting for the delivery infrastructure necessary to convert these investments into a return. However, as will be discussed in Section 4, further exploration and development within the Mackenzie Valley may be limited due to substantial, inherent cost premiums associated with environmental uncertainty and timely and consistent access. Simply put, investment dollars flow to where the return is expected to be greatest, and as will be demonstrated, organizations who are investing in the region have concerns about the region's viability, given these cost inefficiencies.

4. INTERVIEW FINDINGS & OBSERVATIONS

Respondents participating in this study were identified by analyzing the organizations holding oil and gas dispositions in the Central Region of the Mackenzie Valley, as well by identifying other oil and gas and mineral exploration and production firms operating in the Northwest Territories. Appendix A provides an overview of the approach taken to capture and summarize the feedback from respondents. Perspectives among respondents varied regarding the attractiveness of strategic investment as well as immediate to shorter term exploration and development programs in the Mackenzie Valley.

Overall, respondents described exploration investment criteria which are dependent upon a realistic and realizable potential for an exploration well to become a production site. This precedent condition includes the ability to move the product to market. As discussed throughout the interview process, exploration in the Arctic is costly. Several respondents stressed the cyclical nature of exploration investment, noting that investment in exploration is driven by market conditions, and in turn, specific investment decisions are further assessed in view of the likelihood and timing for delivering production from producing wells to the market.

For many respondents representing organizations with multi-national operations, the portfolio of global development potential was noted. For these respondents, prospects in the Mackenzie Valley Region and the NWT represent only a part of their operations. These representatives indicated that all exploration and development projects and strategic investment decisions are carefully weighed against other projects from around the world. Respondent remarks bear out these differences in perspectives and operating mandates. A selection of respondent comments with respect to strategic investment and/or exploration and production in the region includes:

- *"The opportunity is significant: There is one well for every 425 square kilometres in the Northwest Territories. One for every 2.5 square kilometres in Alberta."*
- *"[We are] in Canada because of its lower political risk portfolio."*
- *"[We] are aggressive and optimistic, but really frustrated [by no pipeline certainty]."*
- *"Huge potential in the longer term."*
- *"We've been very aggressive [in this region]."*

While the development prospects in the Mackenzie Valley Region are compelling to many firms, the rising cost of exploring and evaluating those prospects is a concern. A few of the respondents noted that anticipated operating costs in the Mackenzie Valley Region have increased; one respondent estimating the increase to be by factors of 2 and 3 respectively in as many years. Another respondent noted that with many regions in Canada, North America and elsewhere demonstrating similar subsurface potential, it is the costs to be borne for exploration or development that "are everything" in making Canada's Northwest Territories competitive for exploration and development investment. In the opinion of most respondents, anything done to reduce or mitigate the development cost premiums, including the lack of infrastructure in the Mackenzie Valley would improve the attractiveness of the region to ongoing investment.

4.1 HISTORICAL COST OF LIMITED ACCESS

When asked about the potential impacts of the lack of access in the area, a few respondents commented on how the lack of all-weather road access has impacted past undertakings in the region, and in turn, how this retrospective analysis could impact assessment of future exploration programs in the Region.

- *"We will not a approach a project with higher than 25% contingency. This contingency will sometimes necessitate lowering the scope of a project. An all-weather road would lower contingency to 15% … priorities would shift."*
- *"There is a large resource in the North, but no major finds similar in size to original anchor fields . . . could have drilled more, assessed resources more if cost structure was lower."*
- *"Had there been an all-weather road in place, a lot more companies would be up there. It would attract their interest."*

In the Section 5, we have estimated the cost premiums these organizations have paid over the past 10 years, as a function of having limited, seasonal and very expensive access to the Mackenzie Valley region.

4.2 FUTURE COST IMPLICATIONS

With respect to future development prospects, one respondent explained that infrastructure, such as all-weather road access, can "make a big difference" when seeking to compete for a share of a limited pool of international investment funds for exploration and development. This respondent explained that the presence and quality of infrastructure is one of four key decision-criteria for their organization when assessing projects, along with the quality of the prospects, stability of the political regime as well as the reasonableness of the regulatory regime. Given the long-term timelines required to move from prospect to exploration to development to market, one respondent emphasized what a 'big hurdle' it is to achieve development and production of an asset:

- *"You have to put out a lot of money to get it out of the ground."*

For several respondents, where the all-weather road infrastructure could make a difference for the Northwest Territories is in demonstrating a greater likelihood that the region is 'development ready'.

- *"Once infrastructure is there, more looking will start and it will become more attractive to do work up there. . . Just the hope [of better access] makes things more interesting. It could give you an edge and increase your chance of more money being spent."*

Respondents identified where an all-weather road could directly affect areas of their operations, encourage further activity in the Mackenzie Valley, or alternatively, ease efforts currently underway. For respondents who believed all-weather road access could impact their firm's exploration and development priorities or programs, their comments concentrated on three primary impacts:

- **Reduction of exploration expenditures**: All-weather road access could contribute to lower expenditures on exploration programs.
- **Reduction of production expenditures**: All-weather road access could contribute to lower expenditures associates with the operation of production programs.
- **Extension of the drilling season**: All-weather road access could support a longer season with associated increases in, and extension of employment opportunities.

REDUCTION OF EXPLORATION EXPENDITURES

A consistent theme raised by respondents was the perceived positive impact all-weather road access would have on the cost of exploration. The scale of material and labour transport for exploration activities is significant, and the ability to mobilize these materials in a remote area such as the Mackenzie Valley is complex, time-consuming and expensive. A selection of respondent comments includes:

- *"An all-weather road would lessen the pressure surrounding the transportation of materials"*
- *"Could plan our work better with an all-weather road"*
- *"An all-weather road would lead to a new planning process … [would be] better for companies and contractors"*

For many respondents, the prospect of an all-weather road not only presented the opportunity to reduce cost structures for exploration and to strategically reconsider the exploration and development prospects within the Northwest Territories. A selection of respondent comments includes:

- *"The lack of an all-weather road affects the cost of doing business."*

- *"An all-weather road would have a huge impact on an exploration basis."*
- *"A developed all-weather road would reduce our dependencies on river barges and also provide opportunities for summer exploration in certain areas. This would be of significant economic benefit to northern citizens and contractors as well."*
- *"If there were an all-weather road, we could cut down on costs for flying in fuel, drills and other supplies . . . Any way we could cut down on expenditures would make a huge difference."*

The relative impact of reducing exploration costs would be felt differently by each organization. Each pursues opportunity with unique strategic and operational objectives, with holdings in geographically unique locations which present different exploration requirements. The proposed route east of the Mackenzie River may present more significant cost saving advantages to those with assets nearby. For those west of the Mackenzie River, the savings may be more moderate. However, the need for the construction of primary ice roads and ice bridges to transport people and equipment to well locations could be eliminated or reduced with improved access to the region. For others, the costs would be more moderately reduced. A selection of respondent comments includes:

- *"An all-weather road would help, but not everything."*
- *"Not having all-weather road access doesn't discourage us. Having a road would, however enhance our ability to carry out exploration and cut down our costs."*
- *"The element of an [all-weather] road would be an enabler. It would reduce the cost of doing business, but would not be the determining factor [in investment]."*
- *"An all-weather road would reduce overall cost structure. Could use the [savings] to drill elsewhere . . .Construction and access costs are very high [in the North]. An all-weather road would lower them."*
- *"With a road up there, the economics would change."*

Exploration costs undertaken in the Mackenzie Valley by respondent firms have been as high as $150 million, and in making these investments, they have gained a keen understanding of the economics of the activity and the associated cost premiums and risks. Due to the highly competitive nature of the exploration and production industry many companies were not prepared to share detailed costs of their historical expenses. However, most respondents were able and prepared to provide some high level assumptions on the effects of an AWR. For example, logistics costs, including winter/ice construction and drilling, represented between 20% to 70% of respondents' exploration costs. The estimated impact of an all-season road on these expenditures ranged from a marginal reduction to up to a 30% reduction in costs.

We have aggregated the responses and a summary of their estimates of their exploration cost structures is provided in Exhibit 4-1.

EXHIBIT 4-1: Respondents' Estimates of All-weather Road Access on Exploration Cost Structures

Cost components	Estimated exploration costs per project in the Mackenzie Valley	Estimated total investment to date in Northwest Territories	Perceived impact of an all-weather road
Engineering and Planning	6%-30% of exploration costs	respondants not willing/unable to provide	Reduce by up to 50%
Seismic Program	respondants not willing to provide	$8-100 Million dollars	Reduce by 33%
Logistics	25%-70% of exploration costs (38% average)	respondants not willing/unable to provide	Reduce marginally to 33%
Winter ice road construction	up to $10 Million dollars annually	over $30 Million dollars	Reduce by 15%
Drilling	$15-20 Million per well	over $150 Million dollars	Reduce by 20-50%
Labour	respondants not willing/unable to provide	respondants not willing/unable to provide	Reduce by up to 50%
Occupational Health and Safety	respondants not willing/unable to provide	respondants not willing/unable to provide	Reduce by 50%
Insurance	respondants not willing/unable to provide	respondants not willing/unable to provide	Reduce incrementally
Total cost of exploration	respondants not willing/unable to provide	$3.5- 150 Million dollars	Reduce by 10-30%

Note: The entries contained in the table are collected from all firms and represent the range of individual firm estimates of costs and potential savings

In Section 5, we have used this information to estimate the exploration cost savings these organizations might realize, as a function of having all-weather road access to the Mackenzie Valley region.

REDUCTION OF PRODUCTION EXPENDITURES

The focus of this project was on the benefits of an AWR on the exploration programs for industry. Based on the similarities of location, equipment used and operations, it can be assumed that there will be similar economic savings associated with the future development, production, operation and maintenance phases of resource development. As the resource fields are defined by initial exploratory drilling there will be a significant increase in the amount of wells required to maintain the volume of gas. This recovery stage often requires a number of infill wells that will improve production from the same pool which allows the oil or gas to travel a shorter distance to reach a wellbore. Our assumptions are that the subsequent phases of the drilling programs will receive the same cost benefit as earlier phases of development. One of our interview respondents noted,

- *"An all-weather road would dramatically lower development costs."*

As there is limited historical data in the region to estimate the cost savings during the development, production and abandonment phases we have conservatively estimated the benefits will remain constant and consistent with those anticipated during the exploration phase.

EXTENSION OF THE DRILLING SEASON

The most commonly cited impact that could be derived from all-weather road access to the Mackenzie Valley region is the extension of the drilling season. With all-weather road access and less reliance on winter and ice-road construction, drilling can occur earlier in the season and may extend further given that access is not fully dependent on ice road conditions as the weather warms.

Primary ice-road construction generally begins in the Mackenzie Valley on or around December 15, which facilitates the transport of materials beginning January 1. Appendix D illustrates the historical timing of ice road openings in the Mackenzie Valley region. Respondents' estimation of the length of the drilling season extension varied from four to eight weeks, depending on their location within the region and the distance of their holdings from any proposed all-weather roadway. Respondents noted that an all-weather road would allow the transport of many materials to the region whenever required, but that they would still have to bear the cost premiums associated with building ice bridges and spur lines to their holdings. Nevertheless, it was clearly indicated that substantial cost savings would come from having all-weather road access to the region itself.

A selection of respondent comments with respect to the longer drilling season includes:

- *"An all-weather road would save 4 to 6 weeks of winter road construction … and add about two months to the working season."*
- *"The whole season would change dramatically."*

- *"An all-weather road would extend work by 30 to 60 days, making more things [i.e., exploration] more economical."*
- *"An all-weather road would easily lead to a month, almost two months extra work."*
- *"Currently, our biggest risk is driven by the short seasonal window in the winter time. We have not quantified the costs to our organization but development of the road would greatly reduce our risks by providing more options to demobilize in the spring. A developed road would give us the option to take a rig out after April 1 if required rather than being trapped over the summer and autumn seasons."*
- *"An all-weather road [would allow us] to start the drilling season earlier … for an additional 60 to 90 days of drilling."*

In addition, a longer season could require less "over-designing", engineering for redundancy or for managing risk. One respondent noted that the longer season provided by an all-weather road might allow their company to use more expensive, more efficient equipment due to the improved access to the region and lower risk of stranding the equipment through the winter months. With all-weather, year-round access, significant advantages were also seen for several organization's safety and emergency response provisions.

In summary, the majority of respondents agreed that all-weather road access to the region would substantially reduce the cost premium associated with reliable and consistent access. They also noted that there are two primary precedent conditions impacting their interest and willingness to further exploration and production in the Mackenzie Valley.

The first condition relates to the cost premiums associated with operating in the North, relative to other national and international locations. Weather, seasonal and environmental issues place enormous operating constraints, and subsequent cost premiums on exploration companies. These constraints include but are not limited to:

- Equipment design, engineering and manufacturing specifically for the conditions of the North,
- Availability of equipment due to limited transportation facilities and capabilities,
- Delivery of equipment and manpower to the exploration site due to limited capabilities, and
- Shortened exploration season due to accessibility.

The second condition is the undetermined timeframe related to the development and construction of production delivery infrastructure such as the Mackenzie Valley Pipeline. For many respondents, all-weather road access improves the scenario for exploration programs, however does not address the need to move product to market and their subsequent ability to transform investment into return.

- *"An all-weather road is more important for exploration in the North now than will be in 10 years, because there will be a number of facilities up and running. There will be less motivation to build the road post-pipeline."*

Our assumption in estimating the potential future cost savings to oil and gas organizations operating in the Mackenzie Valley region with an all-weather road present is that the issue of a lack of delivery infrastructure has been resolved, thereby providing the stimulus necessary for these organizations to renew their exploration activities AND to transform their exploratory holdings into production holdings.

5. ESTIMATING FINANCIAL IMPACTS & BENEFITS

Based on the findings received from our respondents and on our observations developed after reviewing secondary research undertaken during the project, the project team has estimated the financial impacts that a lack of all-weather road access has had on the Mackenzie Valley Region up to this time, and to estimate the financial impacts of same on future exploration and production.

This estimate is based on the hypothesis that organizations exploring in the Mackenzie Valley region have paid a cost premium to date that can be attributed to the lack of an all-weather road and that in the future these same cost premiums will be present. In addition, the lack of an all-weather road has resulted in a less than optimal drilling season in the region and there have been, and will continue to be employment opportunities lost as a result. Finally, the lack of an all-weather road will retard the rate of future development in the region, thereby sub-optimizing the rate at which investments made in the region will generate a return to both private and public entities.

5.1 EXPLORATION WELL DRILLING COST PREMIUM

In general, the majority of costs of an exploration program are accounted for by the drilling of exploratory wells. A number of factors characterize and impact well costs:

- When particularly difficult weather or other extreme or adverse environmental conditions are present, costs are significantly higher. Waiting for the safe construction of, and travelling on an ice road can be considered adverse conditions.

- The hire of the drilling rig alone can represent between 20% and 35% of the total drilling costs. The daily cost depends on the size of rig, which in turn depends on the depth of the well. Costs will of course also depend on the current availability of drilling rigs on the market. Rigs used in the North must be particulalry robust, to withstand the extreme environmental and operating conditions.
- The cost of hiring a rig in the NWT varies between $20,000 and $30,000 per day for onshore equipment. Costs of mobilizing and demobilizing the dripping equipment can vary between $500,000 and $1,500,000. These costs therefore weigh heavily in the case of drilling program of short duration. Actual costs will be dependant on the initial location of the drilling rig, the other equipment and materials required and the final destination of the exploration lease.
- The main well cost driver is days-to-complete. Drilling duration is difficult to predict due to geological uncertainties regarding the properties of the rock, the interstitial pressures of the formation fluids, the depths, etc. Difficulties and unanticipated setbacks such as mud loss, jamming of the drill bit, etc. can cause delays of several days. In the Northwest Territories, these delays can be compounded by the delay for transporting needed parts or equipment that was not part of the initial mobilization.

On average, respondents estimated that the presence of an all-weather road in the region could result in a reduction of the current cost premium of up to 15 - 20% per unit well for a given exploration program. Unfortunately, none of companies interviewed had specifically estimated costs or potential cost premium reductions assuming the presence of all-weather road access to the region.

Using an estimated total per unit well cost reduction of 15%, the allocation of this cost reduction by activity was done on the basis of five categories of costs, with estimated cost premium reductions by category as noted:

- **Petroleum Services** – Includes mud, cement, casing, tubing, drilling supervision, insurance, equipment rental, mud logging etc. On average this represent 35% of the total cost of a unit well drilled. We estimate that with all-weather road access, there will be a nominal reduction in cost premiums related to improved ease of transportation of materials and labour - 1-2% overal cost saving per well assumed. (See Exhibit 5.1)

- **Consumables** — includes wellhead, piping, drilling bits, mud and cement products, accessories, energy, and water, etc. on average representing 30% of the cost of a unit well drilled. We estimate that with all-weather road access, there will be a minimal reduction in cost premiums related to improved ease of transportation of these materials - 1% overal cost saving per well assumed. (See Exhibit 5.1)

- **Logistics** -- Includes non-rig trucking, share of ice road construction, aircraft services, civil engineering, planning, etc. On average, logistics represent 15% of the cost of a unit well drilled, however, these costs fluctuate substantially in the NWT due to site location. This is the main area where we estimate reductions in cost premiums – we estimate 6% overall cost saving per well. (See Exhibit 5.1)

- **Management and Supervision** — Includes studies and project management, preparation of site, and supervisory arrangements, geology and reservoir monitoring, etc. On average, management and supervision represent approximately 5% of the cost of a unit well drilled. We estimate there will be a nominal reduction in cost premiums related to improved ease of transportation of labour - 1% overal cost saving per well assumed. (See Exhibit 5.1)

- **Hiring of Drilling Rig** - Includes hiring of drilling rigs and crews, drilling contract fees and administration, mobilization and demobilization.etc. Rig costs are estimated to represent 15% of the cost of a unit well drilled. Rig moves, standby charges are costly and highly dependent on the type and quality of driving surface - we estimate 5% overall cost savings per well in this category. (See Exhibit 5.1)

Based on respondent feedback and an analysis of the drilling program costs incurred over the past 10 years, we have assumed an average cost to drill an exploration well in the Mackenzie Valley of $15M. This baseline cost represents the midpoint of our respondent's estimates of their typical well costs and other industry averages and estimates. Given these assumptions and key inputs, it is estimated that the cost premium paid on exploration wells in the Mackenzie Valley, due to the lack of all-weather road access to the region has been in the order of $2.25M per well drilled (Exhibit 5-1):

EXHIBIT 5-1: Cost Savings from All-weather Road – Exploration Well Drilling (15% Savings)

	Average Current Cost/well		Cost/well with AWR	
Drilling Component	**% of Drilling cost**	**Cost**	**% of Drilling Cost**	**Cost**
Petroleum Services	35%	5,250,000.00	39%	4,950,000.00
Consumables	30%	4,500,000.00	34%	4,350,000.00
Logistics	15%	2,250,000.00	11%	1,350,000.00
Management and Supervision	5%	750,000.00	5%	600,000.00
Hire of drilling rig	15%	2,250,000.00	12%	1,500,000.00
Total	**100%**	**15,000,000.00**	**100%**	**12,750,000.00**

5.2 PRODUCTION WELL DRILLING COST PREMIUM

In general, the process and categories of costs associated with drilling a production well are consistent with drilling and exploration well. That being said, given that exploration wells are typically much further apart (in essence, they establish the "edges" of the production area) than production wells and that there are some economies of scale when transporting petroleum service products and consumables to a holding that is "in production", it can be presumed that the cost premium per well for a production well may be somewhat less than that of an exploration well. However, many E&P companies are implementing an exploration and production "factory approach" which may increase efficiencies further. As production of resources in the Mackenzie Valley has not yet started no historical information exists to assess the impact of an AWR on the ongoing operation, maintenance and decommissioning of the wells in the region. Our assumption relative to production wells is that the cost premium due to the lack of all-weather road access remains at 15% per well drilled.

5.3 FORECAST WELL REQUIREMENTS

Estimates of the number of exploration and production wells required in the Mackenzie Valley to achieve certain specific production levels vary quite dramatically, as noted in Exhibit 5-2 below.

EXHIBIT 5-2: Estimated Exploration and Production Levels (Mackenzie Gas Pipeline, Joint Review Panel)[12]

Quantitative Summary of Scenarios 2009 – 2053/59

	0.8 BCFD	1.2 BCFD	1.8 BCFD	*1.8 BCFD (MGP)*	2.5-3.0 BCFD	4.0 BCFD
Total Sales Gas (BCF)	12,812.9 (Calculated)	16,694.9 (GLJ)	22,810.0 (Sproule)	***16,803.1 (GLJ)***	35,579.0 (Sproule)	67,984.1 (Sproule)
Number of Discovered Fields	44 (Sproule)	44 (Sproule)	44 (Sproule)	***31 (GLJ)***	44 (Sproule)	44 (Sproule)
Expected Number of New Producing Fields	51	111	192	***51***	348	1,060
Expected Number of Exploration Wells Required to Find Resource	373	811	1,198	***308***	2,177	6,854
Total Linear Km of New Seismic	93,088	201,472	348,630	***Approx. 25,094***	633,884	1,278,273
Total Linear Km of New Winter Road	3,187	4,421	5,147	***n/a***	6,727	23,962
Total Linear Km of New Pipelines	1,926	2,620	3,656	***2,590***	4,647	12,843

In order to estimate the overall number of wells required, we reviewed the estimates of activity submitted to the Joint Review Panel for the Mackenzie Gas Pipeline and took the average of the estimated wells required for 0.8 BCFD and 1.2 BCFD, including the MGP's estimate. Consequently, for the purposes of our analysis, we have assumed that 500 new wells will be required, and that these 500 wells will be drilled as soon as practical to do so.

5.4 EMPLOYMENT IMPACTS

Specific estimates of incremental job creation or employment extension associated with an all-weather road were not provided by respondents, although several comments were made related to this theme (See Section 4). Our approach to estimating employment impact associated with the presence of an all-weather road in the region was to determine the labor component of a unit well drilled, multiply this by an estimate of the extension of the drilling season and further multiply this value by the incremental number of estimated future wells drilled in the region. With all-weather road access, the drilling season is estimated to be extended from an average of 90 days to 129 days, an increase of 39 days or 43% (Exhibit 5-3):

EXHIBIT 5-3: Estimated Impact to the Duration of the Drilling Season

Average Schedule: Current Drilling Season*	November	December	January	February	March	April
	Possible Ice Road Construction	Ice Road Construction	31 days	28 days	31 days	n/a
Average Days of Vehicle Access	90					
*Data based on historical averages contained in Appendix						
Potential Drilling Season with All-weather Road**	November 24-Decmber 7	December	January	February	March	April
	Ice road consturction on spur lines	24 days	31 days	28 days	31 days	15 days
Average Days of Vehicle Access	129					
** Assumptions based on interview report estimates, and are dependent upon the distance of resources from the AWR						

Over the current 90 day drilling season and assuming 40 days per well drilled, 1 rig can drill 2.25 wells. During this period, the average number of labor hours required is estimated at 27,000, assuming a 25 man crew and a steady state operation. This approximate $1M in labor cost represents approximately 7% of the drilling cost per well. With a seasonal extension of 43% possible due to all-weather road access into the region, 1 rig would now be capable of drilling 3.2 wells, the estimated labor hours required is 38,700 and the associated labor cost is approx. $1.45M.

The extension of the drilling season by 43% allows for 500 wells to be drilled in a period where only 350 could have previously been drilled (assuming the productivity per drill rig remains constant), an incremental increase of 150 wells over the same time period. Extrapolating these labor hours and cost figures over these 150 incremental wells drilled suggests that the availability of an all-weather road in the region could result in the release of $70.2M in incremental compensation over the drilling period, or the equivalent of approximately 1000 new or extended jobs.

The employment impact estimates are limited solely to oil and gas exploration firms and the unit well drilled concept. Drilling rig operations are assumed to be 2 shift, 24-hour operations. No adjustments are made for downtime. It can be presumed that drilling season extension due to the presence of all-weather road access in the region may well have other indirect employment benefits.

In summary, we have estimated the past and future financial impact of an all-weather road in the region as per Exhibit 5-4 below:

EXHIBIT 5-4: Estimating Financial Impact

$$\overbrace{(A \text{ x } B)}^{\text{Cost Premium Paid: Historical Exploration}} + \overbrace{(C \text{ x } D)}^{\text{Cost Premium to Pay: Future Exploration \& Production}} + \overbrace{(E \text{ x } F)}^{\text{Cost Premium to Pay: Future Production}} + \overbrace{(G \text{ x } H \text{ x } J)}^{\text{Incremental Labor \$ Released: Future Exploration \& Production}} + K = \$X$$

A = Cost premium per well drilled in region last 10 years – no AWR in place
B = # of exploration wells drilled in period
C = Cost premium per well drilled in region next 20 years – no AWR in place
D = # of exploration and production wells drilled in period
E = O&M cost premium per production well in region next 20 years – no AWR in place
F = # of production wells drilled in period
G = incremental labor hours available per rig due to extension of season
H = average labor cost per hour
J = incremental # of wells that can be drilled due to extension of season – AWR in place
K = Time value of future production taxes and royalties

Working through the equations we estimate the benefit to be approximately:

$$\boxed{\textbf{(\$2.25M x 48) + (\$2.25M x 500) + (E x 500) + (11,700 x \$40 x 150) + K = \$1.3B}}$$

The value of the cost premium associated with operations and maintenance (O&M) on production wells (E x 500) has not been included in the overall savings calculation. However, it is a valid component of the overall cost savings and can be assumed to be a positive increment to the estimate cost savings.

A significant incremental benefit associated with the presence of an all-weather road in the Mackenzie Valley region would be the release of (K) direct government revenues (production royalties, taxes, etc.) at a rate faster than could be anticipated without this access. This faster rate of release can be attributed to (a) the extension of the drilling season and the associated number of additional production wells that could be completed in a given period of time and (b) to the fact that the reduction in the cost premium per well drilled would act to stimulate further exploration and resource production at a rate faster than if the cost premium stayed constant.

These direct government revenues were also estimated (see Appendix E for details). Exhibit 5.5 illustrates the impact of this increased rate or release of direct government revenues:

EXHIBIT 5-5: Estimated Annual Accumulation of Direct Government Revenue

Annual Accumulation of Direct Government Revenues ($millions)

		(FV of $588/y in year_)			(FV of $400/y in year_)
AWR*	Year 1	588	**No AWR***	Year 1	400
	Year 5	3250		Year 5	2210
	Year 10	7399		Year 10	5031
	Year 15	12693		Year 15	8631
	Year 17	15200		Year 17	10336
	Year 20	17596		Year 20	13226
	Year 25	22458		Year 25	19091

Year 25- AWR	22458
Year 25- No AWR	19091
Difference in future value of direct government revenues	**3367**
Present Value @5%	**994**

*Assumptions

Direct government revenues estimated of 10 Billion over 25 years
Assumes straight line revenues
Renvested yearly at 5%

The estimated rate of increase in the release of the economic benefit is approximately 43%, relative to the current situation where an all-weather road is not present in the region. With an all-weather road present, the economic benefit associated with the drilling and subsequent production from 500 wells expected over a 25 year period would accrue in approximately 17.5 years.

The impact of this permanent increase in the rate of release of economic benefit due to the presence of an all-weather road in the region yields a potential additional gain of $3.4 Billion to government at the end of 25 years. This net gain has the present value equivalent of approximately $1 Billion at 5% annual growth.

5.5 OTHER INCREMENTAL BENEFITS

Many of our respondents commented that the uncertainty risk related to mobility of equipment as a significant built-in cost premium for conducting work in the region. This was due to the high stand-by cost, rental cost and capital expense for many pieces of equipment that are used such as seismic equipment and drilling rigs. Maximum utilization of this equipment is imperative as they are expensive to acquire and to lease. An all-weather road and the associated 365 day access through the region was noted as a key mitigator of this risk, allowing for greater equipment mobility and a decreased chance of having equipment over the summer months.

Finally, it is recognized that enhanced access would create a host of both direct and indirect benefits to the region, including decreased prices for material goods; lower transportation costs for local residents and substantial other socio-economic benefits resulting from better integration and mobility of people and goods to other parts of Canada and the rest of the world.

5.6 BRITISH COLUMBIA'S SIERRA-YOYO-DESAN ROAD

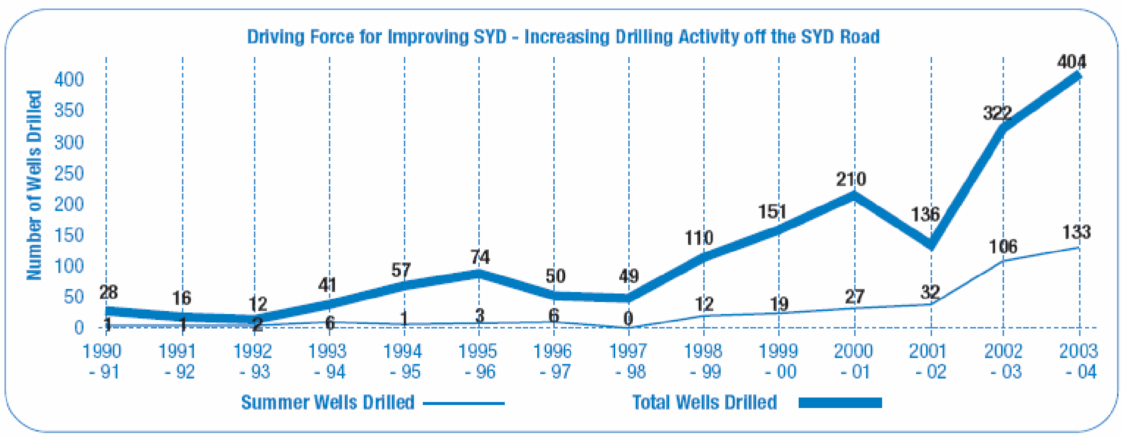
The establishment of an all-weather road in the Mackenzie Valley region is required in order to meaningfully reduce the cost premium being paid by organizations involved in the development of the natural resource base of the region. As has been estimated, over $1.3B in cost savings could be released over the next 20 years as the industry installs the necessary production infrastructure to deliver the natural resources to global markets. Several assumptions have been made in developing this cost savings estimate, one of the most basic being that if the access to the region was improved by means of an all-weather road, investment in the region would occur at a rate faster than if the road was not present, and this investment would be beneficial to both the investors and the people of the region and of Canada. The recent construction of the Sierra – Yoyo-Desan (SYD) road in British Columbia is an example where this assumption has been proven true.

The SYD road in British Columbia may be used as an example of the increased activity that may come because of improved infrastructure. The SYD road was constructed and improved as an industry road only as there are only a few full-time residents in the area. SYD runs 173 kilometers from Fort Nelson, British Columbia eastward to the South Helmet Airstrip in Northeastern British Columbia, and provides necessary infrastructure for oil and gas companies to transport goods for industrial activities.

Prior to the improvements to the road, access to the region was difficult. Between 1993 and 1997, only about 50 wells per year were drilled (largely in winter) due to environmental conditions very similar to the Mackenzie Valley region. It has been estimated that the Province lost up to $25M per year in royalty revenues because of the difficulty in accessing the region. Cost premiums associated with this access challenge were high and they were perceived to retard investment in the region.

Measuring the impact of the road on the E&P industry in Northeast British Columbia in 2004 can be carried out in part by examining the historical drilling activities in the region. The number of wells has increased since the development of the road, as illustrated in the Exhibit 5-6.

EXHIBIT 5-6: Exploration Activity after the Sierra-Yoyo-Desan Road[13]



This increase in the number of wells drilled in the region has led to a sustained increase in annual oil and gas royalties paid to the BC provincial government of $50-60 million dollars per year. The addition of technological improvements in rig mat technology has allowed a greater number of wells to be drilled in the summer months, an example of a situation where the impact of technological improvements is enhanced due to the presence of infrastructure fundamental to industry sustainability.

The establishment of a public-private partnership (P3) for infrastructure development and investment has been a successful model throughout Canada and may be considered a potential model for the development of the Mackenzie Valley all-weather road. The creation of the SYD road in 2004 was made possible through an agreement between the BC Ministry of Energy, Mines and Petroleum Resources and Ledcor Projects Incorporated. The positive and beneficial impact of the

SYD in BC does provide a valuable and proven operating model for such a project in the Northwest Territories.

[1] TM010001 - QUARTERLY POPULATION ESTIMATES, Canada, Provinces and Territories. GNWT, Bureau of Statistics

[2] CORPORATE REGISTRY, NWT. Number on Register. Month-End Totals. Bureau of Statistics, GNWT ITI Analysis

[3] Sourced from GNWT, http://www.stats.gov.nt.ca/Statinfo/Industry/non_renew/shipment.otp.

[4] Energy for the Future: An Energy Plan for the Northwest Territories, Energy, Tourism and Investment, Government of the Northwest Territories, March 2007.

[5] Energy for the Future: An Energy Plan for the Northwest Territories, Energy, Tourism and Investment, Government of the Northwest Territories, March 2007.

[6] Energy for the Future: An Energy Plan for the Northwest Territories, Energy, Tourism and Investment, Government of the Northwest Territories, March 2007.

[7] Natural Resources Canada. Taking the Chill Off: Climate Change in the Yukon and Northwest Territories. Sourced at: http://adaptation.nrcan.gc.ca/posters/wa/wa_01_e.php

[8] Oil and Gas Prices, Taxes and Consumers, Department of Finance, Canada.

[9] Oil and Gas Rights Digital files. Sourced at: http://www.ainc-inac.gc.ca/oil/act/Lan/dig/index_e.html

[10] Northern Oil and Gas Annual Report 2006, Exploration Activity in the North: Northern Operations. Sourced at: http://www.ainc-inac.gc.ca/oil/ann/ann2006/exp_e.html

[11] Government of the Northwest Territories. Corridors for Canada: An Investment in Canada's Economic Future.

[12] Petr Cizek, Cizek Environmental Services, 2007. A Choice of Futures: Cumulative Impact Scenarios of the Mackenzie Gas Project. Prepared for Canadian Arctic Resources Committee.

[13] British Columbia Ministry of Energy and Mines, "Project Report: Achieving Value for Money for the Sierra yoyo Desan Resource Road Upgrade Project" November 2004

APPENDICES

APPENDIX A – PROJECT BACKGROUND

PROJECT BACKGROUND

Mackenzie Aboriginal Corporation (MAC), an Aboriginal-owned company, was formed to provide unique construction solutions to major projects in the North. The ownership group is comprised of the Gwich'in Development Corporation, the Denendeh Development Corporation, Flint Energy Services Ltd., Kiewit Corporation, Ledcor Group, Midwest Management Ltd., and North American Construction Group. MAC engaged Meyers Norris Penny (MNP) to provide an independent assessment of the opportunities that may be lost given the lack of an all-weather road in the Mackenzie Valley Region.

PROJECT OBJECTIVES

Evaluating the potential socio-economic impacts of transportation infrastructure can require a comprehensive analysis of the particular benefits and costs that could be generated with a specific all-season road and related infrastructure. This study comprises a first phase in the analysis and is primarily exploratory. This study's specific objectives are to:

- Assess the opportunity costs that a of lack of all-season access to the Mackenzie Valley Region has had on regional natural resource development, and to
- Estimate development opportunities which could result from potential access to remote exploration and production sites in the Mackenzie Valley Region.

The purpose of this study is not to summarize previously conducted research. Rather, we have engaged with regional industry stakeholders to assess current and future investment in the Mackenzie Valley Region and its relationship to the all-weather road. Existing research is referenced in the Appendices for further background information on current issues within the area.

PROJECT APPROACH

FOCUS ON EXPLORATION AND PRODUCTION FIRMS

Achieving successful implementation of any proposed infrastructure project would require stakeholder consultation with economic development agencies, First Nation Governments and communities, the Government of the Northwest Territories, the Government of Canada and others. Given the specific objectives of this project, the focus of this analysis was to consult with senior decision-makers within the exploration and production firms that currently have interests in the Mackenzie Valley. These firms were selected as the most representative parties with knowledge of the potential investment and development opportunities within the region.

CONSULTATION AND DATA COLLECTION

Consultation formed a key part of this analysis. Our approach was based upon a systematic process and included the collection of perspectives on the development issues and prospects within the Mackenzie Valley and application of reasonableness testing of all information collected. Senior executives and their representatives with detailed knowledge of their respective organization's exploration and production investment decision-making were interviewed for this analysis. The interview protocol and other data collection materials are provided in Appendix A. The project analysis process involved:

- Finalizing the analytical approach with the MAC project lead,
- Reviewing relevant MAC organizational documents,
- Conducting a literature review of Mackenzie Valley development issues,
- Consulting with exploration and production firms through surveys and personal interviews,
- Synthesizing results and findings of the analysis, and
- Presenting the final report.

In an effort to attain an accurate picture of the exploration and development decisions made within the region, MNP contacted current license holders. Our final interview participants collectively hold licenses for 2,327,764 hectares of land within the region.

PROJECT LIMITATIONS AND QUALIFICATIONS

While this study specifically addresses the impact of all-weather road infrastructure development within the Northwest Territories, many interviewees and stakeholders repeatedly spoke of the Mackenzie Gas Project, the development of the pipeline and potential socio-economic impacts to the Region. However, the scope of this project is strictly limited to exploring the potential impacts from the construction of an all-weather road.

CONFIDENTIALITY AND NOTATION

Given the sensitivity of this project and the competitive nature of much of the discussion surrounding investment criteria, cost structures and investment priorities, MNP conducted the interviews with agreed-to terms for confidentiality. Extensive stakeholder interviews were carried out as a key part of MNP's project approach. Where possible, verbatim participant comments are provided, placed within quotation marks and italicized. Comments placed within [brackets] are the interviewer's completion of participant references to other points in conversation. Comments are cited without direct attribution to individuals to preserve the confidentiality of participating organizations. MNP maintained participant confidentiality throughout this engagement as dictated by the Confidentiality Agreement attached in Appendix B.

CONSULTATION WITH E&P FIRMS

Consultation is a key component of this analysis. Its main purpose is to collection information, comments and insights from representatives from exploration and production firms that are directly or indirectly involved in evaluating exploration and production opportunities within the Mackenzie Valley. The consultation includes both the design and review of the interview protocols with MAC, and conducting the interviews with the identified parties. The purpose of this chapter is to highlight the results of the consultation.

INTERVIEW RESPONDENTS

Exploration and production firms considered for desired participation in this study were identified from total oil and gas dispositions in hectares held in the Central Region of the Mackenzie Valley as well by identifying other oil and gas and mineral exploration and production firms operating in the Northwest Territories. These organizations were then pre-screened to determine whether they maintained assets or operations within the Mackenzie Valley. The target group of participants in the study were at the senior executive level. Participation was obtained from company presidents to senior management with experience in the NWT. Twenty organizations were approached from June to September 2007 representing all of the exploration lease holdings within the Mackenzie Valley for participation in the study. , MNP completed interviews with firms with holdings of 2,327,764 hectares or 49% percent of the total area licensed for exploration or development. Several mineral companies were also included in the participant list and provided feedback mainly on logistic costs to their respective exploration programs.

REGULATORY PROCESS A SIGNIFICANT CONCERN

While the focus of this study is the assessment of perceived impacts of the lack of all-weather road access in the Mackenzie Valley on resource industry development, often stakeholder comments strayed to observations or experiences regarding the Mackenzie Valley Pipeline regulatory process. Of particular concern was the duration of the process to date and the anticipated completion date for the pipeline and related infrastructure if the application is successful. Many participants indicated that the regulatory process is one of, if not the most, significant obstacles for consideration when evaluating a prospective undertaking in the region. The speed at which an organization can pursue appropriate approvals affects both the cost of successfully achieving the objectives of a project as well as the estimation of the returns from exploration or development projects. Both of these factors contribute to the overall assessment of an opportunity in the region. A selection of participant comments with respect to the regulatory process includes:

- *"A pipeline to Norman Wells will be the single biggest issue."*
- *"We need to discover more oil and gas before we can consider more development. Uncertainty over the Mackenzie Gas Pipeline also is a huge factor in limiting development in the region."*

APPENDIX B: DATA COLLECTION MATERIALS

Participant Letter

RE: Mackenzie Valley Infrastructure Study – Interview Request

Further to our conversation regarding the Mackenzie Valley Infrastructure Study, we would like to outline our approach and commitment to confidentiality and aggregation of data collected.

> Meyers Norris Penny LLP (MNP) has been engaged by Mackenzie Aboriginal Corporation (MAC) to determine the economic impact of not having an all-weather road and fibre-optic cable between Wrigley and Tuktoyuktuk. Impacts may include jobs not being created and capital investment that is not occurring. This study is being carried out to determine what additional regional development may result from additional and appropriate infrastructure investment of an all-weather road and fibre optic cable between Wrigley and Tuktoyuktuk, Northwest Territories.

In July 2007, the MNP team will be in Calgary and Edmonton to conduct a series of interviews with key industry decision-makers able to provide informed opinion on potential development scenarios in this region. We would appreciate the opportunity to meet with you to discuss the current and potential future needs of your company, which could be supported by the development of such infrastructure.

MNP will be using these interviews as one means of gathering information on the potential development opportunities that might be created as a result of road and access infrastructure to the region. The interviews are anticipated to last between 60 and 120 minutes. Once our interviews and analysis are completed, MNP will be submitting our opinion to MAC and all participants in order to build a case for federal government investment in the region.

> Due to the nature of this data, we will provide confidentiality agreements to ensure the protection of privacy. All data collected will be aggregated; companies will not be identified through their investments or potential future opportunities. We have attached this confidentiality agreement for your information and preparation.

Based on the data collected and aggregated, the conclusion could result in infrastructure investment being promoted to the federal government, expanding infrastructure in the Northwest Territories, and the ability for many companies to release or expand operations or investments in the region.

> We greatly appreciate your participation. If you believe materials may be of assistance in understanding your organization's perspectives on potential investment in the region, please forward them to Clayton.Norris@mnp.ca in advance, or bring copies to our meeting. Additionally, please feel free to invite any additional representatives from your company that would be of benefit.

Should you have any questions about this project, the interview process or the attached confidentiality agreement, please contact any of the team members:

Clayton Norris
Director, MNP Aboriginal Services
(403) 537-7606
clayton.norris@mnp.ca

Robert Baldauf
MNP Engagement Partner
(403) 537-7604
robert.baldauf@mnp.ca

Andrea Mondor
MNP Project Manager
(780) 451-4406
andrea.mondor@mnp.ca

We are endeavoring to schedule all participant interviews as soon as possible in recognition of approaching summer vacation schedules. A member of our project team will contact you to formally schedule your interview.

We thank you for your participation and look forward to the opportunity to meet with you.

Sincerely,
MEYERS NORRIS PENNY LLP

Clayton Norris, MBA, CAFM, Director, MNP Aboriginal Services Practice

CONFIDENTIALITY AGREEMENT

This agreement is made between Meyers Norris Penny LLP and [company] regarding the information shared during interviews while completing a study on behalf of Mackenzie Aboriginal Corporation. Meyers Norris Penny LLP and [company] may be referred to as "Party" or collectively "Parties".

The Parties will or already have had discussions and exchanged information. The Parties agree as follows:

"CONFIDENTIAL INFORMATION" is defined as any information that is disclosed in connection with the discussions and is furnished by a Party to the other Party in one or more of the following forms:

a. Written information, including reports, assessments, drawings, documents, financial statements and projections, product and product cycle plans and any other written information or data, or any information provided in electronic form
b. Information, including presentations, which is provided orally by a Party

NON DISCLOSURE

The receiving Party shall maintain the confidentiality of Confidential Information and will limit its disclosure of such to its directors, employees, agents, advisors or subsidiaries as have a need to know such Confidential Information in order to achieve the objectives of the discussions. The receiving Party shall be responsible for the compliance by such directors, employees, agents, advisors or subsidiaries with the provisions of this Agreement.

OWNERSHIP OF CONFIDENTIAL INFORMATION

Confidential information shall remain the exclusive property of the disclosing Party. The receiving Party agrees that Confidential Information disclosed hereunder is being received subject to the disclosing Party's ownership rights in such Confidential Information, and, further, subject to all relevant intellectual and/or proprietary property rights of the disclosing Party, including relevant laws governing patents, trademarks, copyrights, semiconductor chip protection, trade secrets and unfair competition.

EXCEPTIONS TO CONFIDENTIALITY OBLIGATIONS.

The confidentiality and limited use obligations of this Agreement will not apply to information received pursuant to this Agreement, which:

- Is or becomes publicly known other than through a breach of this Agreement by the receiving Party; or
- Is already known to the receiving Party at the time of disclosure as evidenced by the receiving Party's written documentation; or
- Is lawfully received by the receiving Party from a third party without breach of this Agreement or breach of any other agreement between the disclosing Party and such third party; or
- Is independently developed by employees of the receiving Party who have not had access to or received any Confidential Information under this Agreement; or
- Is furnished to a third party by the disclosing Party without restriction on the third party's right to disclose;

- Is authorized in writing by the disclosing Party to be released from the confidentiality obligations herein, or
- Is ordered to be produced by a Court, regulator, body, quasi-judicial or governmental body having appropriate authority to so order.

Specific information shall not be deemed to be within the foregoing exceptions merely because it is included within general information, which is within the exceptions, nor will a combination of features be deemed to be within such exceptions merely because the individual features of the combination are separately included within such exceptions.

The Party relying on any of the foregoing exceptions to the confidentiality obligations herein shall bear the burden of proving the acceptability of the exception.

RETURN OF CERTAIN CONFIDENTIAL INFORMATION
Upon the expiration or termination of the discussions, or upon the earlier request of the disclosing Party, the receiving Party shall, at its own expense, either promptly return to the disclosing Party all originals and copies of the writing and hardware in its possession which contain Confidential Information or by written notice, executed by the receiving Party, certify that such writings or hardware have been destroyed.

USE OF CONFIDENTIAL INFORMATION
Confidential Information will not be copied or used by the receiving Party for any purpose other than in connection with the discussions. With regard to Confidential Information, which is covered by copyrights belonging to the disclosing Party, it is agreed that the disclosing Party reserves all rights therein.

Meyers Norris Penny LLP	[company]
Signed	Signed I have the authority to bind Company
Name	Name
Title	Title
Date	Date

INTERVIEW PROTOCOL

1. Does the lack of all-weather road access to the Mackenzie Valley, specifically the corridor between Wrigley and Tuktoyuktuk, prevent, limit or discourage your organization from pursuing development in this region? If yes, how so?

2. If not, what are the other factors/issues preventing, limiting or discouraging development at this time?

3. What is lacking in this geographic area and preventing development by your organization? What is required? Which route(s)? What supporting infrastructure is required?

4. If these conditions were in place, what is the most likely development scenario? What would be built, when?

5. By order of magnitude, can you estimate the approximate investment (spend) that would be made? Over what period of time?

6. What has been the opportunity cost or additional risk premium for working in the region? How would development in this area affect your risk premium?

7. As a potential user of this road, is there any other information you would like to provide us to help quantify the economic impact of this infrastructure development?

8. Should the names of participating companies be listed in the final report, would you like your company name to be included?

APPENDIX C: MACKENZIE VALLEY

Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

Northern Oil and Gas Directorate | Direction du pétrole et du gaz Nord
OIL AND GAS DISPOSITIONS | DISPOSITIONS DE DROITS PÉTROLIERS ET GAZIERS
Mackenzie Valley -- Central Region | Vallée du Mackenzie -- région centrale
August 2007 | Août 2007

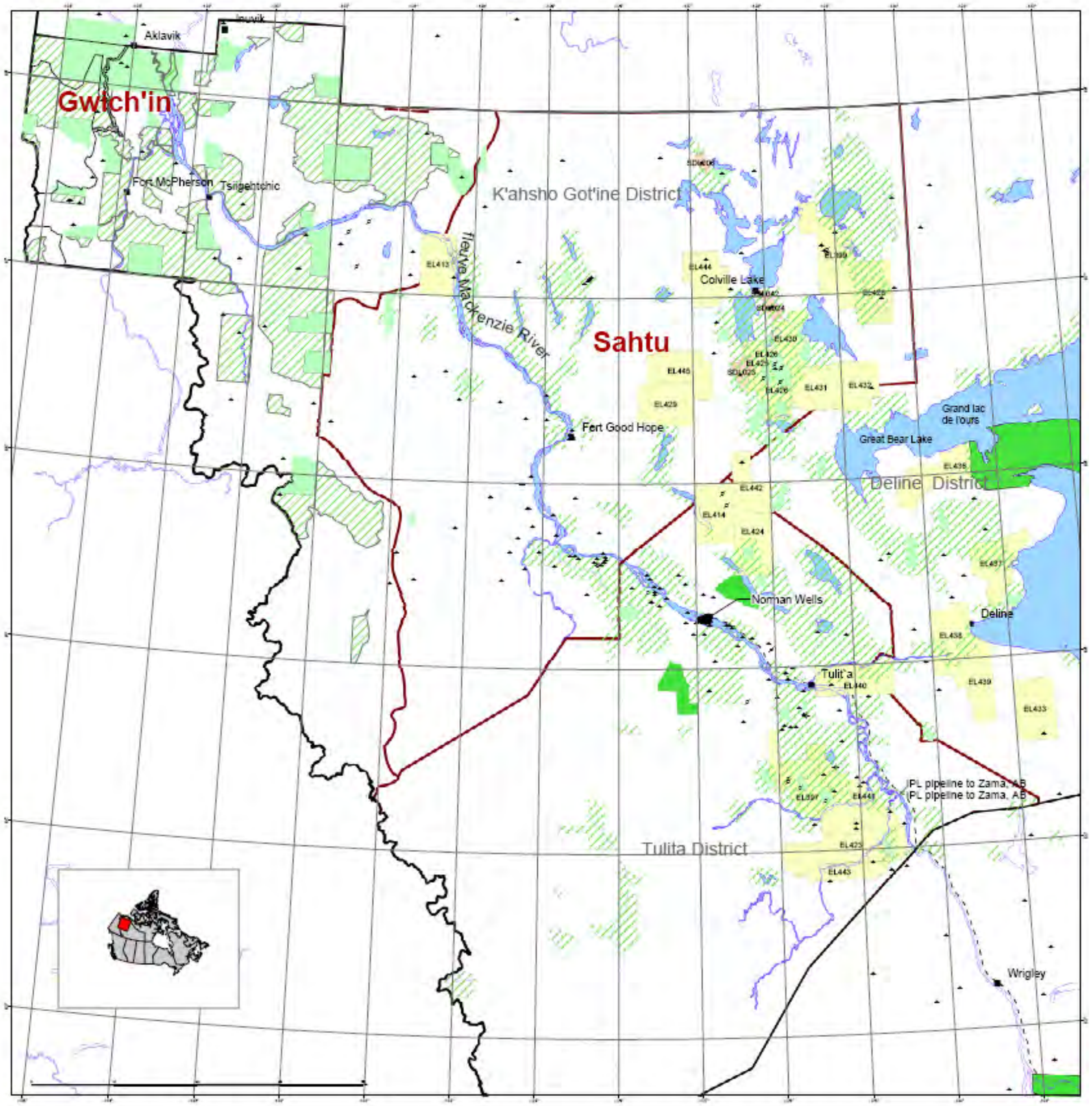
Exploration Licence — permis de prospection
Significant Discovery Licence — attestation de découverte importante
Production Licence — licence de production
Areas subject to specific environmental conditions — zones d'exclusion pour raisons environnementales
Surface owners are First Nations — les Premières Nations sont propriétaires du sous-sol
Subsurface and surface owners are First Nations — les premières nations sont propriétaire de la surface et du sous-sol
Pipeline — pipeline

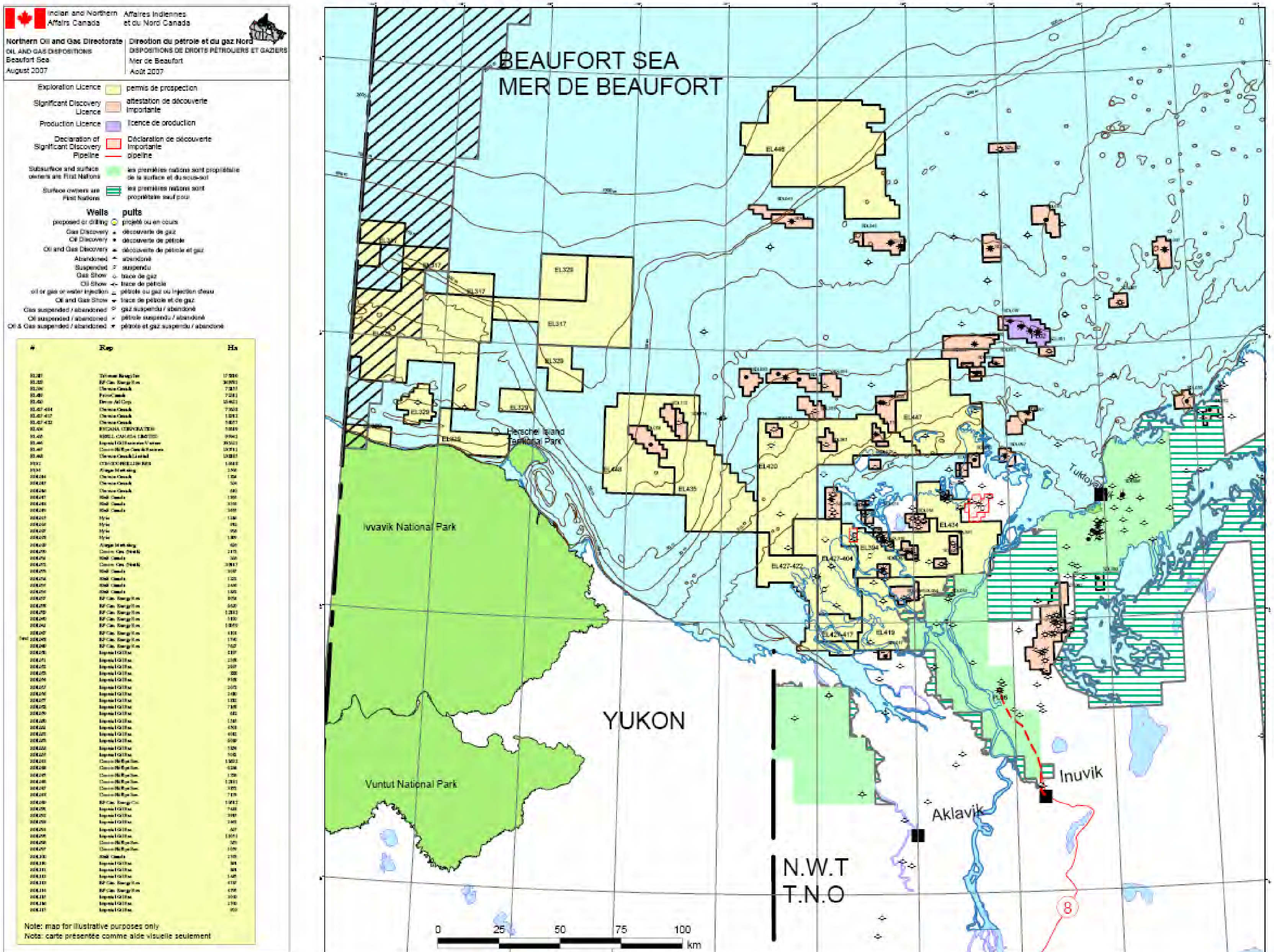
Wells — puits

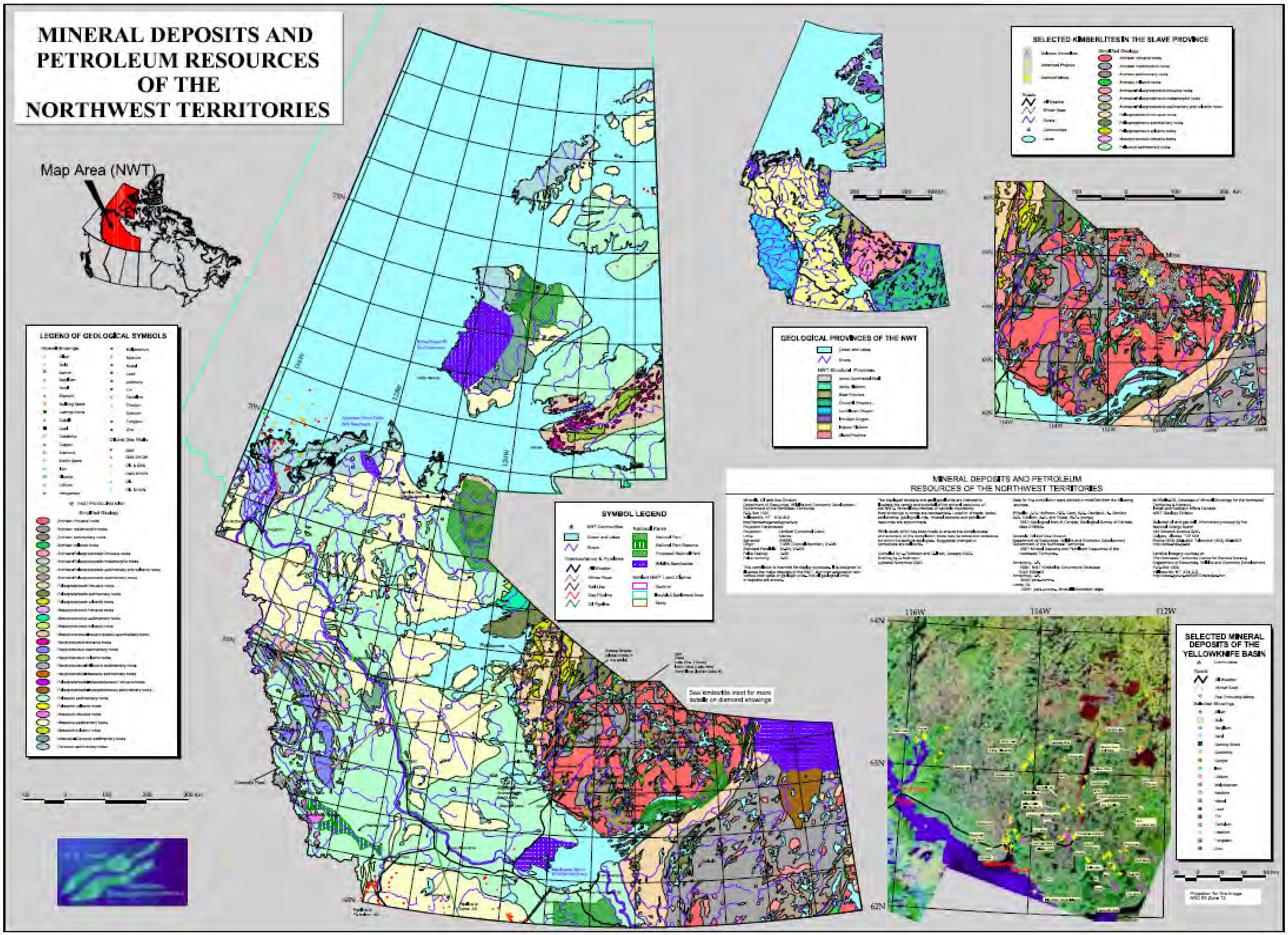
proposed or drilling — projeté ou en cours
Gas Discovery — découverte de gaz
Oil Discovery — découverte de pétrole
Oil and Gas Discovery — découverte de pétrole et gaz
Abandoned — abandoné
Suspended — suspendu
Gas Show — trace de gaz
Oil Show — trace de pétrole
oil or gas or water injection — pétrole ou gaz ou injection d'eau
Oil and Gas Show — trace de pétrole et de gaz
Gas suspended / abandoned — gaz suspendu / abandoné
Oil suspended / abandoned — pétrole suspendu / abandoné
Oil & Gas suspended / abandoned — pétrole et gaz suspendu / abandoné

Note: map for illustrative purposes only
Nota: carte présentée comme aide visuelle seulement

#	Rep	Ha
EL397	Husky Oil Operations	134964
EL399	Apache Oil	120496
EL413	Kodiak Energy Inc	80464
EL414	Apache Oil	84880
EL423	Husky Oil Operations	90632
EL424	Paramount	80608
EL425	Petro-Canada	27230
EL426	Paramount	36728
EL428	Apache Oil	81008
EL429	BG Canada Exploration and Prod	82880
EL430	Paramount	51637
EL431	Petro-Canada	78516
EL432	BG Canada Exploration and Prod	64048
EL433	Petro-Canada	88004
EL436	TALISMAN ENERGY INC.	84353
EL437	Talisman Energy Inc	85993
EL438	TALISMAN ENERGY INC.	87183
EL439	Talisman Energy Inc	82820
EL440	Paramount	87872
EL441	HUSKY OIL OPERATIONS LIMITED	88452
EL442	MGM Energy Corp	63312
EL443	Husky Oil Operations Limited	91116
EL444	BG International Limited	74604
EL445	BG International Limited	81292
PAA	IMPERIAL OIL RES.	3603
SDL006	BP Can. Energy Res.	7367
SDL023	Petro-Canada	18267
SDL024	Petro-Canada	11420
SDL042	BP Can. Energy Res.	2024




Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Northern Oil and Gas Directorate
Direction du pétrole et du gaz Nord
OIL AND GAS DISPOSITIONS
DISPOSITIONS DE DROITS PÉTROLIERS ET GAZIERS
Beaufort Sea
Mer de Beaufort
August 2007
Août 2007
Exploration Licence
permis de prospection
Significant Discovery Licence
attestation de découverte importante
Production Licence
licence de production
Declaration of Significant Discovery
Déclaration de découverte importante
Pipeline
pipeline
Wells
puits
Note: map for illustrative purposes only
Nota: carte présentée comme aide visuelle seulement
BEAUFORT SEA
MER DE BEAUFORT
Herschel Island Territorial Park
Ivvavik National Park
Vuntut National Park
YUKON
N.W.T
T.N.O
Tuktoyaktuk
Inuvik
Aklavik
EL446
EL317
EL329
EL420
EL435
EL447
EL434
EL427-422
EL419
0
25
50
75
100
km


MINERAL DEPOSITS AND PETROLEUM RESOURCES OF THE NORTHWEST TERRITORIES
Map Area (NWT)
LEGEND OF GEOLOGICAL SYMBOLS
SYMBOL LEGEND
GEOLOGICAL PROVINCES OF THE NWT
SELECTED KIMBERLITES IN THE SLAVE PROVINCE
MINERAL DEPOSITS AND PETROLEUM RESOURCES OF THE NORTHWEST TERRITORIES
SELECTED MINERAL DEPOSITS OF THE YELLOWKNIFE BASIN
See kimberlite inset for more details on diamond showings
116W
114W
112W
64N
63N
62N

APPENDIX D: ICE ROAD HISTORICAL DATA

MACKENZIE DELTA ICE ROADS (Inuvik area)

YEAR	Inuvik to Tuktoyaktuk (187 km)		Junction (km 34) to Aklavik (86 km)	
	Opened	Closed	Opened	Closed
1980 / 1981	Feb 02/81	Apr 25/81	Feb 02/81	Apr 25/81
1981 / 1982	Jan 21/82	Apr 30/82	Jan 20/82	Apr 30/82
1982 / 1983	Dec 23/82	Apr 26/83	Dec 20/82	Apr 26/83
1983 / 1984	Jan 16/84	May 02/84	Dec 22/83	May 02/84
1984 / 1985	Dec 11/84	May 01/85	Dec 24/84	May 04/85
1985 / 1986	Dec 12/85	May 02/86	Dec 12/85	May 02/86
1986 / 1987	Jan 05/87	May 08/87	Jan 05/87	May 07/87
1987 / 1988	Feb 15/88	Apr 19/88	Feb 17/88	Apr 19/88
1988 / 1989	Feb 07/89	May 03/89	Jan 18/89	May 03/89
1989 / 1990	Jan 03/90	May 07/90	Dec 23/89	May 07/90
1990 / 1991	Dec 23/90	Apr 25/91	Dec 21/90	Apr 25/91
1991 / 1992	Dec 05/91	Apr 26/92	Dec 09/91	Apr 27/92
1992 / 1993	Dec 18/92	Apr 30/93	Dec 15/92	May 02/93
1993 / 1994	Jan 05/94	Apr 28/94	Jan 18/94	Apr 28/94
1994 / 1995	Dec 22/94	Apr 24/95	Dec 23/94	Apr 24/95
1995 / 1996	Dec 19/95	Apr 19/96	Dec 19/95	Apr 26/96
1996 / 1997	Dec 20/96	Apr 25/97	Jan 12/97	Apr 25/97
1997 / 1998	Jan 02/98	Apr 15/98	Jan 26/98	Apr 16/98
1998 / 1999	Dec 16/98	Apr 20/99	Dec 14/98	Apr 21/99
1999 / 2000	Dec 14/99	Apr 17/00	Jan 17/00	Apr 17/00
2000 / 2001	Dec 20/00	May 09/01	Jan 24/01	May 08/01
2001 / 2002	Dec 02/01	May 02/02	Dec 31/01	May 02/02
2002 / 2003	Dec 17/02	Apr 26/03	Jan 17/03	Apr 27/03
2003 / 2004	Dec 17/03	Apr 27/04	Dec 23/03	Apr 26/04
2004 / 2005	Dec 07/04	Apr 27/05	Dec 06/04	Apr 25/05
2005 / 2006	Jan 09/06	May 09/06	Jan 13/06	May 08/06
2006 / 2007	Dec 05/06		Dec 06/06	

Ice Road to TUKTOYAKTUK (Opened)		Ice Road to AKLAVIK (Opened)	
Earliest	Dec 02/01	**Earliest**	Dec 06/04 & 06
Latest	Feb 15/88	**Latest**	Feb 17/88
Last 5 Years Avg.	Dec 17	**Last 5 Years Avg.**	Dec 25
Last 10 Years Avg.	Dec 17	**Last 10 Years Avg.**	26
Last 15 Years Avg.	Dec 19	**Last 15 Years Avg.**	Jan 01
Last 20 Years Avg.	Dec 25	**Last 20 Years Avg.**	Jan 02
Last 25 Years Avg.	Dec 25	**Last 25 Years Avg.**	Dec 31

Ice Road to TUKTOYAKTUK (Closed)		Ice Road to AKLAVIK (Closed)	
Earliest	Apr 15/98	**Earliest**	Apr 16/98
Latest	May 09/01 & 06	**Latest**	May 08/01
Last 5 Years Avg.	Apr 30	**Last 5 Years Avg.**	Apr 30
Last 10 Years Avg.	Apr 27	**Last 10 Years Avg.**	Apr 26
Last 15 Years Avg.	Apr 26	**Last 15 Years Avg.**	Apr 27
Last 20 Years Avg.	Apr 27	**Last 20 Years Avg.**	Apr 28
Last 25 Years Avg.	Apr 28	**Last 25 Years Avg.**	Apr 28

MACKENZIE VALLEY WINTER ROADS (Wrigley (km 690) to Fort Good Hope (km 1172). Includes Tulita to Deline 105 km and Fort Good Hope to Colville Lake (165 km))

YEAR	Wrigley (km 690) to Tulita (km 938) - 248 km		Tulita (km 938) to Norman Wells (km 1023) - 85 km		Norman Wells (km 1023) to Ft. Good Hope (km 1172) - 149 km		Tulita (km 914) to Deline - 105 km		Fort Good Hope to Colville Lake - 165 km	
	Opened	Closed	Opened	Closed	Opened	Closed	Opened	Closed	Opened	Closed
1982 / 1983	Jan 27/83	Mar 31/83	Jan 27/83	Mar 31/83			Jan 27/83	Mar 31/83		
1983 / 1984	Jan 13/84	Apr 04/84	Jan 13/84	Apr 04/84			Jan 16/84	Apr 04/84		
1984 / 1985	Jan 15/85	Mar 20/85	Jan 15/85	Mar 20/85			Jan 15/85	Mar 20/85		
1985 / 1986	Jan 25/86	Apr 03/86	Dec 23/85	Apr 03/86			Jan 17/86	Apr 03/86		
1986 / 1987	Jan 13/87	Mar 25/87	Jan 19/87	Mar 26/87			Jan 09/87	Mar 26/87		
1987 / 1988	Jan 11/88	Mar 28/88	Jan 08/88	Apr 05/88			Jan 13/88	Apr 05/88		
1988 / 1989	Jan 16/89	Apr 05/89	Jan 16/89	Apr 10/89	Feb 27/89	Apr 10/89	Jan 27/89	Apr 10/89		
1989 / 1990	Jan 15/90	Mar 30/90	Dec 16/89	Apr 05/90	Jan 15/90	Apr 05/90	Jan 12/90	Apr 04/90		
1990 / 1991	Jan 08/91	Mar 31/91	Jan 08/91	Apr 08/91	Jan 02/91	Apr 08/91	Feb 07/91	Apr 04/91		
1991 / 1992	Dec 20/91	Mar 25/92	Dec 20/91	Apr 04/92	Dec 20/91	Mar 25/92	Jan 24/92	Mar 31/92		
1992 / 1993	Jan 11/93	Mar 26/93	Jan 11/93	Mar 29/93	Jan 14/93	Mar 29/93	Jan 18/93	Mar 29/93		
1993 / 1994	Dec 23/93	Mar 29/94	Dec 29/93	Mar 30/94	Dec 29/93	Mar 31/94	Jan 25/94	Mar 30/94		
1994 / 1995	Jan 12/95	Mar 19/95	Jan 18/95	Mar 26/95	Jan 19/95	Mar 26/95	Jan 20/95	Mar 26/95		
1995 / 1996	Jan 26/96	Mar 20/96	Jan 08/96	Mar 20/96	Jan 08/96	Mar 20/96	Jan 18/96	Mar 20/96		
1996 / 1997	Feb 14/97	Mar 17/97	Jan 14/97	Mar 17/97	Jan 14/97	Mar 17/97	Feb 04/97	Mar 17/97		
1997 / 1998	Feb 06/98	Mar 16/98	Jan 23/98	Mar 13/98	Jan 14/98	Mar 16/98	Feb 03/98	Mar 16/98		
1998 / 1999	Feb 01/99	Mar 16/99	Dec 31/98	Mar 16/99	Jan 07/99	Mar 16/99	Jan 21/99	Mar 16/99		
1999 / 2000	Feb 03/00	Mar 15/00	Jan 11/00	Mar 15/00	Dec 24/99	Mar 15/00	Jan 28/00	Mar 15/00		
2000 / 2001	Jan 19/01	Mar 15/01	Jan 15/01	Apr 05/01	Jan 08/01	Apr 05/01	Jan 20/01	Apr 05/01	Feb 23/01	Apr 05/01
2001 / 2002	Dec 20/01	Mar 18/02	Jan 10/02	Mar 18/02	Jan 11/02	Mar 18/02	Jan 18/02	Mar 18/02	Jan 09/02	Mar 18/02
2002/2003	Jan 22/03	Mar 18/03	Jan 22/03	Apr 10/03	Jan 20/03	Apr 10/03	Jan 27/03	Apr 10/03	Jan 20/03	Apr 10/03
2003/2004	Dec 19/03	Mar 16/04	Dec 29/03	Mar 16/04	Dec 19/03	Mar 31/04	Jan 23/04	Mar 16/04	Dec 19/03	Mar 31/04
2004/2005	Dec 13/04	Apr 01/05	Jan 04/05	Apr 01/05	Dec 13/04	Apr 01/05	Jan 21/05	Apr 01/05	Dec 13/04	Apr 01/05
2005/2006	Dec 19/05	Apr 07/06	Dec 19/05	Apr 07/06	Dec 29/05	Apr 07/06	Jan 25/06	Mar 22/06	Jan 13/06	Mar 22/06
2006/2007	Dec 22/06		Dec 20/06		Dec 21/06		Jan 19/07		Jan 04/07	

Winter Road to TULITA (Opened)		Winter Road to NORMAN WELLS (Opened)		Winter Road to FT GOOD HOPE (Opened)		Winter Road to DELINE (Opened)		Winter Road to COLVILLE LAKE (Opened)	
Earliest	Dec 13/04	Earliest	Dec 16/89	Earliest	Dec 13/04	Earliest	Jan 09/87	Earliest	Dec 13/04
Latest	Feb 14/97	Latest	Jan 27/83	Latest	Feb 27/89	Latest	Feb 07/91	Latest	Feb 23/01
Last 5 Years Avg.	Dec 25	Last 5 Years Avg.	Dec 31	Last 5 Years Avg.	Dec 27	Last 5 Years Avg.	Jan 23	Last 5 Years Avg.	Jan 01
Last 10 Years Avg.	Jan 08	Last 10 Years Avg.	Jan 06	Last 10 Years Avg.	Jan 01	Last 10 Years Avg.	Jan 24	Last 10 Years Avg.	N/A
Last 15 Years Avg.	Jan 11	Last 15 Years Avg.	Jan 07	Last 15 Years Avg.	Jan 04	Last 15 Years Avg.	Jan 23	Last 15 Years Avg.	N/A
Last 20 Years Avg.	Jan 10	Last 20 Years Avg.	Jan 06	Last 20 Years Avg.	N/A	Last 20 Years Avg.	Jan 23		
Last 25 Years Avg.	Jan 12	Last 25 Years Avg.	Jan 07			Last 25 Years Avg.	Jan 22		

Winter Road to TULITA (Closed)		Winter Road to NORMAN WELLS (Closed)		Winter Road to FT GOOD HOPE (Closed)		Winter Road to DELINE (Closed)		Winter Road to COLVILLE LAKE (Closed)	
Earliest	Mar 15	Earliest	Mar 13/98	Earliest	Mar 15/00	Earliest	Mar 15/00	Earliest	Mar 18/02
Latest	Apr 05/89	Latest	Apr 10/89&03	Latest	Apr 10/89&03	Latest	Apr 10/89&03	Latest	Apr 10/03
Last 5 Years Avg.	Mar 24	Last 5 Years Avg.	Mar 29	Last 5 Years Avg.	Apr 01	Last 5 Years Avg.	Mar 26	Last 5 Years Avg.	Mar 29
Last 10 Years Avg.	Mar 20	Last 10 Years Avg.	Mar 24	Last 10 Years Avg.	Mar 26	Last 10 Years Avg.	Mar 23	Last 10 Years Avg.	N/A
Last 15 Years Avg.	Mar 21	Last 15 Years Avg.	Mar 25	Last 15 Years Avg.	Mar 26	Last 15 Years Avg.	Mar 24	Last 15 Years Avg.	N/A
Last 20 Years Avg.	Mar 23	Last 20 Years Avg.	Mar 28	Last 20 Years Avg.	N/A	Last 20 Years Avg.	Mar 27	Last 20 Years Avg.	N/A

APPENDIX E - ESTIMATE OF DIRECT GOVERNMENT REVENUES

The project team has used several sources to estimate the potential revenues that would accrue to federal, territorial and provincial governments. All of these studies have used different methodologies to estimate potential direct government revenues driven from the Mackenzie Gas Project. We have assumed a base case number of 500 new wells to be drilled in estimating the potential benefit of saving for an all weather road. This number of new wells is based on the number of wells estimated to be required to maintain the 1.2Bcf required to keep consistent volume in the pipeline. Exhibit 5-2.

The report "An Evaluation of the Economic Impacts Associated with the Mackenzie Valley Gas Pipeline and Mackenzie Delta Gas Development" Wright Mansell Research, 2004, has estimated the potential direct government revenues using different scenarios ranging from $5-11 Billion dollars. Exhibit 3-5 estimates 16.5 billion dollars of direct government revenues from existing and new projects. With an all weather road the time to realize these revenues may be decreased due to cost savings and increased drilling season

We considered the different government revenue projections from these reports and feel that the estimates should be based upon the scenarios of existing or new projects. Our assumptions are based upon a round number split between Case scenarios 2 and 3 from the Wright Mansell report and from the existing and new projects projected in the NWT study. Our baseline assumption is $10 Billion dollars of direct government revenues over 25 years. We have not considered long term or possible future discoveries that may significantly increase the potential resources and associated direct government revenues. Depending on commodity prices, the time to realize these revenues could also be decreased with increased activity.

EXHIBIT 3-5: Projected Resources and Associated Revenues, Northwest Territories

Commodity	Projected Resources	Gross Revenue	Federal Royalties	Federal Taxes	Northwest Territories Taxes
Existing Projects					
Natural Gas	1 Tcf	$2.70	$0.60	$0.50	$0.20
Oil	0.107 Billion bbls	$3.40	$0.80	$0.30	$0.10
New Projects					
Natural Gas	14.9 Tcf	$33.80	$6.10	$5.40	$2.50
Possible Projects					
Natural Gas	47.4 Tcf	$107.50	$19.40	$17.50	$8.00
Oil	1.65 billion barrels	$39.40	$9.50	$7.60	$3.70
Totals		**$186.80**	**$36.40**	**$31.30**	**$14.50**

Projected Resources and Associated Revenues, Northwest Territories

TABLE A.5: DISTRIBUTION OF DIRECT GOVERNMENT REVENUES – $4US GAS PRICE : 2010-2035*
(millions of 2004 Cdn $)

CASE 1	Property Tax	Income Tax	Royalties	Total
Federal		2391	939	3330
Alberta	33	28		61
NWT	291	1429		1720
- Grant Reduction	233	1143		1376
Adjusted NWT	58	286		344
Adjusted Federal	233	3534	939	4706
Total	**324**	**3848**	**939**	**5111**

CASE 2	Property Tax	Income Tax	Royalties	Total
Federal		3769	3009	6778
Alberta	41	34		75
NWT	389	2276		2665
- Grant Reduction	311	1821		2132
Adjusted NWT	78	455		533
Adjusted Federal	311	5590	3009	8910
Total	**430**	**6079**	**3009**	**9518**

CASE 3	Property Tax	Income Tax	Royalties	Total
Federal		4168	3867	8035
Alberta	41	34		75
NWT	396	2529		2925
- Grant Reduction	317	2023		2340
Adjusted NWT	79	506		585
Adjusted Federal	317	6191	3867	10375
Total	**437**	**6731**	**3867**	**11035**

* Personal income taxes on direct labour income not included

Source: "An Evaluation of the Economic Impacts Associated with the Mackenzie Valley Gas Pipeline and Mackenzie Delta Gas Development" Wright Mansell Research, 2004

EXHIBIT 5-5: Estimated Annual accumulation of Direct Government revenue

Annual Accumulation of Direct Government Revenues ($millions)

		(FV of $588/y in year_)			(FV of $400/y in year_)
AWR*	Year 1	588	**No AWR***	Year 1	400
	Year 5	3250		Year 5	2210
	Year 10	7399		Year 10	5031
	Year 15	12693		Year 15	8631
	Year 17	15200		Year 17	10336
	Year 20	17596		Year 20	13226
	Year 25	22458		Year 25	19091

Year 25- AWR	22458
Year 25- No AWR	19091
Difference in future value of direct government revenues	**3367**

Present Value @5%	**994**

*Assumptions

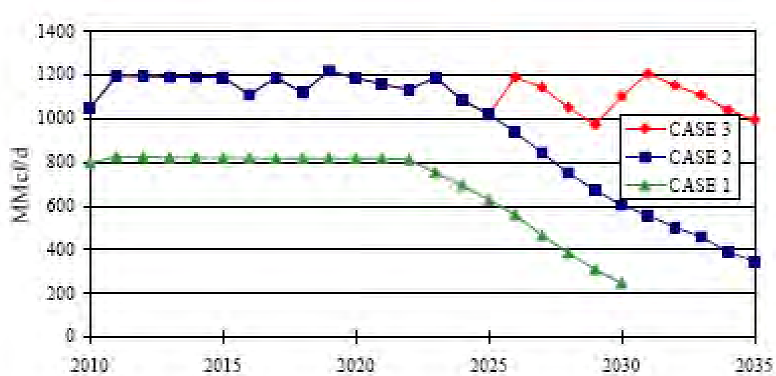
Direct government revenues estimated of 10 Billion over 25 years
Assumes straight line revenues
Renvested yearly at 5%

The estimated rate of increase in the release of the economic benefit is approximately 43%, relative to the current situation where an all-weather road is not present in the region. With an all-weather road present, the economic benefit associated with the drilling and subsequent production from 500 wells expected over a 25 year period would accrue in approximately 17.5 years.

The impact of this permanent increase in the rate of release of economic benefit due to the presence of an all-weather road in the region yields a potential additional gain of $3.4 Billion to government at the end of 25 years. This net gain has the present value equivalent of approximately $1 Billion at 5% annual growth.

In addition, an all weather road may change some of the projections of gas production profiles Projections on the gas production profiles may be impacted as exploration expands due to extended drilling seasons and cost savings. Additional exploration may lead to Case 3 from the chart below as the more likely scenario as volume levels can be maintained due to increase proven resources.

FIGURE 2.1: GAS PRODUCTION PROFILES UNDER THE THREE VOLUME CASES



Source: “An Evaluation of the Economic Impacts Associated with the Mackenzie Valley Gas Pipeline and Mackenzie Delta Gas Development” Wright Mansell Research, 2004

APPENDIX F: RECOMMENDED READING

The GNWT has commissioned several studies and reports to examine the effects of the construction of an all- weather road from Wrigley to Tuktoyuktuk. MNP reviewed and referenced a number of these studies during the preparation of this report, including:

GeoNorth Limited & Golder Associates. Mackenzie Valley Highway Extension: Scoping, Existing Information and the Regulatory Regime. September 1999.

Government of the Northwest Territories. Corridors for Canada- An Investment in Canada's Economic Future: A Proposal for Funding Under the Strategic Infrastructure Fund Government of Canada. 2002.

Government of the Northwest Territories. Corridors for Canada II: Building on Our Success: A Proposal for Investment in Strategic Transportation Infrastructure. 2005.

Government of the Northwest Territories. Connecting Canada- Coast to Coast to Coast: A Proposal to Complete the Mackenzie Valley Highway to the Arctic Coast. 2005.

Government of the Northwest Territories, Department of Transportation. Summary Report of the Highway Strategy, October 1999.

Government of the Northwest Territories, Department of Transportation. Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories. November 2000.

Government of the Northwest Territories, Department of Transportation. Mackenzie Highway Extension: Wrigley to the Dempster Highway, 1999 Engineering Update.

Nichols Applied Management and Economic Consultants. Final Report: Highway Financing Study. Submitted to Government of the Northwest Territories, Department of Transportation. August 1999.

Nichols Applied Management and Economic Consultants. Final Report: Benefit-cost and Regional Economic Impact Analysis: Mackenzie Highway Extension. Submitted to Government of the Northwest Territories, Department of Transportation. April 1999.

Wright Mansell Research Ltd. An Evaluation of the Economic Impacts Associated with the Mackenzie Valley Gas Pipeline and Mackenzie Delta Gas Development: An Update. Prepared for Resources, Wildlife and Economic Development, Government of the Northwest Territories, and TransCanada Pipelines Limited. August 21, 2004.

ACKNOWLEDGEMENTS

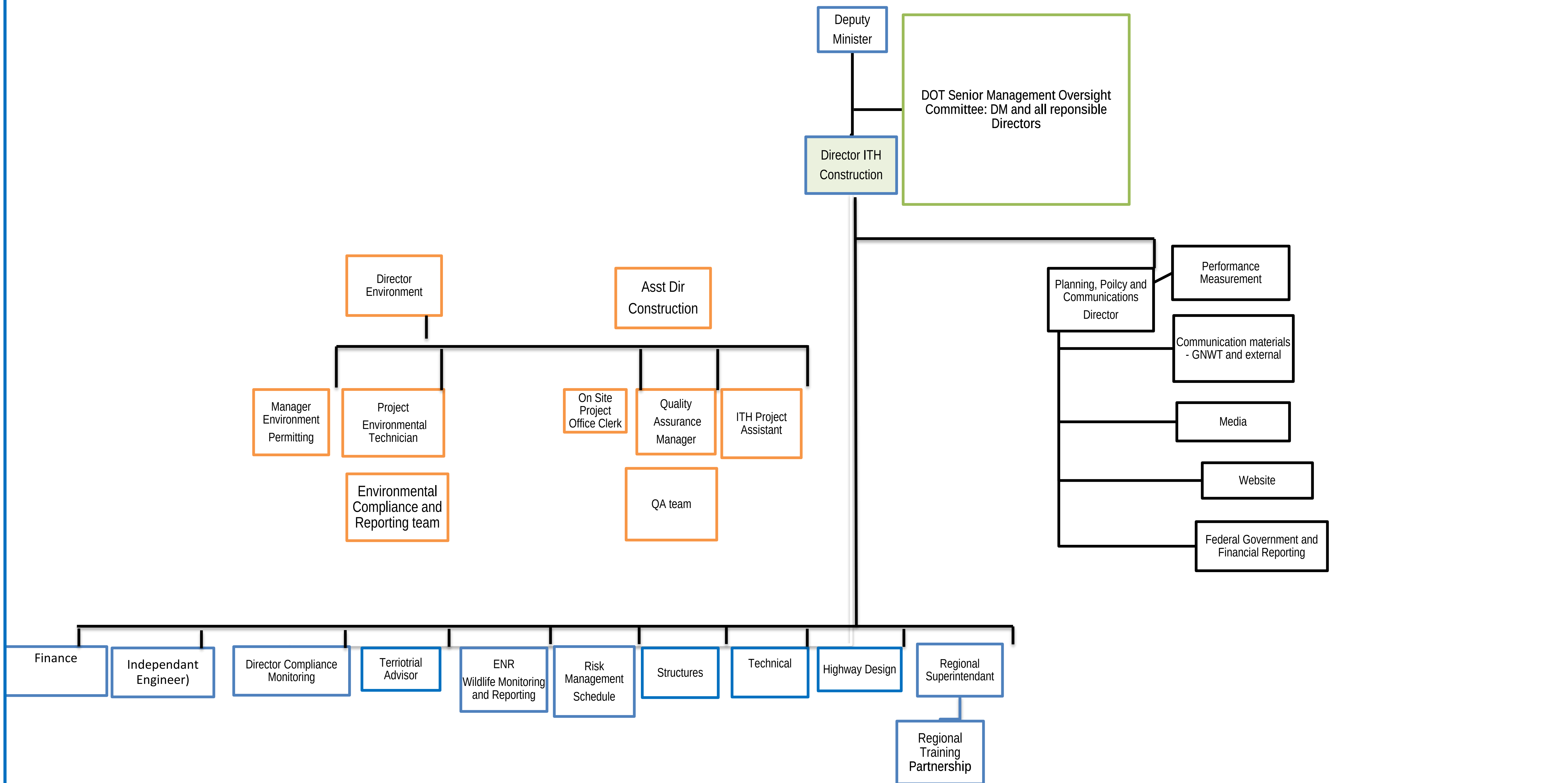
We would like to extend our sincere thanks to the following organizations that provided information surrounding operations in the Northwest Territories:

- Akita Drilling
- Apache Canada Ltd.
- BG International Ltd
- Chevron Canada Resources
- Eagle Plains Resources Ltd.
- Flint Energy Services
- International Frontier Resources Corporation
- Kodiak Petroleum ULC
- MGM Energy Corporation
- Paramount Resources Ltd.
- Shetah Nabors
- Talisman Energy Inc.

Appendix 7

Project Management Organizational Structure

MVH PROJECT MANAGEMENT STRUCTURE



Appendix 8

Risk Assessment Framework for the Mackenzie Valley Highway

Mackenzie Valley Highway (MVH) Project

Preliminary Risk Matrix Framework
(Draft Framework – No Risk Ratings]

PROJECT GOALS

- **To provide a safe, secure and effective Highway from Wrigley to Norman Wells with a view to:**
    - **Meet all applicable codes, guidelines and regulations to include technical, environmental and legal**
    - **Deliver the Project on budget, using a cost effective method and with minimum impact on the Region's O and M budget**
    - **Deliver the high quality Project on schedule and within the budget of $700m**
    - **Develop Community Partnerships and Northern Companies by building capacity and providing meaningful and transferable skills and training**
    - **Deliver a well-run Project that can be a model for future major projects.**

RISK MATRIX EXPLANATORY NOTES-

Every major project should acknowledge the risks inherent in the project- assess the risks and clearly articulate mitigation measures. This Risk Matrix attempts to accomplish this.

- It is important to assess both the **probability** and the potential **consequences** of any event that may impact the project. A high risk of an event happening with a low consequence may be more acceptable than a low risk event with severe consequences. In some cases we have noted some impacts. This risk matrix will be reviewed throughout the project as lessons are learned, new risks are identified, and old risks are reduced.
- Rating manual:
  Level of Risk (how likely) - the assigned a rating of 1-5 corresponding to Low (1-2), Medium 3 or High/Unknown (4-5) risk.
  Impact (magnitude of consequences) - assigned a rating of 1-5 corresponding to Low (1-2), Medium 3 or High/Unknown (4-5) impact.
  Ratings (level of risk *impact) - The resulting overall ratings can range from a lowest risk/lowest consequence rating of 1 to the highest risk and consequence rating of 25. The Project should pay attention to the ratings of 15 or higher and is depicted in a red highlighting.
- To some extent, the consequences of an 'event' will impact all aspects of the project. However, the table notes who bears the greatest responsibility and liability for this event (the owner or the contractor). Our Assessment is based on risks from the Govt point of view. In some cases risks can be cumulative in nature – (if two or more occur then a third risk is likely) and risks can be compounded (if one happens then another will occur). The GNWT will bear all the owner responsibilities.
- It is important to note that "Risk Assessment" is subjective and can be seen differently by a variety of agencies and importance can be a point of discussion – cost vs environmental issues for example.
    - The level of knowledge and understanding of a given situation may increase or decrease the perception of risk.
    - Contingency plans or mitigation plans are devised to deal with the "what ifs"; and
    - Some risks have a defined cost attached and where possible an estimate is provided.
- Risks will change or mature over the life of the project. This document is an "ongoing assessment tool". A risk may increase, decrease or be eliminated. Reducing, increasing or eliminated risks are marked with a (R), (I) or (E). New risks may be identified. Some risks may not be identified, until they are actually realized.
- The following are the key risks to the project as perceived by the GNWT.

Serial	Risk Area	Risk Element	Description	Primary Resp	Level of Risk (likely to occur) 1-5	Level of Impact 1-5	Rating 1-25 15 is high	Actions - Mitigation/Risk Reduction/Contingency	Potential Impact Notes
					Planning Risks				
1	Planning Commitments	Project team needs continuity and mission focus.	Planners could enter into compliance agreements that handcuff the design and construction phases of the project.	DOT GNWT				Project leader should be appointed early and remain throughout the project. This will ensure a focus on delivering the end-product.	If Planners agree to restrictive compliance items it could drive up the construction costs or limit the design options to the detriment of the final product.
2	Overselling Benefits	Sets this project and future projects up for failure in public and or government opinion.	If benefits are oversold and unattainable the project will be viewed as a failure and endanger GNWT's ability to gain support and funding for similar projects.	DOT GNWT				Realistically assess the economic and quality of life benefits that should be derived by completion of the Highway from Wrigley to Norman Wells.	
3	Underestimating Costs	Government and public tend to select the lowest cost they hear.	When presenting potential cost scenarios if the low end is unlikely then do not use it as part of the estimate. Cautious estimates must be presented clearly.	DOT GNWT				Use the most probable cost estimate with a 10% contingency added on.	
4	Rushed Planning Schedule	Certain planning activities are weather and time dependant.	Rough estimates can be completed using desktop data. Final planning estimates require the time and effort to prove on the ground and during the correct time of year.	DOT GNWT				Route selection, terrain analysis, hydrotechnical studies, and wildlife and fish surveys must be done on the terrain in question. Survey done in the winter will give different results than that done in the summer.	Planning cycles will likely require 18 months. Improper crossing alignment will result in poor coverage and could negatively impact fish population.
5	Access to technical data and traditional knowledge.	Access to information that is already gathered will save time and error.	Technical data was used in developing the initial Project Description Reports and would save time redoing the same technical studies. Access to reliable traditional knowledge as to waterways, ice patterns and wildlife will provide valuable support to technical data.	DOT GNWT				Those that live on the land all year will have knowledge of crossing sites and water levels and other data that will support or refute technical survey data.	
6	Consultations	When people are consulted by the Government there is a presumption that their views will be addressed.	The consultation process must be honest and open with a view to managing expectations.	DOT GNWT				The goals, requirements, and limitations of the project must be clearly presented during all consultation periods.	

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7	Funding Agreements	Funding agreements must have the flexibility to match the cash flow requirements of the project.	Funding agreements must be reviewed and understood prior to writing construction contract specifications and funding criteria. There should be a process to adjust milestones if required.	DOT GNWT				The funding criteria in the contract should fit with the funding agreement and milestones reached between the GNWT and the Federal Government. The milestones should achieve a reasonable cash flow for the pace of the project.	Improper funding arrangements can negatively impact the GNWT borrowing capacity and/or affect contractor solvency.
8	Project Approval Process	Ensure project is properly approved by the various regulatory agencies	This is a complex project involving EIRB, Water Boards, Feds, local boards ,two land claims settlement areas, all have their own process and all produce reports and recommendations. The DOT must ensure approvals are not given with a long list of restrictions which may be impossible to comply with.	DOT GNWT				Ensuring the proper information is provided to the various agencies. Ensuring the DOT is aware of the recommendations and any restrictions and all "knock on" effects are assessed. Land Use Permit and Water Authority License are the responsibility of DOT while municipal permits are the responsibility of the contractor.	Significant O and M costs or very restrictive construction costs could be added to the project. All those involved need to be aware of the whole picture. Compliance issues must be manageable and will require vigilance and detailed reporting.
Project Management Risks									
9	Project Management	Experienced PM team and consultants required	Project can be complex with technical issues, legal issues, regulatory challenges and budget challenges. An experienced team with depth and knowledge is required.	DOT GNWT				The department must assign a team to manage the issues and have the proper checks and balances in the system to ensure oversight. The DOT to ensure any proponent and consultants has the proper people and processes in place to take on the project.	The project team needs to assess all risk and all options. Clear contingency plans to be developed, prepared and costed. The contingency fund should be 10% of the construction costs or the sum of the costed contingency plans, whichever is higher.
10	Contractor Competencies	Experience of Contractors and Sub Contractors	The Contractor and Sub Contractors lack experience and knowledge reference best practises regarding road and bridge construction. Inexperience leads to errors and potential violations of regulatory conditions	DOT GNWT				Due diligence checks need to be done with Public Works and Government Services Canada (PWGSC) to confirm the contractor exhibited sound project management practices in the past. In a design-Build Contract the Project Company assumes more responsibility for the preparation and training of its sub-contractors.	

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11	Project Administration	Contractors and Subs are Poor Administrators	This project has a number of moving parts. Both the Contractor and the Sub Contractors must follow sound administrative practices. Work, site investigations, surveys, soil sample results and invoicing must be meticulously documented and filed. Many Contractors and Subs are proud of their construction techniques but may fall woefully short in organizing administration.	Contractor Sub-Contractors DOT GNWT				Integrated Team to address protocols and expectations regarding administration and document control. DOT to sponsor dedicated training sessions. DOT and Human Resources to assist in attracting experienced and competent administrative staff for Contractors and Sub Contractors. DOT must also have staff available for quick response to change requests and access to technical expertise for decision making.	Research indicates that within the construction industry there is a reported significant incidence of errors resulting in change orders with associated costs, delays and issue disputes directly attributable to poor front office administration.
12	Initial Cost Estimates and Budgets are used to make early decisions	Important to ensure accurate cost estimates as under bidding is a major concern.	The project is in the early stages and it is important to evaluate the accuracy of estimates available at this time; funding is being secured at this stage and if enough contingencies are not built in or the estimates are not complete; it may be high risk in the later stages of the project. As this is a joint project with the Feds - all cost estimates must be as accurate as possible.	DOT GNWT				The Department must evaluate current estimates and make sure that enough contingencies are built in the cost estimates.	Under budget may jeopardize the delivery of completed project and pressure a contractor to make many claims.
13	Procurement Process	Ensure a fair and transparent process that is auditable and makes sense	This is a mega project worth many millions and the pressures to award will be great. The GNWT/DOT need to be extremely careful in ensuring an approved process is agreed to early in the project life and there is a clear and auditable trail for decision making and awarding work. Initial steps may lead to other decisions or force decisions which must be avoided.	DOT GNWT				The Project team and the various Departments involved needs to articulate a process or various options and a timetable to follow as soon as possible. There will be pressure to keep the work in the region and to also spread around the NWT. A balance will need to be achieved. There are many examples from other provinces/territories that could be used as a model. The audit trail for the awarding of the project must be well documented.	The project could get mired into a difficult and protracted process that detracts from the actual work. Lessons learned from other projects must be reviewed.
14	Legal	Claims	As a complex and multiyear project, early legal advice must be sought to ensure DOT avoids costly claims, law suits and other complex legal issues.	DOT				Early legal advice from DOJ required. Ensure a legal expert assigned to the project and remains fully engaged throughout.	Depending on the procurement option the legal issues could be extremely complex or simple.

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15	Project Schedule Possible Delays	Delays and Claims	The project schedule will include a timetable for: planning, design, permitting, procurement and construction. Contractors will lease/purchase equipment and delays may cause equipment to stand still. Opening the Hwy is not tied to any specific date such as a major bridge. Delays for the GNWT are not a huge issue.	DOT				Have a clear project schedule and logistics supply plan with enough time to do all the key steps. Depending on the construction contract the contractor may take the risk on the construction. The overall project delivery must be clearly communicated to avoid unnecessary gaps between activities.	Permitting, weather, geotech, design decisions, logistics and production rates will all impact the schedule. Permitting requires advance notice so if the scheduling and permitting notices are not synchronized the project company could inadvertently infringe on a permit or be held at a standstill.
Design and Technical									
16	Design and pre-engineering Works	Need to undertake all the proper design steps and site investigations	The project to be designed using current codes, standards and practices. Design build/P3 model may accelerate the project completion. Missing a key step or rushing a process may add significant risk	DOT GNWT				Efforts must be made to ensure all the relevant information is available before key decisions are made. Poor information will lead to significant errors in planning, cost estimates and budgets and increase risk. Extensive Geotech, Hydrotech, Geothermal and terrain studies need to be completed as part of the design phase. The studies need to be completed during the correct seasons and conditions to avoid inaccurate determinations.	Decisions made with erroneous data or poor assumptions will add unnecessary risks. Poor design or lack of information may increase the O & M costs in the life cycle of the infrastructure.
17	Design Team experience and depth of knowledge	Team depth and capacity to respond	The GNWT must ensure the technical Design Team is capable and has the necessary depth of resources to carry this project to completion and can react to all the project requirements. Any contractor or JV must have a high capacity team.	DOT GNWT				Ensure the Design Team has the necessary backup to deal with issues to include RFIs and technical questions. Track the exact timeline of all questions and responses. Contractor must also be fully capable to deal with issues in the field as well. DOT expertise supported by the TA will assist, as best possible, to validate and adjust any design flaws. High reliance on a proactive QC and QA plan.	**Any lack of depth and or experience may cause added costs or construction risks.**

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Regulatory and Process Risks									
18	Skilled Labour	Lack of Skilled Labour	The Contractor will require skilled labour (mechanics, welders, carpenters, heavy equipment operators, surveyors, techs, engineers) for this project. Failure to secure and retain skilled labour reduces productivity. This is a 5-6 year project that will be in direct competition with other projects.	Contractor GNWT				The Project Manager may facilitate an attraction plan by linking the Contractor with other Ministries involved in the training. While attraction and recruitment is primarily a contractor responsibility, the Government can offer assistance in shaping an attraction plan. It should leverage GNWT Department of Education, Culture and Employment programs. Communities along the project route should be encouraged to organize Class 1, 3, and 5 licensing training to prepare their youth for employment on the project.	It is in GNWT best interest to see the successful attraction of both skilled and semi-skilled labour to the project. Where it is practicable, Contractors should be encouraged to hire locally and offer employment to graduates of GNWT Department of Education, Culture and Employment certified apprenticeship programs such as Aurora College – School of Trades, Apprenticeship and Industrial Training.
19	Promoting local and Aboriginal Employment	GNWT Non-Compliance with Policy	Government Projects must reflect its policies regarding the promotion of employment among aboriginal peoples. Failure to do so brings a lack of confidence and public censure with the potential for litigation.	Contractor GNWT				The Project Manager will facilitate linking the Contractor with the Ministry of Aboriginal Affairs and Inter-Government Relations to ensure understanding of and compliance with these policies. The contractor will be required to report on local hiring percentages as well as equipment, rations and supplies purchased in the NWT and local region.	The intent is to demonstrate the GNWT is actively encouraging Contractors to support its policy of Aboriginal Affirmative Action. Northern Employment should be reported weekly and benefits to Northern Economy reported in the annual report.
20	Permits	Permits must be secured and remain valid	Permit Control can be problematic. Given the expected duration of the project there is risk of either permits not being secured in time; or, equally troublesome, permits expire before work is completed.	Contractor				Project Manager to transfer to Consultant who will be responsible to maintain a Permit Register, identify permit requirements and coordinate permits. Land Use Permit and Water Authority License are the responsibility of DOT while municipal permits are the responsibility of the contractor. To maintain the level of coordination and supervision required for this project the project manager cannot be double-hatted within DOT.	Project Manager to review Permit Register (monthly) Permitting requires advance notice so if the scheduling and permitting notices are not synchronized the project company could inadvertently infringe on a permit or be held at a standstill.

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					Construction Risks				
21	Project Management	Delay, claims geotech risk and engineering risks	The Project Manager must have the necessary resources (people and processes) to be able to properly manage this $700M project. This is a large and complex project that requires a high skill level and expertise to successfully manage and execute. Contracts, payments, planning, detailed scheduling, accounting, quality assurance and proper on site leadership are all functions that must take place to effectively execute this project. We need to ensure that GNWT has adequate resources and the time to handle these issues.	DOT GNWT				Ensure a Risk Analysis is conducted for each new company/team added to the Project and review work progress and quality of existing team. Ensure the proper staff and processes are in place and the key functions have enough depth to deal with a number of issues at the same time. Constantly review the organization and conduct post activity reviews to ensure all is being done to ensure success. This includes weekly updates. The project requires dedicated management, quality assurance personnel and administration which cannot be double-hatted with other projects.	Claims, time delays, court action, legal issues and cost overruns could occur. Work to be redone. Work delayed due to capacity issues. Quality issues arise. Public confidence would be affected.
22	Project Contracting	Type and number of contracts impacts the project management and quality assurance requirements.	Project can be a Design-Build-Maintain-Operate contract or any lesser combination. Each variant requires specific management and QA structures. If multiple construction contracts are awarded regionally this would also increase the scale of Project Management and QA.	DOT GNWT				Ensure that the appropriate project management structure and resources are in place to match the proposed contract before final negotiation of the contract. QC, QA, and Project Management must be designed to keep pace with the proposed construction schedule.	
23	Project Oversight And Quality Assurance	Project Risks	Project oversight committee to oversee the project at all stages. In case of P3 project delivery, the Concession Agreement to be drafted with complete risk assessment, risk mitigation and risk sharing aspects. For a standard construction contract the consequences of late completion, poor quality and not performing to the permits need to be laid out.	DOT GNWT				Ensure the proper staff and processes are in place and the key functions have enough depth to deal with a number of issues at the same time. Constantly review the organization and conduct post activity reviews to ensure all is being done to ensure success. Respond quickly to the issues and ensure risks are eliminated or mitigated or have a clear understanding of risk sharing. The project team should have members	Significant political and financial impact if project goes astray due to lack of oversight. Public Confidence eroded. Media interest extreme.

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								from all functional disciplines across DOT.	
24	Changes during Construction	Change Orders increase Time and Costs	Changes to design create change orders which bring either delays or added costs.	GNWT				Comprehensive Design Review is critical to ensuring a consistent construction plan. A DISCIPLINED control and approval process for change orders will be implemented. An Independent Engineer will be hired to, interalia, assist with verifying change requests. The requirement and process to have change orders approved in writing must be part of the contract.	Change Order approvals must be reviewed expeditiously so that construction work is not impeded or delayed awaiting decisions. Project Manager may require the services of a qualified consultant (with the experience on similar projects) to vet change orders.
25	Project Oversight	Project Manager`s Time is spread among several competing projects	Lack of attention causes missed problems that come to have major consequences	DOT GNWT				Project Manager should be assigned this single project permitting him/her to dedicate his/her full attention. Project Manager should have a dedicated financial assistant and administrative assistant throughout the project to ensure issues are tracked accurately.	

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Environmental Risks (Climate Change, Permafrost, Wildlife)									
26	Environmental Reviews and Approvals	Environmental restrictions or new elements add to costs	An Environmental Impact Study will describe and support the methodologies to be used during the construction project, but the decision to approve the project will be contingent upon the institution of conditions, cautions and restrictions regarding construction impacts. There is risk that these conditions could be ignored, misunderstood, or overlooked (and therefore violated) by the contractor. The contractor would thereby risk regulator responses that could include work stoppages, dismantling or redoing work and incurring procedural delays.	DOT GNWT				Environmental Affairs to be engaged in Risk Management Process. Both the Project Manager and the Contractors will review all environmental terms and conditions to ensure clarity and responsibilities. Review will include highlighting of sensitive areas such as waterways, wildlife sanctuaries and no go areas along each phase of the route. A dedicated environmental/regulatory resource will ensure and report on contractor understanding of, and compliance with, the GNWT's commitments, as well as the terms and conditions of the regulatory instruments obtained for the project.	
27	Work Spread Sites and Environmental Impacts	Operating Practises at Spread Sites cited for environmental infractions	The regulatory regimes under which the construction will take place impose stringent rules and regulations regarding camp operations and equipment sites. Violations frequently result in fines (contractor responsibility) or shut down/close orders. In the latter case, such delays could seriously jeopardize work on road construction and a cascade effect on cost escalations as equipment and crews stand by.	Contractor DOT GNWT				Before any spread site, staging camp or equipment fleet site is established, the Contractor will brief the Project Manager on the site location, concentration of personnel & equipment, and review the Health, Safety and Environmental Protection measures that will be in place. The Project Manager will confirm that the Contractor will be in compliance. Project Manager is to be on distribution for all cited infractions which will serve as an	

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								indicator of compliance There will be Environmental and Wildlife Monitors on site, with whom DOT's environmental/regulatory resource will liaise on a weekly basis, or as needed. The contractor is responsible to adhere to the project's overall Environmental Management Plan and to the site-specific management plans for which they have sole responsibility to produce and implement. DOT has the responsibility to confirm contractor's compliance.	
28	Environment - Wildlife	Impacts on Wildlife	Wildlife migration patterns are disrupted resulting in government intervention, project delays and change orders with increased costs. The GNWT could be perceived to disregard the wellbeing of subsistence animals and, by extension, of traditional harvesters.	Contractor GNWT				Ensure that construction activities avoid sensitive areas and times. Bird Nest sweeps must be conducted each day during the nesting season. All nests to be reported to DOT Environmental Affairs. Environment and Natural Resources (ENR) should be contracted to monitor the impact on wildlife during the duration of this project. The contractor is required to hire and administer wildlife monitors on site. These monitors will ensure and report not only the presence of, but also that the contractor allows wildlife to pass through active construction areas. Project activities can be adjusted to accommodate wildlife needs.	The global litmus test for an environmentally conscious public is the construction project's direct and indirect disruptions to wildlife habitat. The GNWT aim is to have demonstrable measures that safeguard both Nest sweeps must occur in all source pits, camps and construction areas. Raptors can fledge as late as October. These measures are to be included in the Project`s Communication Plan. Work may have to be halted temporarily while animals pass through the active project area. Occupied nests need to be avoided which could significantly delay work in the area.
29	Environment - Noise	Unanticipated Noise Impacts	High decibel or extended exposure to medium decibel noise affects both the public and wildlife Blasting could be problematic, affecting both humans and wildlife. If not rigidly	Contractor				Noise discipline practises to be enforced. Confirm blasting plan and communicate it to both the public and the Government. DOT to facilitate this understanding with other Government Departments	

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			controlled it could result in public enmity.					Spread Camps routine to address noise. Shut off equipment not in use (except in extreme temperatures when continuous running is the norm) Ensure that construction activities avoid sensitive areas and times. Environment and Natural Resources (ENR) will be responsible to monitor and report on the impact on wildlife during and following the project in accordance with the WEMP. The contractor is required to hire and administer wildlife monitors on site Project activities can be adjusted to accommodate wildlife needs.	
30	Environment - Water	Impacts to Water	Water will be in contact with project activities throughout the duration of the undertaking. The quality and quantity of water in the receiving environment could be adversely impacted by adjacent activities. Regulatory response could result in work stoppages, increased monitoring measures, and increased requirements for remedial measures.	Contractor				DOT's regulatory/environmental resource will monitor and liaise with project personnel to ensure that permit requirements are respected. Violations monitored by both legal authorities and the public. The Water Licences has very stringent terms and conditions. The environmental monitors will also need to act as aquatic effect monitors.	Too much water draw from a lake can impact fish and game thereby impacting subsistence hunters and fishermen. Lack of sediment and erosion controls can damage water quality downstream.
31	Climate Change and Weather	Ice Road and Barge operations and capacities as well as work delays and stoppages	Risk of road and barge operations commencing later and closing earlier. Risk of lack of transport capacity to deliver materials to the job sites. Ice Road serves all community resupply so this project will be in direct competition for convoy space. Staff work in inclement weather with: • Reduced productivity • Increased spread of disease and illness	Contractor Sub-Contractors Project Manager				Related to other serials concerning logistics and monitoring. This will require close monitoring. Scheduling and loading priorities are critical to avoid conflicts with community resupply requirements. Prepositioning of materiel via barge may serve to offset the demands on the winter roads.	Climate change can sometimes be more dramatic in the NWT and will need to be assessed. Inability to get supplies in by barge in summer due to aspects like low water levels may delay starting work until supplies can be delivered on an operational ice road.

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		Forest Fires	Water levels have been lower in recent summers which could indicate drought and increased threat of forest fires.					Depending on the construction schedule the impact would be greater on summer construction but could also impact how and where supplies should be stored. Will require an evacuation plan for summer workers.	Potential resupply route closures due to smoke and fire similar to summer 2014. Risk to employees due to smoke inhalation or fire.
32	Permafrost Region - discontinous	Road and Bridge building in permafrost to be considered during design and planning	Road and bridge building in permafrost is technically challenging and must be properly designed and controlled. This is a design challenge to build a road that is constructible and survives in the permafrost region without jeopardizing permafrost conditions or incurring major O&M costs.	Contractor DOT GNWT				The Design team to use all available tools and information to make sure road design will be effective in the environmental conditions. The QC and QA teams to ensure on site practices are being strictly adhered too. There are not many contractors or sub-contractors with experience in building roads in a permafrost environment. However, once the design is accepted, DOT bears the bulk of the risk for design failures.	Increased maintenance, operation and lifecycle costs.
			Along most of the route the high ground is to the East and the melt and subsequent water flow will be East to West where the road might act as a dike.	Contractor				Design must take into account allowance for ground water flow to escape to the Mackenzie River. This may require arch culverts at regular intervals.	If melt and ground water is blocked by road, flooding will occur in traditional hunting and harvesting areas leading to public backlash and expensive remediation measures.
			Karst Lakes are subject to collapse resulting in twice the normal average flooding	Contractor				The design must be able to withstand three times the 100 year average flooding. There should be no construction planned for the freshet period where risk of flooding is highest.	Biggest risk is to partially constructed sections at the end of the winter season.
			Risk that the surface around ponds and lakes will collapse due to the additional strain from the weight of the road if too close to water's edge.	Contractor DOT GNWT				Since it is known that the additional weight of the road can result in surrounding lake shores collapsing, should the contractor choose to build close to a water body, the	

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								contractor is assuming the risk that it may collapse during the warranty period.	
33	Intervention of Special Interest Groups/ Environment Lobby Groups	Agitation and confrontation impacting the Project	The Arctic is a sensitive area with local, national and global communities claiming an interest and/or a stake. All will have an opinion on the practises of the contractor and the GNWT regarding environmental stewardship. Infractions and either perceived or confirmed incidents or acts of negligence will negatively impact reputations of both the government and the contractors. This will invite even greater regulatory oversight with the attendant demands for changes to construction. Equally important, should the project fall into disfavour with the public (both Territorial constituents and those external to the NWT) it could jaundice future projects	Contractor GNWT				The Project Team will develop a Communications Strategy that showcases the GNWT commitment to the environment and the regulatory regulations to be followed. The environment will be an identifiable and separate agenda at all project and Risk Management Reviews. The Communications Plan will include the concrete measures it institutionalizes integral to the project's management as evidence that it is a strong environmental steward. There will need to be detailed consultation with all regulatory, co-management, and community stakeholders There should be a working group established to provide regular stakeholder engagement opportunities under a DOT Chair that meets to update the members and seek their input.	The impact of a poor report card regarding environmental stewardship is multi-facetted. Some consequences will be obvious such as fines and re-construct or redo orders. Others may be indirect but no less painful for both the Government and the Contractor and could include: • Reluctance of financial institutions to lend to the contractor • Reduced public support for the Government because of an eroded confidence in its environmental protection practises
34	QA/QC All Special Advisors	Not completing the required due diligence	QC/QA teams ensure all design and construction meet exacting standards. The Project places significant trust in and relies upon the work and recommendations of various experts and consultants involved.	DOT GNWT				Qualified companies and personnel who have the knowledge and experience to add value to the project are doing this work. Quality Control (QC) requirements are clearly stated in the relative sections of the contract documents. Proper processes are in place to ensure the work is complete and proper checklists or procedures are in place and nothing is over looked or missed. DOT will hire qualified personnel for the Quality Assurance (QA) functions.	Redoing major components of the project. Court action. Loss of public confidence. Safety issues.

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35	Public Confidence Media	The public see this project in many different ways. Public confidence is important for the project.	Lack of good and timely communications and spreading of rumours may lead to the public lacking confidence in the Project. The Procurement process must be transparent and accountable to the public.	DOT GNWT				Concentrate on good communications and excellent coordination Having a clear and concise process that is approved early and all are aware is important to get ahead of the folks who want to get the word via unofficial channels	Poor press and a lack of communication will impact the project with added distractions. Develop a web site that communicates • Notifications to the Public • Health & Safety tips • Progress and Milestone Achievements
36	Political Risks	Political Influence	There may be opportunities for decisions to be influenced through the political process	DOT GNWT				A clear and concise process for decisions and procurement are developed using the best practises for PM	PM team to be fully aware of all the issues and the impact of decisions.
			This project will span two separate land settlement agreement regions.	DOT GNWT				Need to ensure that all aspects and any differences between the agreements in each region are understood and applied in the contract.	Failure to adhere to the land settlement agreements will cause political and public dissent towards the project.
37	QA/QC against Inferior Materials	Materials are not of sufficient quality or good materials are not of a sufficient quantity.	Use of Inferior materials (geotextile, bridge materials) risks the integrity of the construction and places public at risk. Delays and increased costs (both time and money) to reorder/reship materials and redo construction.	Contractor DOT GNWT				Establish product specifications and procure from reputable suppliers with experience in providing to the North Establish stringent quality assurance/ quality Control measures that include inspections and testing before products leave manufacturer and on receipt and installation.	Gravel for base is quarried in region, surface gravel is not.
38	Scarce Resources	Resources and products not available	Pre-fabricated steel products, attachments, culverts and other materials required for road and bridge construction	Contractor DOT GNWT				Project Manager to determine materials specification early and share supplier information	

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			may be in short supply – creating delays in construction					Integrated Team to conduct a staff check of availability and lead times. Integrated Team to host a transportation working group with ground and barge service providers to confirm capacity It is assumed that the contractor being from this region is aware of the supply chain limitations and has designed his schedule accordingly. Finalize schedule and order materials well in advance of requirement.	
			NWT Manufactured Products Policy requires contractors to purchase certain items such as bridge components and signage from a limited number of Northern Manufacturers.					The tender and contract documents must clearly explain the policy. The project schedule must take into account the manufacturers' procurement process and schedule.	This could drive up the cost to the contractor and be passed on to the owner. The supply chain may not be able to keep up with the demand.
39	Material Price Escalation	Increased Costs	Prices may escalate over time or due to scarcity.	Contractor				Negotiate Fixed Price Contracts early.	
40	Transport Monopolies	Increased Transport Costs	There are a limited number of safe haulage companies and independent truckers willing to travel the ice road to Spread Sites. Barge operators – no excess capacity. This creates a potential for monopolistic pricing. For most of the project the winter road or barging will be the only means of resupply. Supplies can get to Wrigley via an all-weather road.	Contractor DOT GNWT				Lock in price agreements early Extend completion date Confirm Work Schedule and deploy resources early.	The volumes of material (aggregate, concrete, lumber, culverts, guard rails, rebar for bridging, etc.) must be purchased early and transport booked within narrow window times. All of this is predicated on confirming a realistic work schedule (Gant Chart)

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41	Projects in Competition	Equipment and Material Scarcity	There are numerous projects (Oil and Gas drilling, communications cable and tower construction, infrastructure improvements) all competing for materials, leased equipment and cargo capacity to bring it forward on rail (to Hay River) barge or ground transport. Risk this Project may suffer lack of availability of material and equipment resulting in delays	Contractor GNWT				Finalize Work Schedule and build in flexibility with road construction such that if materials or equipment is not available at one job site, switch priority to other sites. Consider pre-positioning quantities of material in advance of need.	Just in Time Delivery increases the risk of non-availability or non-delivery. Project may have to accept increase costs of idle equipment.
Financial Risks									
42	Project Funding	Project is Underfunded	Global economies restructure debt, creating liquidity issues, inflation and higher interest rates. The Contractor incurs higher prices for goods and services and increased borrowing costs. Subsequent phases of the project may be cash strapped	Contractor DOT, GNWT				Develop innovative payment schedule that recognizes the Contractor needs. Develop a Joint Presentation to Lending Institutions to build confidence in viability of the project. Where possible, secure long term leases for fixed price goods and services.	The global economy is fragile. The direct impact on the Mackenzie Valley Highway Project will be higher costs largely because inflation will drive up the prices of goods and services. Banks may be reluctant to loan money for subsequent phases of the project and then only at higher interest rates.
43	Compatibility of Payment Schedule linked to Work Progress	Contractor has Cash Flow Problems and fails to meet payroll and pay suppliers.	The Contractor must pay out large sums to secure labour, materials and transport for delivery to spread sites. Insufficient cash flow could result in skilled labour quitting and suppliers and service providers refusing service or litigation Worse Case – Contractor becomes insolvent and project is jeopardized	Contractor DOT GNWT				DOT to develop a complete understanding of the Contractor's Concept of Construction and the Project Manager's work and payment schedules. QA Staff must be on site to quickly verify milestone completion achievements to facilitate timely payments. Due diligence will be done to the best of DOT ability to verify the contractor's fiscal health.	While there is always some conflict between the Contractor who wants payment early and often as opposed to the Government who must exercise probity and due diligence and therefore only wishes to pay for (verifiably) completed work – achieving a balance requires a collegial resolution. A Milestone adjustment process needs to be in place and synchronized between completed milestones and construction progress payments.

Serial	Risk Area	Risk Element	Description	Primary Resp	Level of Risk (likely to occur) 1-5	Level of Impact 1-5	Rating 1-25 15 is high	Actions - Mitigation/Risk Reduction/Contingency	Potential Impact Notes
44	Insolvency	Contractor Enters Bankruptcy Protection	Contractor becomes insolvent with risk that he ceases work and creditors cease materials, plant and equipment.	Contractor GNWT				Organize the construction process such that it is a series of stand-alone projects with achievable milestones. Develop a reasonable payment schedule and ensure prompt payment (See serial 34)	Bankruptcy affects reputation of Government and Contractor.
Health and Safety Risks									
45	Labour	Health and Safety Programs	The job sites incur a high incidence of accidents resulting in lost time, fines and the potential for criminal charges. Specific injuries could be attributable to: • Failure to wear Personal Protective Equipment • Preventable Vehicle and Earth Moving Equipment Accidents • Over exposure to the elements • Unsafe movement around water • Failure to install guards, barriers or hazard notices • Improper Storage of Hazardous Materials • Failure to protect the public from exposure to unsafe conditions	Contractor Sub Contractors GNWT				Integrated Team to collegially develop a Project Health and Safety Program which will include formal training. All hired trades must have current certifications for handling of equipment and execution of duties (includes safe-backing courses, chain saw operators course, demolitions certificates) Contractor is responsible to follow Workers' Safety and Compensation Commission (WSCC) Health and Safety Standards and to ensure that the sub-contractors also adhere to those standards.	Studies indicate Health and Safety issues are the 4th Greatest Risk in the Construction industry. Workmen's compensation claims are increasing while Sureties demand higher premiums and scrutinize claims.
46	Labour Workman's Compensation Claims	Claims	Reduce the number of WSCC claims	Contractor Sub Contractors				Develop a dynamic Health and Safety Program that includes training focused on the most common injuries in the industry. Ensure workers are protected from the	

Serial	Risk Area	Risk Element	Description	Primary Resp	Level of Risk (likely to occur) 1-5	Level of Impact 1-5	Rating 1-25 15 is high	Actions - Mitigation/Risk Reduction/Contingency	Potential Impact Notes
								elements. Actions to include: • Ensure heat is available at job sites • Introduce an incentive program for good safety records (and negative reinforcement for infractions)	
47	Labour - Injuries	Slow Response Times to Treat Injured	Reduce injuries	Contractor DOT GNWT				The Integrated Team will develop a Medical Coverage Plan that includes: • Qualified First Responders at every job site (Training and incentives to be offered to Lead Hands for Advanced First Aid certification) • Medical Aid Stations established at all Camps and Spread Sites • Designated evacuation vehicle at all camps, job sites if not isolated site • Isolated Sites will have registered aero-medical evacuation coverage. Sites will have a designated Landing Zone and communications with sufficient range to either talk direct to medical staff or to a Spread Site who can • Spread Site to have limited pharmacy to issue cold and flu and related non-prescription drugs (can be user pay) Contractor is responsible to follow WSCC Health and Safety Standards and to ensure that the sub-contractors also adhere to those standards.	Camp life forces large numbers of workers to share close quarters with risk of contagious disease outbreaks. Early treatment of symptoms will help mitigate sick time among the workforce. Scheduling regular preventative maintenance inspections will identify potential health problems and mitigate the risk of illnesses.
48	Public Health and Safety	Public Exposed to Job Site Hazards	Risk of irritation/injury from roads not marked/barricaded close to public, unprepared for blasting, vehicle accidents from movement of oversized equipment.	Contractor DOT GNWT				Integrated Team to publish and place notifications with radio and on web site. Signage and notifications are evident and construction is outside populated areas. Advanced warning of detours on winter roads due to MVH Construction.	

Serial	Risk Area	Risk Element	Description	Primary Resp	Level of Risk (likely to occur) 1-5	Level of Impact 1-5	Rating 1-25 15 is high	Actions - Mitigation/Risk Reduction/Contingency	Potential Impact Notes
					Culture and Heritage				
49	Impacts on Traditional Hunting and Fishing	Violation of Public Trust/Change Order Risks	Public surveys demonstrates there is widespread support for the Road but conditional on there is to be no disruption to bear and carnivore denning, bird and fish breeding grounds or the migratory routes of bison and caribou. Indigenous people expect their traditional ways of life, including ties to the land through hunting and fishing will remain unchanged. Not all wildlife sanctuaries are known but as they are discovered, the conditions must be respected and change orders affected to by-pass these sensitive areas. Deliberate violations will bring dissent and public intervention.	Contractor Sub Contractors DOT, GNWT				Crews must be educated for signs of these sensitive areas, note them and advise of the need for variations. Staff working on the road's construction must be trained to recognize and respect wildlife sensitive areas. Bird Nest sweeps must be conducted each day during the nesting season. All nests to be reported to DOT Environmental Affairs. The Project is to incorporate a three tiered approach: • Avoid and by-pass; • Temporal – at all costs stay clear of breeding sites; and • Operational – train and enforce these measures Publicize Project efforts regarding respect for Inuit culture on web site.	There is a local respect for the flora and fauna. Violations will quickly transform support to dissent. Nest sweeps must occur in all source pits, camps and construction areas. Raptors can fledge as late as October. There is a delay between construction occurring and wildlife and fish impact surveys. Key risk to monitor and report annually.
50	Archaeological Discoveries	Change Order Risks	There are many known archaeological sites noted in the PDR within the area through which the road will pass. Inevitably, other sites of archaeological significance will be discovered. These must be by-passed and the road re-routed. Risk of increased costs to address variations. Potential risk of Public dissent should violations occur. High risk of this occurring because staff and construction crews do not have the technical knowledge to interpret a site of archaeological significance.	Contractor Sub-Contractors DOT, GNWT				Seek professional assistance in recognizing these sites. Establish a protocol with professional teams to investigate. The route has already been reviewed and mapped for archaeological sites. Will require GNWT Department of Education, Culture and Employment personnel to stand by to verify any archaeological claims that may be raised. Train and educate crews.	Indigenous people hold their heritage close to their hearts. There is a resurgent interest in Northern history and these archaeological finds are a link to the past. Violations will be seen as a blatant disregard for local culture and can become a rallying cry for dissent.

Appendix 9

Letters of Support

norman wells

August 19, 2014

Minister Tom Beaulieu
Rec'd 8-21-14
Log #
To MTB RH
Brief req'd
Resp req'd ✓
Info Item
Other
File
Review Initial

Honourable Tom Beaulieu
Minister of Transportation
Government of the NWT
Box 1320
Yellowknife, NT

Dear Minister Beaulieu:

Thank you for meeting with members of Town Council on July 17th. We appreciated the updates provided regarding your portfolios and, in particular, the update on plans for the Mackenzie Valley Highway.

The Town of Norman Wells is fully supportive of the plan to complete the Wrigley to Norman Wells section as the next phase of highway construction. As discussed at our meeting, we would like to recommend that construction funds be directed solely towards highway construction prior to funding of the Bear River bridge. While we support the eventual construction of the bridge, the completion of the construction of the highway combined with the use of ferries would provide a significant improvement in transportation access for both industry and residents. We feel it is crucial to future development, that access between Wrigley and Norman Wells be expedited as soon as possible.

We thank you for the opportunity to meet with you and contribute our perspective for your consideration. We will support your decision on the Mackenzie Valley Highway project.

Sincerely,

Gregor Harold McGregor, Mayor
Town of Norman Wells

cc: Hon. David Ramsay, Minister of Industry Tourism and Investments
Norman Yakeleya, MLA, Sahtu Region

Town Office
Box 5
Norman Wells, NT
X0E 0V0

Oil Capital of the N.W.T.

PH: (867) 587-3700
FX: (867) 587-3701

THE SAHTU SECRETARIAT INCORPORATED
P.O Box 155,
Deline, NT X0E 0G0
Tel:(867) 589-4719, Fax (867) 589-4908

June 3, 2014

Honourable Tom Beaulieu
Minister of Transportation
Government of the Northwest Territories
P.O. Box 1320
Yellowknife, NWT X1A 2L9

Re: Mackenzie Valley Highway

Dear Minister Beaulieu;

With regards to the above, this is to inform you that recently, the Sahtu Secretariat Incorporated passed a resolution at our regular board meeting on Thursday, March 27th, 2014.

This resolution is in agreement to support the extension of the completion of the Mackenzie Valley Highway from Wrigley, Northwest Territories to Inuvik, Northwest Territories.

Should you require further information, please call Executive Director, David Little @ 867-589-4719, ext: 24 or email him at ssi_exec_director@gov.deline.ca

Respectfully,

Ethel Blondin-Andrew
Chairperson

Appendix 10

P3 Suitability Assessment Questionnaire

P3 Suitability Assessment Questionnaire

Under the GNWT P3 Policy and Management Framework, all projects over $50 million must undergo a full P3 feasibility/opportunity analysis and P3 business case process. This analysis framework meets the full P3 Canada requirements. This independent assessment is currently underway and the results will be shared with Infrastructure Canada once completed.

No.	Criteria	Explanation	Score	Response Indicators				
				5	4	3	2	1
1	**Asset Life: What is the anticipated useful life (i.e. service life) of this asset?**	The duration of P3 contracts tends to be tied to the useful life of the asset and, in general, longer-lived assets tend to be better suited to a P3.	5	Asset life is greater than 25 years.	Asset life is 20–24 years.	Asset life is 15–19 years.	Asset life is 10–14 years.	Asset life is less than 10 years.
	Scoring Rationale for criteria 1	With routine maintenance and occasional rehabilitation, the Wrigley to Norman Wells segment of the Mackenzie Valley Highway will be a permanent asset.						
2	**Asset Complexity: How complex is the asset both with respect to construction and operations & maintenance?**	P3s lend themselves to complex investments. Complexity can arise as a result of the nature of the asset, the site on which it will be constructed, or the number of distinct asset classes involved in the investment.	2	Combines three or more asset classes or varying complexity (i.e. building + road + outbuildings).	The planned investment by its nature is very complex.	Combines two asset classes of medium complexity (i.e. rail line and station).	Combines two asset classes of low complexity (i.e. road and toll booths, or one asset of higher complexity, water treatment plant).	Single asset of low complexity.
	Scoring Rationale for criteria 2	Road and bridge.						
3	**Outputs and Performance Specifications (Construction): What is the availability of output specifications for the construction of the asset?**	P3s are characterized by the public sector setting their desired outcomes or outputs in the form of measurable technical output/service/performance specifications that provide the basis for performance based contracts.	5	Output specifications for the construction of same type of asset(s) exist and are available.	Output specifications for the construction of similar asset are available.	Existing conventional specifications can easily be converted into output or performance specifications for construction.	Existing conventional specifications can be converted into output or performance specifications for construction.	New technical outputs and specifications for construction will have to be developed.

No.	Criteria	Explanation	Score	Response Indicators				
	Scoring Rationale for criteria 3	Very similar specifications to Inuvik-to-Tuktoyaktuk project.						
4	**Stability of Operational Requirements: Are the long term operational requirements of the planned asset relatively stable and predictable?**	Assets with stable and predictable performance and maintenance requirements lend themselves to P3delivery.	5	Operational and maintenance requirements are predictable and stable.	Operational and maintenance requirements are predictable, but have some instability based on known factors.	Operational requirements are unstable, but maintenance requirements are predictable.	Operations requirements are not stable and maintenance requirements are somewhat predictable.	Operations and maintenance requirements cannot be predicted and are unstable over the useful life of the asset.
	Scoring Rationale for criteria 4	May change year-to-year due to changes in weather, use, and permafrost, but operational and maintenance requirements are predictable and stable over a multi-year rolling average.						
5	**Performance Specifications and Indicators (Operations Period): What is the availability of operations- and maintenance-related performance specifications and indicators?**	Establishing and monitoring performance in relation to key performance indicators (KPIs) is an important element of performance based contracts, a foundational element of P3s.	5	Performance outputs and indicators for operations and maintenance are available.	Performance outputs and indicators for operations and maintenance exist, but are not readily available.	Performance outputs and indicators for operations and maintenance of comparable assets exist and are available.	Performance outputs and indicators for operations and maintenance of comparable assets exist, but are not readily available.	Performance outputs and indicators for operations and maintenance will have to be developed.
	Scoring Rationale for criteria 5	Standard road construction and maintenance in a northern environment.						
6	**Life-Cycle Costs: Can most of the full life-cycle costs of the asset, mainly related to construction and fit-up (i.e. project costs) and long-term operations, including maintenance, be quantified upfront with reasonable assumptions and/or availability of historic data?**	Life cycle costs are very important factor in success of a P3. The public authority will pay for maintenance and/or operation through the P3 agreement and expects the asset to be well-maintained and efficiently operated at the lowest cost possible.	5	The total asset life-cycle costs are well understood and accurate estimates can be developed by the public authority.	The total asset life-cycle costs are understood but estimates, while accurate are incomplete to some extent.	The total asset life-cycle costs are well understood, and can somewhat be accurately estimated by the public authority.	There is limited understanding of life-cycle costs but costs cannot be accurately estimated by the public authority.	The total asset life-cycle costs are not well understood and cannot be estimated by the public authority.

No.	Criteria	Explanation	Score	Response Indicators				
	Scoring Rationale for criteria 6	Standard road construction and maintenance in a northern environment.						
7	**Revenue Generation: Does the planned investment have inherent scope to generate any revenue?**	Revenue generation is not a requirement for a successful P3. However, where an asset could potentially generate revenue and reduce the burden on public funds, the P3 model is ideally suited to leveraging that potential.	3	The planned investment will generate revenues and the private sector may be willing to assume associated revenue risk.	The planned investment could generate revenues and private sector may be willing to share revenue risk.	The planned investment could generate revenues and the private sector's willingness to accept revenue risk is unknown.	The planned investment could generate minimal revenues and the private sector is unlikely to accept any revenue risk.	It is unlikely that the planned investment will generate any revenues.
	Scoring Rationale for criteria 7	The potential for toll revenue exists, but this will not be enough to operate on even a full cost-recovery basis. The road will generate significant secondary and tertiary revenues through opening up the Central Mackenzie Valley to resource development, but these revenues will be realized in resource revenues, increased wages and tax revenue, etc.						
8	**Private Sector Expertise: How many private sector firms have the capacity to deliver and maintain this type of asset?**	The availability of private sector expertise is critical for two reasons: (1) ensuring a competitive bidding environment; and (2) ensuring that there is private sector capacity to perform the functions and manage the risks envisioned in the P3.	5	There are more than 5 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset.	There are more than 5 private sector firms capable of designing, constructing and maintaining this type of asset. Operations capability is not yet determined.	There are 3 to 5 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset.	There are 3-5 private sector firms capable of designing, constructing and maintaining this type of asset. Operations capability is not yet determined.	There are fewer than 3 private sector firms capable of forming teams with the expertise to design, construct and maintain/operate this type of asset.
	Scoring Rationale for criteria 8	There are five NWT Construction firms, as well as numerous southern firms, that would be capable of combining with engineering and structural firms to design, construct, maintain, and operate this section of the Mackenzie Valley All-Weather Highway.						

No.	Criteria	Explanation	Score	Response Indicators				
9	**Market Precedents: Have investments with similar requirements and of similar size and scale been delivered through the P3 model?**	The existence of P3s for similar assets is a key indicator regarding the viability of a P3.	4	Investments of similar size and scope have been delivered as P3s in Canada.	Smaller investments of similar scope or, of similar size but smaller scope have been delivered as P3s in Canada.	Investments of similar size and scope have been delivered as P3s internationally.	Smaller investments of similar scope or, of similar size but smaller scope have been delivered as P3s internationally.	Investments of similar size and scope have not been previously delivered as P3s.
	Scoring Rationale for criteria 9	Road projects have been delivered as P3s in Canada, and to higher standards, although the length and construction environment of the MVH Wrigley to Norman Wells makes it somewhat different.						
10	**Nature of Development Site: What is the nature of the development site (greenfield vs. brownfield) and what proportion of this investment involves the expansion/renovation of existing facilities/assets?**	In general, investments involving all new construction on previously undeveloped sites lend themselves to maximizing risk transfer to the private sector.	3	Asset is new construction on an undeveloped site.	Asset is new construction on an already developed site.	The planned investment involves at least 50% new construction and also significant renovations to the existing asset.	The planned investment involves expansion and/or refurbishment of an existing asset.	The planned investment mainly involves refurbishment, modernization, minor renovation, or involves integration of new facilities with existing facilities.
	Scoring Rationale for criteria 10	The site is disturbed by the yearly construction, maintenance and use of the winter road system, but this melts away every year; no previous development exists except for permanent bridges. Much of the route follows along cleared winter road right of way.						
11	**Scope for Private Sector Innovation Gains: To what extent will the public sector be able to rely on output/performance-based requirements/specifications?**	The scope for private sector innovation is inversely related to the public sector's need to be prescriptive.	3	The public sector is able to use output specifications for all phases of the investment life-cycle.	There are very few areas where the public sector feels it must be prescriptive/use input-based specifications.	The planned investment requirements will be a mix of input-based and output-based requirements.	The planned investment's design and construction will be based on input specifications.	The public sector must define specific input requirements for the majority of the asset.

No.	Criteria	Explanation	Score	Response Indicators				
	Scoring Rationale for criteria 11	The Mackenzie Valley Highway will need to meet certain road output capabilities and environmental compliance requirements, but we will be seeking design and construction innovations based on various permafrost studies ongoing in Alaska, the Yukon, as well as on NWT Highway 3 test sections and the ITH test sections.						
12	**Potential for Contract Integration: Which elements of the potential P3 (i.e., design, build, finance, maintain, operate) can be integrated into one contract?**	One of the mechanism by which P3s generate value is the integration of various elements of the potential P3 (i.e., design, build, finance, operate/maintain). The greater the potential for integration, the more likely a P3 will be viable.	4	All elements of a potential P3 (i.e. design-build-finance-maintain-operate) could be integrated into one contract.	Design-build-finance-maintenance and some operations could be integrated into one contract.	Design-build-finance and some maintenance could be integrated into one contract.	At least design- build-finance could be integrated into one contract.	Only two elements could be integrated into one contract.
	Scoring Rationale for criteria 12	There is potential to incorporate design, build, operate, and maintain elements into the contract; however, ongoing risk associated with permafrost, isolation of the route and the fact anticipated toll revenue would not be sufficient to fully fund the maintenance costs of the road may impact viability.						

Appendix 11

Environmental, Aboriginal Consultation and Project Location Questionnaire

Environmental, Aboriginal Consultation and Project Location Questionnaire

Part A.1: General information

Project Name: Wrigley to Norman Wells segment of the Mackenzie Valley Highway

Project Proponent: Government of the Northwest Territories

Contact person and their contact information for any question Infrastructure Canada could have regarding the environmental assessment and/or aboriginal consultation:

Name:	Rhonda Batchelor, Director of Environmental Affairs
Address:	Lahm Ridge Tower, 2nd Floor 4501 50 Avenue P.O. Box 1320 Yellowknife, NT X1A 2L9
Phone:	867-873-7063
Email:	Rhonda_batchelor@gov.nt.ca

Part A.2: Project and existing environment description

Project Description:

The Wrigley to Norman Wells segment of the Mackenzie Valley Highway (the Project) involves the construction of a 333 km all-weather road from Wrigley to Norman Wells. Highway design parameters are based on published and accepted guidelines and best practices for developing infrastructure in the NWT, including best practices for permafrost management. The highway design would see a road placed within a 60 metre wide right-of-way (ROW) except where large cut and fill sections will be required. The design is for a 333 km Rural Arterial Undivided (RAU-90) road.

Typical activities proposed over the project's six-year construction phase include embankment construction, development of borrow sources, construction of remaining water course crossings, and supporting activities such as access road development, fuel and material storage, camp operation, and waste management.

The proposal also requires the construction of one major bridge designed in 2006 to span the Great Bear River near Tulita, a community south of Norman Wells. An environmental assessment and water license required for the Great Bear River Bridge are already complete bringing the estimated cost of its construction to $70 million, which is included in the total proposal of $700 million.

Description of the existing environment:

The highways alignment, defined by Public Works Canada in the 1970's, is expected to be predominately within a footprint already established for the public winter road and incorporates the existing permanent bridges at water crossing locations. No additional land is anticipated to be required to be secured for the project.

Instructions to respondent: For **Parts B and C of the Environmental Assessment Questionnaire**, select only "Yes" if applicable to the proposed project. When "Yes" is not selected, "No" will be assumed.

Part B.1: Projects identified on the *Regulations Designating Physical Activities* – Does any part of your project involve the construction, operation, decommissioning or abandonment of the following infrastructure?

Yes ❑ Electrical transmission lines
Yes ❑ Electrical generating facility
Yes ❑ Structure for the diversion of water including dam, dyke or reservoir
Yes ❑ Canal, lock or structure to control water level
Yes ❑ Oil and gas pipeline
Yes ❑ Marine terminal
Yes ❑ Railway line and / or Railway yard
Yes ☑ All season public highway
Yes ❑ Aerodrome, airport or all-season runway
Yes ❑ Hazardous waste facility
Yes ❑ Waste management facility
Yes ❑ Industrial facility
Yes ❑ Offshore exploratory wells
Yes ❑ Off-shore floating or fixed platform, vessel or artificial island
Yes ❑ International or interprovincial bridge or tunnel
Yes ❑ Bridge over the St. Lawrence Seaway

Part B.2: Are any part of the project or activities proposed to be located within:

Yes ❑ A wildlife area
Yes ❑ A migratory birds sanctuary

Part B.3: Is the project a designated project according to the *Regulations Designating Physical Activities*?

Yes ❑ No ☑ Unknown ❑

If "Yes" to the question above, have you provided the Canadian Environmental Assessment Agency with a project description as per Section 8(1) of the *Canadian Environmental Assessment Act*?

Yes ❑ No ❑

Comments (if any): Mackenzie Valley Resource Management Act Applies – EA in process

Part B.4: Federal Lands
Would any part of the project or activities be located on:

Yes ❑ Federal land
Yes ❑ Indian Reserve land

Part B.5: Would any part of the project or activities be located in:

Yes ❑ Internal waters of Canada, in any area of the sea not within a province
Yes ❑ The territorial sea of Canada, in any area of the sea not within a province
Yes ❑ The exclusive economic zone of Canada
Yes ❑ The continental shelf of Canada

- If you answered "yes" to any of the above (B.4 and B.5), please provide the information regarding the federal land administrator and a description of federal lands (a map should be included if available).
- Also indicate if the entire project footprint is located on federal lands. If not, please indicate the portions that will take place on federal lands.
- Are important environmental issues expected as a result of this project? If "yes", please elaborate.
- Are important public concerns expected as a result of this project? If "yes", please elaborate.

Part B.6: Is any part of the project located in whole or in part on land potentially contaminated by previous activities:

Yes ❑ No ☑

Comments (if any):

Part B.7: Is an environmental site assessment available for this project regarding contaminated site(s):

Phase I:
Yes ❑ No ❑
Phase II:
Yes ❑ No ❑
Phase III:
Yes ❑ No ❑

If you answered "yes" to any of the above, please provide any report(s) that are related to the project if not already done. If the report(s) is/are at the development stage, please, provide the following information: which phase(s), when it/they will be completed and when it/they will be sent to INFC.

Part B.8: Does the project (either in full or in part) require a provincial environmental assessment or an environmental assessment under a northern regime or other regime?

Yes ☑ No ❏

If you answered "yes", please provide any report(s) that are related to the project if not already done. If the report(s) is/are at the development stage, please, provide the following information: when it/they will be completed and when it/they will be sent to INFC.

The Project Description Report submitted to the Mackenzie Valley Environmental Review Board is attached as Appendix 2. Detailed technical Project Description Reports completed in partnership with the Aboriginal Organizations in the Mackenzie Valley Highway are available on the Mackenzie Valley Environmental Review Board and Department of Transportation's websites. Due to extreme file size and pages, they have not been submitted as part of this package. The Terms of Reference for the Developer's Assessment Report was issued by the Mackenzie Valley Environmental Review Board in February 2015. The Government of the Northwest Territories is currently working to complete the Developer's Assessment Report. DOT anticipates completing the environmental assessment process and all permitting activities in 2017.

Part C: Aboriginal Consultation Questionnaire

Part C.1: Involvement of the Crown –
Other Federal or Provincial Departments or Agencies who may have a duty to consult Aboriginal peoples due to their involvement in the project (e.g.: permit and/or authorization), such as, but not limited to:

Other Federal or Provincial Departments or Agencies	Yes	No	Unknown
Fisheries and Oceans Canada (e.g. *Fisheries Act*)	Yes ❏	No ☑	Unknown ❏
Transport Canada (e.g. *Navigable Waters Protection Act*)	Yes ❏	No ☑	Unknown ❏
Environment Canada (e.g. *Species at Risk Act, Migratory Birds Convention Act, Canadian Environmental Protection Act*)	Yes ❏	No ☑	Unknown ❏

Other Federal or Provincial Departments or Agencies	Yes	No	Unknown
Natural Resources Canada **(e.g. *Explosives Act*)**	Yes ❑	No ☑	Unknown ❑
Canadian Environmental Assessment Agency	Yes ❑	No ☑	Unknown ❑
Parks Canada Agency	Yes ❑	No ☑	Unknown ❑
Health Canada	Yes ❑	No ☑	Unknown ❑
Other departments **(e.g. federal department, provincial department, funding department, ...)** **If applicable, please identify the federal department or agency and approval required ____________________)**	Yes ❑	No ❑	Unknown ☑

If you answered "yes" to any of the above, please describe the involvement of the identified department(s)/agency(s) in detail.

Note that federal agencies will be involved in Environmental Assessment and permitting process and related consultations. Aboriginal groups along the Mackenzie Valley were directly involved in the development of the project description reports to help ensure local concerns were mitigated through project development.

Part C.2: Activities Related to the Project

Activities related to the project	Yes	No
Does the project involve works or activities on, under, over, through or across a water body such as a wetland, stream, river or lake?	Yes ☑	No ❑
Are there any land use changes that may affect traditional activities such as, but not limited to, deforestation or clearing of vegetation?	Yes ☑	No

Activities related to the project	Yes	No
Is any component of the proposed project located outside the existing project footprint?	Yes ❑	No ☑
Will ownership of land change as a result of the project?	Yes ☑ ❑	No
Is the project occurring on land that has yet to be developed / disturbed?[1]	Yes ☑ ❑	No
Are there any relevant project activities that might affect other aspects of the environment (e.g. sound and/or noise level increased, barrier limiting the access for harvesting, runoff in a watercourse excavating activity)?	Yes ☑	No ❑

[1] If you answered yes, please, provide details regarding how much land will be affected by the project in the description below.

- If you answered "yes" to any of the above, please provide a description or the activities described in part C.2.
- Have you been in contact or do you plan to contact any Aboriginal groups regarding this project? If "yes", please provide some details regarding the nature of your communication and include in an attachment any information that may be useful (e.g. contact information, letters, emails, public notices, and any other types of communications).
- Are any potential issues expected as a result of this project? If "yes", please elaborate.

The project will involve crossing over the Bear River, through the construction of the Bear River Bridge. Permits have already been acquired for the Bear River Bridge construction, however they will have to be renewed. The construction of the all-weather highway will also mean that access will be year-round access to communities in the Central Mackenzie Valley, which will result in socio economic impacts (both positive and negative).

Aboriginal governments are very supportive of the project. Community meetings held in each of the Sahtu communities have expressed support for the highway, and keen interest in participating in its construction. Official letters of support have been received from the Town of Norman Wells and the Sahtu Secretariat Incorporated. Copies of these letters are attached as Appendix 9.

No potential issues with Aboriginal groups are anticipated as a result of the Project. They have been involved as partners since project inception.

Part D: Project Location Questionnaire

In order to facilitate and accelerate the assessment of your request for funding, Infrastructure Canada needs to geographically locate your project accurately. The information provided will ensure the proper location of the project for future reference. You are therefore asked to complete this questionnaire to the best of your knowledge and with as much precision as possible.

Part D.1: Project Location

Project with no fixed address or multiple components

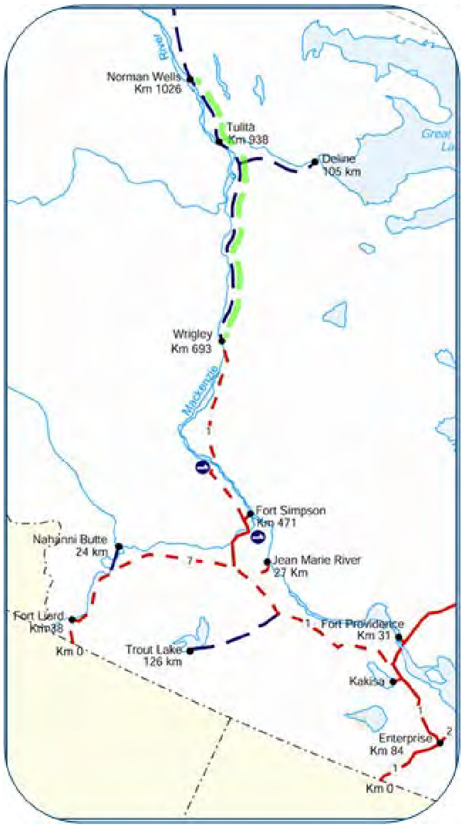
*Please indicate, **for each project component**, any points of interest, intersections, major highways or streets, or other physical characteristics located in the vicinity of the project (i.e. near airport, adjacent to Lions Gate Bridge, 3 km east from Centennial Park, at intersection of Fifth and Queen, etc.)*

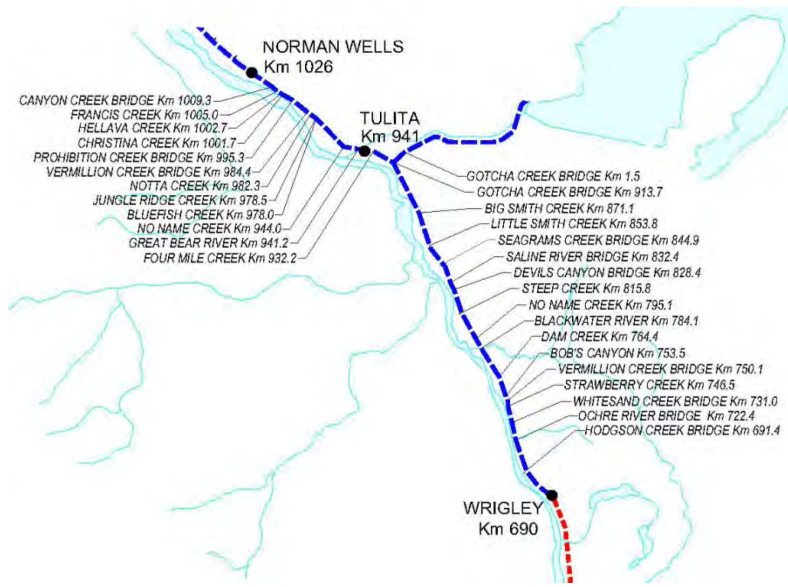
Component A: A 333 km all-weather road, from Wrigley, NT (63°13′41″N 123°28′12″W) beginning at km 693 of the existing Mackenzie Valley Highway, extending to Norman Wells, NT (65°16′52″N 126°49′53″W) and ending at what will be km 1026 of the Mackenzie Valley Highway.

Component B: Bear River Bridge, near Tulita, NT (64°54′01″N 125°34′39″W), km 941 of the Mackenzie Valley Highway.

Project Location Documents:

As a minimum, please include in an attachment (hard copy or electronic file) a project location map. If available, please include any further project location documents that may be useful in locating the project, such as: a site plan, hand drawings on a printed map, print of maps from Google Maps/Google Earth/MapQuest/Yahoo Maps etc., location plan, aerial photo, legal or written description of project location, survey plan, engineering plan, or any other plans or drawings from reports, studies or analysis.





The existing highway is shown in the graphic to the left in red. The proposed Project is shown in green, stretching from kilometre 693 at the current end of the all-weather highway near Wrigley, to kilometre 1026 at Norman Wells. On the right, the existing permanent bridges are shown, which will be used in the highway construction. The Bear River Bridge will be located at kilometre 941 of the Mackenzie Valley Highway, near Tulita.

Details maps are included in the project description report in Appendix 2. LIDAR surveys, aerial photos and engineering drawings are available upon request.

Part E: Declaration of Information

Part E.1: Declaration of Information:

I certify that the information provided is accurate to my knowledge and understand that inaccurate information may result in the requirement for additional environmental and/or aboriginal review.

Questionnaire completed by: ____

Signature: ____

Date: ____