FINAL REPORT

Benefit-Cost Analysis of the Deh Cho Bridge

Prepared for:

Department of Transportation

Government of the Northwest Territories

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EXECUTIVE SUMMARY

The Department of Transportation (DOT) of the Government of the Northwest Territories (GNWT), responding to a proposal by the Combined Council Alliance of Fort Providence, is reviewing the economic, financial, and technical feasibility of constructing a bridge across the MacKenzie (Deh Cho) River at Fort Providence.

The bridge would replace the current ferry/ice bridge crossing of the river and allow for reliable, all-season road travel between Yellowknife and supply centres in the western NWT and the south.

This study supports the DOT's review of the proposed bridge by providing an economic evaluation and economic and financial impact assessment of the project.

STUDY METHODOLOGY

In carrying out the economic evaluation, the study team has relied on:

- traffic, costing, and operational data provided by DOT;
- data developed in earlier studies of the Deh Cho bridge;
- demographic and business data prepared by the GNWT and Statistics Canada;
- telephone interviews with truck and air transport companies, shippers, retail and other businesses serving the greater Yellowknife area; and
- relevant information from other provincial and federal agencies including Alberta Transportation.

BENEFIT-COST ANALYSIS

The quantified benefits and costs of the proposed bridge are summarized in the following table. All figures are expressed in constant dollars. Bridge construction is assumed to begin in 2003, with completion in 2005 and the first year of operation in 2006. The estimated life of the bridge is 75 years.

Summary of Benefit-Cost Analysis

	Total (undiscounted)	Net Present Value (5%)	Net Present Value (10%)
Costs ($ million 2002)			
Bridge Capital Cost	55.0	50.2	46.0
Bridge Operating Costs	41.3	9.3	4.1
Total Costs	96.3	59.4	50.1
Benefits ($ million 2002)			
Ferry Salvage Value	1.1	0.9	0.8
Avoided Ferry Operating Costs	105.0	23.6	10.5
Avoided Ferry Capital Costs	5.5	1.2	0.6
Avoided Ice Bridge Operating Cost	10.5	2.4	1.1
Cost Savings Non-Commercial Traffic	80.1	15.7	6.5
Cost Savings Commercial Traffic	139.4	28.1	11.8
Other Business Savings	101.5	19.8	8.2
Total Benefits	443.2	91.7	39.4
Net Benefit ($ million 2002)	346.9	32.3	-10.7
Benefit Cost Ratio	3.60	1.83	0.83

In undiscounted dollars, the project is shown to generate net benefits over its life of approximately $347 million, with net annual benefits in most years ranging between $4.3 million and $5.8 million.

In dollars discounted at 5%, the project is shown to generate net benefits of $32 million and a benefit-cost ratio of 1.8. Discounted at 10%, the project costs exceed the benefits by $10.7 million (in present-value terms), and the related benefit-cost ratio is 0.83. The economic return for the project -- the discount rate that balances the present value of costs and benefits (i.e., produces a benefit-cost ratio of 1.0) -- is 7.9%. As these figures make clear, the project generates net benefits within the normal range of acceptable returns.

A number of sensitivity analyses incorporating alternative assumptions regarding bridge construction and operating costs, traffic growth, and project benefits show that the project returns remain acceptable under a generally wide range of conditions.

This conclusion is further reinforced by a number of non-quantified benefits that are expected to accrue to the NWT from the bridge project. These include, among others, increased regional and territorial economic development stimulated by the greater efficiency and reliability of the highway network and a reduced sense of isolation during the unpredictable freeze-up and scheduled break-up ferry service disruptions.

The benefits of the proposed bridge will accrue generally to the following sectors: government, 30%; individual travelers, 17%; transportation companies and their customers, 31%; and other retail and commercial businesses, 22%.

ECONOMIC IMPACT ANALYSIS

Project Construction

Of the estimated project cost of $55 million, $24.3 million or 44% will accrue to NWT businesses and households. Much of the construction labour and a portion of the project engineering and supervision and required equipment supply is likely to be sourced from the NWT. The project construction is expected to provide a total of 125 person-years of direct employment for NWT-based workers.

Project Operations

By removing the need for the continued operation of the ferry and ice bridge, the proposed bridge would eliminate seasonal employment for a total of 21 people or about 8 person-years of employment per year. An estimated 17 of these workers are from the local area, with the balance resident elsewhere in the NWT. The household income associated with the current ferry/ice bridge employment is estimated to be $350,000 per year, of which about two-thirds accrues to households in Fort Providence, with the balance to other communities in the NWT.

The Deh Cho bridge has the potential to provide some on-going maintenance-related employment, equivalent to perhaps one full-time person, and will generate some periodic repair and rehabilitation work for contractors. The potential operation of a toll booth facility and other initiatives funded by a proposed local economic development fund would reduce the negative local employment effects arising from the displacement of the ferry and ice bridge.

FINANCIAL IMPACT ANALYSIS

The study has examined the potential financial impacts of the bridge to different stakeholder groups and sectors.

For the Government of the NWT, the bridge will generate financial benefits in the form of reduced annual outlays required to maintain the NWT transportation network.

Within the NWT, the local Fort Providence area is likely to realize lower community incomes because of the loss of ferry and ice bridge employment and associated business revenues. However, these adverse effects may be mitigated through the employment and income impacts of toll operations and a proposed local economic development funding initiative.

In the absence of commercial bridge tolls, a wide variety of transport companies, shippers, and other businesses and consumers would realize direct and indirect financial savings from the replacement of the ferry and ice bridge with the proposed all-season bridge crossing. The average savings across all commercial users of the bridge are estimated to be approximately $5.90 per tonne.

Tolls

If a toll system is implemented, the net savings that accrue to various users and beneficiary groups will depend on the nature of their individual transport patterns. In general, the lowest level of net benefits will be realized by mine re-supply traffic. Much of that traffic utilizes the winter ice bridge, which imposes moderate costs in terms of added travel time and inconvenience. If that traffic was obliged to pay a $5 per tonne toll, for example, the added costs of using the bridge would exceed the associated economic savings, implying some increase in costs to trucking companies and ultimately to the mining industry itself.

For those shippers that are currently unaffected by seasonal interruptions of freight traffic during spring break-up, a $5 per tonne tariff would also somewhat exceed the bridge benefits realized, thus placing some upward pressure on trucking costs and hence the delivered price of goods to NWT businesses and households.

However, a number of other businesses in the Yellowknife area now incur substantial costs associated with spring break-up. For many of those businesses, a potential $5 per tonne tariff would yield residual savings that would ultimately spill over into reduced costs for them and their customers.

1. INTRODUCTION

1.1 BACKGROUND TO THE REPORT

In response to a proposal to construct a bridge over the Deh Cho (Mackenzie) River near Fort Providence, the Government of the Northwest Territories (GNWT) through the Department of Transportation (DOT) is reviewing the economic, financial, and technical feasibility of the project. Nichols Applied Management, an economic consulting firm with an extensive background in the evaluation of transportation and other infrastructure developments, has been commissioned to independently evaluate the economic costs, benefits, and impacts of the proposed Deh Cho bridge.

The findings of the consultants are summarized in this report.

1.2 DEH CHO BRIDGE PROJECT

The proposed Deh Cho bridge, almost one kilometer in length, would provide a two-lane all-season crossing of the Deh Cho River at kilometre 24 of the Yellowknife Highway (#3). The bridge would be located approximately 12 kilometres from Fort Providence and 314 kilometres from Yellowknife. At the present time, a ferry provides access across the river from approximately May to December, and an ice bridge operates from about January to April. During spring break-up, no vehicle access across the river is available for about a four-week period.

The Yellowknife Highway is the only all-season road linking Yellowknife and other communities in the region to Hay River and to centres in Alberta, the major source for community supplies and equipment. The Yellowknife Highway is also the only all-season road providing access to the gold and diamond mines located to the north of Yellowknife along the Lupin winter ice road. The route thus directly serves over one-half of the population of the NWT and, through the air hub of Yellowknife, indirectly serves the rest of the NWT and Nunavut.

The current Deh Cho bridge proposal, as brought forward by the Combined Council Alliance of Fort Providence, is not the first to document the benefits of a bridge across the Mackenzie at Fort

Providence.[1] A bridge was proposed by GNWT as early as 1970, some ten years after the completion of the highway to Yellowknife.[2] The project was considered again in a 1978 study.[3] And, in 1980, the bridge was the subject of a detailed cost-benefit analysis commissioned by the Yellowknife Chamber of Commerce.[4]

1.3 STUDY CONTENTS AND METHODOLOGICAL APPROACH

The main part of the study examines and compares the expected economic costs and benefits of the proposed Deh Cho bridge from a societal perspective and concludes with an assessment of the net economic value of the project. The report discusses as well the sectoral and geographic distribution of project costs and benefits and the likely economic impacts of construction of the bridge. The focus of the study is on economic rather than financial aspects, so alternative project financing arrangements are not relevant to the analysis. However, the financial implications of potential bridge tolls are examined within the context of the estimates and distribution of economic benefits.

In carrying out the economic evaluation, the study team has relied on:

- traffic, costing, and operational data provided by DOT;
- data developed in earlier studies of the Deh Cho bridge, including the recent bridge study prepared by Andrew Gamble & Associates for the Fort Providence Combined Council Alliance;
- population, income, business activity and other statistics prepared by the GNWT and Statistics Canada;
- telephone interviews with truck and air transport companies, shippers, retail and other businesses serving the greater Yellowknife area;

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1 Deh Cho Bridge, Fort Providence, NWT Feasibility Study, Andrew Gamble & Associates, February 2002.

2 "Mackenzie River Crossing Study" by T.B. Howard and D. S. Mann, Government of the Northwest Territories, March 1970.

3 A Study in Comparative Costs, Fort Providence River Crossing, Ferry vs. Bridge Services. Peter J. Hart, November, 1978.

4 "Mackenzie River Bridge Study: A Cost-Benefit Analysis of a Permanent Crossing of the Mackenzie River at Fort Providence, Northwest Territories." Robert Given. February, 1980.

- relevant information from other provincial and federal agencies including Alberta Transportation.

The assumptions and sources of data used in the analysis are discussed in the main body of the report. Sensitivity tests have been carried out to ascertain how alternative assumptions and estimates affect the project economics.

1.4 OUTLINE OF THE REPORT

Following the report's introductory section, Section 2 provides an overview of the current transportation arrangements that would be affected by the proposed bridge.

The benefit-cost analysis of the Deh Cho project, together with a discussion of analytical limitations and sensitivity tests, is provided in Section 3.

Section 4 reviews the income and employment impacts of the bridge project on the NWT.

Section 5 discusses a number of key financial implications that may arise from development of the bridge, including the potential impact of tolls on various users.

2. SITUATION ANALYSIS

The Deh Cho bridge would have the effect of materially changing existing transportation arrangements at the Highway 3 crossing of the Deh Cho (Mackenzie) River.

Ferry Operation

During the period from early to mid-May until winter freeze-up in November-December, vehicles now cross the river by ferry, which operates daily from 6 a.m. to midnight.[5] Allowing for normal waiting, loading and unloading, and normal transit time, the average crossing by ferry consumes a total of about 20 minutes.

Service Disruption

Ferry service is disrupted at times, increasing the average crossing time for all trips to about 30 minutes. These service disruptions relate to due to peak-season congestion, mechanical difficulties, and nautical hazards, mostly as the river freezes up.

During freeze-up, generally between November and January, the ferry continues to operate but ferry service is interrupted periodically for periods ranging from several days to more than two weeks. The unpredictable nature of these interruptions, caused by a number of factors, including low water levels and ice jams, gives people in Yellowknife a sense of isolation during the early winter period and negatively influences travel plans. The current operating practice is to remove the ferry from the water during the initial freeze-up, return it to the water, and then open a channel through the newly formed ice so that the ferry can move back and forth across the river.

Since the ice bridge is under construction during that time and therefore not ready to bear loads, vehicle traffic across the river ceases during these interruptions of the ferry service. Most passenger and cargo traffic between Edmonton and Yellowknife is therefore suspended, although some is diverted to fixed wing aircraft flying between Hay River and Yellowknife and, less frequently, between Edmonton and Yellowknife.

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[5] During the past 8 years, the ferry service has extended over an average period of 252 days. Service interruptions during the ferry season average about 10 days per year, mostly during the freeze-up period (Source: DOT, GNWT).

Sometime between early December and early January, light vehicle traffic can begin to cross the river on the ice bridge, but truck traffic continues to use the ferry until it ceases operations, usually around the middle of January.

Ice Bridge Detour

From about the middle of January (usually within a few days of the end of the ferry service) until just after the middle of April, vehicle traffic -- including heavy trucks -- crosses the river on the ice bridge.

The ice bridge involves a detour that adds 15 kilometres to the distance vehicles travel during the ferry operating season. The speed limit on the 12-kilometre road portion of the detour is 80 kilometres per hour for both light vehicles and trucks. The normal speed on the 3-kilometre ice bridge portion of the detour is 20 kilometres per hour for trucks and 50 kilometres per hour for light vehicles. The ice bridge detour thus adds time and distance in comparison to a permanent bridge crossing.[6]

Break-Up

Vehicles are unable to cross the river for about four weeks from just after the middle of April, when the ice bridge is closed, until early to mid-May, when the ferry begins to operate. During this time, most passenger traffic between Edmonton and Yellowknife is suspended.

A significant amount of cargo, however, is trucked to the river, transferred onto slings, and shuttled by helicopter across the river where it is loaded onto other trucks and transported onward by road.

Similarly, a significant number of passengers divert to fixed wing aircraft flying between Yellowknife and Hay River. Some freight is also diverted in this way, although far less than the volumes that pass over the river on the helicopter shuttle.

Summary

The proposed Deh Cho bridge would eliminate the need for the ferry, the ice bridge, and much of the air transportation required when neither the ferry nor the ice bridge is operating. The bridge therefore would eliminate the seasonal interruptions of vehicle travel on the Yellowknife Highway during break-up, freeze-up, and at other times of the year, thus regularizing vehicle traffic movement.

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[6] For the last 10 years, the ice bridge has been open for an average of 111 days per year. As indicated above, the bridge opens for light vehicles before it can accommodate heavy trucks.

3. BENEFIT-COST ANALYSIS

3.1 GENERAL PURPOSES AND APPROACH

The purpose of the economic benefit-cost analysis for the Deh Cho bridge is to determine whether the economic returns from the proposed project are sufficient, relative to alternative investments, to justify proceeding with its development. The economic evaluation that is discussed in this section of the report is distinct from a financial analysis, which would normally include matters of financing and financial viability, including the costs and revenues to the enterprises responsible for the construction and operation of the project.

The economic analysis of the Deh Cho bridge compares "with bridge" and "without bridge" scenarios over the expected life of the project, estimated to be 75 years. The "without bridge" scenario is defined as the continuation of the current ferry and ice bridge crossing of the Deh Cho river. The additional costs and benefits of a bridge relative to that base case scenario are quantified and then compared to ascertain whether the resources consumed by the project yield commensurate returns to the NWT.

Table 1 summarizes the cost and benefit elements that have been quantified and "captured" in the benefit-cost analysis and identifies other project effects that are discussed in qualitative terms in the report but which are not included in the formal benefit-cost framework.

3.2 PROJECT COSTS

3.2.1 Capital Costs

The DOT estimates the capital costs of the Deh Cho bridge to range between $50 million and $55 million. The study team has used the high end of that range in the base case analysis. All project costs and benefits are expressed in $2002, and it is assumed that future cost escalation and inflation for costs and benefits will accrue at similar rates.

The bridge will take an estimated three years to construct, with the costs distributed over the construction period as follows: Year 1, 30%; Year 2, 50%; and Year 3, 20%.

Table 1 Deh Cho Project Benefit-Cost Elements

	Benefit-Cost Elements	Quantified & Incorporated in Benefit-Cost Framework	Not Included in Formal Benefit-Cost Analysis	Explanatory Comments
Project Costs	Initial bridge capital costs	✓	-	
	Regular bridge operation and maintenance costs	✓	-	
	Periodic bridge rehabilitation costs	✓	-	
	Toll facilities and operations	-	✓	Not included in economic analysis but relevant to financial projections
	Operation and maintenance costs of connecting highway	-	✓	Increased traffic on connecting highways during the spring break-up period could affect highway O&M costs if the bridge is built. These potential cost effects have not been quantified.
Project Benefits	Residual or salvage value of bridge at end of its economic life	-	✓	The net value, allowing for dismantling costs, is expected to be minimal.
	Avoided ferry operating costs	✓	-	
	Avoided costs of recurring ferry rehabilitation/ replacement	✓	-	
	Salvage value of ferry at bridge completion	✓	-	
	Avoided operating costs of ice bridge	✓	-	
	Transport time and cost savings compared to ferry/ice bridge	✓	-	
	Non-transport savings to businesses related to spring break-up disruptions.	✓	-	
	Transport time and cost savings during winter freeze-up period	✓		Occasionally, both ferry and ice bridge operations are disrupted during freeze-up period, with resultant time and cost effects to traffic. Disruptions are reflected in the estimate of the average crossing time.
	Increased regional and territorial economic development stimulated by the greater efficiency and reliability of the highway network and reduced transportation costs	-	✓	
	Environmental effects of bridge construction and operation versus continued ferry/ice bridge operation.	-	✓	

No provision is included in the project costs for the construction and operation of potential toll facilities. Those facilities are deemed not to be integral to the function of the bridge itself and are therefore not part of the economic assessment. Toll revenues and associated capital and operating costs would be relevant to the bridge financial analyses.

3.2.2 Operating Costs

Bridge Operation and Maintenance

In addition to its capital costs, the bridge will incur on-going operational costs for ice and snow removal, repairs, inspections, and preventive maintenance. Periodic deck resurfacing and other replacement and rehabilitation work will also be required. It is estimated, based on DOT communications, that these regular and periodic costs will average approximately 1% of the original capital costs (i.e. $550,000) annually over the life of the bridge.

Road Operation and Maintenance

The development of the Deh Cho bridge would provide uninterrupted year-round road access on Highway 3 between Hay River and Yellowknife. The bridge would therefore attract some additional traffic that now utilizes air transport alternatives, particularly during the spring break-up period. This increased road usage may precipitate some additional road operation and maintenance costs.

However, much of the freight traffic disrupted during spring break-up is now transported by road to the Deh Cho River, where it is airlifted across by helicopters to trucks on the other side and transported onward by road. No additional road costs would be associated with these freight movements when the bridge is in operation. The main effect of the bridge on road traffic during the break-up period would be to increase modestly the number of commercial and non-commercial vehicles associated with some fixed wing air passenger and freight movements that now occur between Hay River and Yellowknife and, to a limited degree, Edmonton and Yellowknife during that three-to-four week time. The additional road costs associated with this new traffic are not expected to be significant and have not been quantified and incorporated within the benefit-cost analysis.

3.3 PROJECT BENEFITS

3.3.1 Avoided Ferry Operating Costs

The construction of the Deh Cho bridge would negate the need to operate the ferry, thus avoiding the on-going costs of operation. The annual ferry operating costs total $1,399,500. Those costs include the contract outlays for the ferry operation, equipment rental, fuel and utilities expenses, and costs of staff overtime and casual positions.

3.3.2 Avoided Ferry Capital Costs

The GNWT incurs recurring costs of a capital nature required to maintain the ferry. These costs, totalling approximately $74,000 annually, include provision for ferry refits and ancillary facilities and equipment.

3.3.3 Salvage of the Ferry

The construction of the proposed Deh Cho bridge would allow for disposition or alternative use of the existing ferry.

The ferry currently in use at the Fort Providence crossing of the Deh Cho River, the Merv Hardie, is a 43 metre craft with a maximum capacity of 14 light vehicles or 2 B-train tractor-trailers and 6 light vehicles. In 1995, the official salvage value of the ferry was U.S. $750,000, or about Cdn. $1.125 million.[7] That value has been incorporated into the benefit-cost analysis as a benefit associated with the bridge development.

3.3.4 Avoided Ice Bridge Construction and Operating Costs

A permanent bridge crossing of the Deh Cho River would eliminate the need to construct and maintain an ice bridge during the winter months, with attendant savings to the GNWT. The annual costs of the ice bridge are estimated to be $140,000. The costs include ice bridge construction and maintenance, access road maintenance, and associated labour and equipment costs.[8]

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[7] Source: DOT, GNWT.

[8] Source: DOT, GNWT.

3.3.5 Transportation Cost Savings

The construction of the Deh Cho bridge will:

- reduce the travel time taken to cross the Deh Cho River by ferry during the period May to November/December. Users of the ferry incur a travel time that can include waiting for the ferry, loading and unloading, queuing during peak periods, occasional operational disruptions, restricted ferry operating hours (6:00 a.m. to 12:00 midnight), and a reduced transit speed compared to road transport.

- reduce travel times and the distance travelled for traffic utilizing the ice bridge during the winter season, generally from late December or early January to April. The ice bridge requires an additional 15 kilometers in travel distance and involves a slower travel speed compared to transit on the proposed Deh Cho bridge.

- reduce transport costs incurred by commercial and non-commercial traffic during the roughly three-week spring break-up period when neither the ferry nor the ice bridge is operational. During this period, helicopters are used to move freight across the river and added fixed-wing air transport is used to transport passengers and freight between Edmonton and Hay River and Yellowknife and other NWT centres.

The economic value of the transportation cost savings that would accrue from construction of the proposed bridge is discussed below.

Non-Commercial Traffic

Traffic Numbers

An estimated 38,000 passenger and other light vehicles and trailers use the ferry annually, and another 12,000 non-commercial vehicles use the ice bridge. The ferry traffic figures are based on actual counts, while the ice bridge figures are estimates based on total vehicle counts taken on Highway #3 near its junction with Highway #1. These traffic volumes are projected to increase by 1% per annum until 2050. That rate of growth is similar to the growth in population of the greater Yellowknife

region, which experienced a 1.3% average annual population increase between 1991 and 2000.[9] Road usage is held constant after 2050. The detailed traffic forecast used for the benefit-cost analysis is presented in Appendix A.

The economic analysis assumes that the bridge, if constructed, would attract all the non-commercial traffic that would otherwise use the ferry and ice bridge.

Cost Savings

The economic benefits of the bridge attributable to non-commercial traffic include the value of time saved compared to the ferry and ice bridge, and the savings in vehicle operating costs arising from the greater distance of the ice bridge detour.

These travel time savings are estimated at $605,000 when the bridge opens for traffic. The savings increase over time as traffic increases. The cost savings are based on:

- a bridge-versus-ferry travel time saving of 30 minutes[10];
- a bridge-versus-ice bridge time saving of 12.6 minutes; and
- an average value per passenger hour saved is based on $15.00 per hour[11].

The operating cost savings are related to the number of vehicles now using the ice bridge and the reduced travel distance implied in the bridge crossing. This cost savings are estimated at $93,000 in the year the bridge opens and will increase after that in line with traffic forecasts. The operating cost saving assumes:

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9 Recent population projections by the NWT Bureau of Statistics suggest that future population growth in the Yellowknife area could reach 1.6% p.a., exceeding the base projections used in the bridge economic analysis. Sensitivity analyses, discussed further in Section .5, quantify the effects of these higher projections on the project economics.

10 As discussed in Section 2, the 30 minute estimate for the ferry crossing includes the effects of short duration ferry service disruption due to mechanical difficulties and nautical hazards during freeze-up.

11 Derived from 1987 figures used by Alberta Transportation of $5 per hour for non-working passengers and $12 per hour for working passengers. Assuming two passengers per vehicle, one working and the other non-working, the blended value per hour has been adjusted for wage escalation since 1987 and further adjusted to reflect wage differentials between the Yellowknife area and Alberta.

- a bridge-versus-ferry distance reduction of 15 km; and
- an average total operating cost of $0.48 per km.

The combined economic savings to non-commercial traffic that would arise from the replacement of the ferry and ice bridge are estimated to total approximately $778,000 per annum, rising over time to $1.2 million by 2050, all figures in $2002. Detailed calculations are presented in Appendix B.

More than three-quarters of those savings relate to ferry traffic, because of the higher traffic volumes using the ferry as compared to the ice bridge and the higher time savings per trip that accrue from displaced ferry traffic.

Diverted Air Traffic

It is estimated that approximately 700 passengers are diverted on an annual basis to airlines during the spring break-up period when neither the ferry nor the ice bridge are accessible. It is expected that with development of the Deh Cho bridge, those passengers, most of whom are travelling between Hay River and Yellowknife, would revert to road travel. A comparison of costs as between air travel and road travel suggests that some nominal savings would accrue from use of the bridge. These savings are not significant enough to affect the economics of the bridge and have not been included in the benefit-cost framework.

Commercial Traffic

Projections of commercial traffic for the ferry and ice bridge also are included in Appendix A. Commercial traffic, which includes truck units, semitrailers, buses and other commercial vehicles, is subdivided into two components:

- mine re-supply; and
- community re-supply

Traffic Numbers: Mine Re-Supply

Mine re-supply traffic, much of which originates from the south via Highway 3, takes place almost exclusively during the winter months. It crosses the ice bridge on the Deh Cho River, continues northward from Yellowknife along the Lupin winter ice road.

Accurate traffic counts and volume figures are available for mine re-supply movements because of the monitoring of the ice road travel that occurs. Mine re-supply shipments fluctuate according to mine development and operational activity. In 2002, 15,470 vehicle movements were reported, marking a slight decline from 2001 but representing an increase in total tonnage transported over the previous year. Mine re-supply volumes have increased significantly in recent years. Future mine traffic may increase if new mines now in the preliminary investigation stages proceed but at the same time traffic volumes in the longer term could be adversely affected if an Arctic port with connecting roads to the mines are developed and provide an alternate routing. Taking these various factors into account, the consultants have accepted as reasonable the median projections of 12,000 annual vehicle movements provided in the recent feasibility study by Andrew Gamble & Associates.

Traffic Numbers: Community Re-Supply

The remaining -- and larger -- component of commercial traffic encompasses the year-round vehicle movements across the ferry and ice bridge involved in community re-supply. Historical traffic figures are available through ferry statistics and highway counts. Traffic projections have been based on growth of 1% per annum, a rate generally consistent with the historical population growth of the primary region served by Highway 3. The traffic projections developed by the study team are in line with the “optimistic” set of projections in the Gamble & Associates report.

In addition to the traffic using the ferry and ice bridge, an estimated 500 tonnes annually is now airlifted over the river by helicopter during spring break-up. That volume is projected to increase at a rate consistent with other community re-supply traffic.

Cost Savings

The economic benefits that would accrue in relation to the commercial traffic diverted to a new bridge include the savings in transportation costs due to reduced travel time and, in the case of the ice bridge, travel distance.

This cost saving is estimated at $3.83 per tonne for the community re-supply traffic now using the ferry and $2.30 per tonne for community re-supply traffic now using the ice bridge, for a total of $743,000 in the first year of bridge operations. The corresponding per tonne saving for the

mine re-supply traffic is estimated at $2, reflecting the marginally bigger loads of this traffic flow, for a total of approximately $400,000. These estimates are based on:

- a time saving of 30 minutes travel time on a one-way trip compared to the ferry, and an estimated 18 minutes compared to the ice bridge;
- a cost savings per vehicle-hour of $83.33 and $110.00, respectively, for community re-supply and mine re-supply vehicles;[12] and
- the savings shippers will realize in transportation costs for freight now airlifted by helicopter over the river during spring break-up. Those costs are estimated to be $310,000 annually in 2002 and would be expected to increase over time in proportion to rising freight volumes.

The total transport cost savings to commercial traffic that would accrue with development of the bridge are estimated to be $1.46 million in the first year of bridge operation, rising over time to about $2.0 million. Appendix C and D provide the detailed tables.

The approximate distribution of those savings as between community and mine re-supply and diverted ferry, ice bridge, and airlift traffic is as shown in Table 2. It shows that almost three-quarters of the commercial traffic-related economic savings accrue to the community re-supply traffic flow. The table also shows that 64% of the total economic savings associated with commercial traffic relate to the fact that the bridge obviates the need for ferry and airlift operations.

Table 2 Distribution of Economic Savings to Commercial Traffic

	Ferry	Ice Bridge	Airlift	Total
	% of total Economic Savings			
Mine Re-supply	-	27	-	27
Community Re-supply	42	9	22	73
TOTAL	42	36	22	100

[12] Based on average truck charges divided by route travel times.

3.3.6 Other Savings to Businesses

The current interruptions of traffic that occur during winter freeze-up and spring break-up when neither ferry nor ice bridge access is available across the Deh Cho would be avoided with the proposed bridge.

Costs Related to Freeze-up

Interruptions during freeze-up, notably when the ferry is removed from the water to allow the river to freeze over and a channel for the ferry to be cleared, tend to be short in duration. As a result, they generally do not entail added costs for businesses in the Yellowknife region, though they do involve inconvenience. Occasionally, interruptions during freeze-up do generate costs for Yellowknife area businesses, obliging them, for example, to transport some goods on fixed wing aircraft. Due to the occasional nature of such costs, they have not been quantified in this study. To the extent that such costs have been excluded, this study underestimates the benefits of the proposed bridge.

Costs Related to Break-up

Interruptions during break-up are long in duration, lasting up to four weeks. These interruptions therefore have a number of operational and cost implications for businesses in Yellowknife and other regional communities, including Fort Providence, Rae-Edzo, Wha Ti, Rae Lakes, and Snare Lakes. Shippers and distributors in supply centers such as Edmonton are also affected.

Businesses in the Yellowknife region face added costs associated with:

- warehousing and handling additional inventories acquired in advance of the transportation disruptions during spring break-up;
- the carrying costs of those larger inventories; and
- extra damages and shrinkage linked to the additional inventory handling and to the shipments by helicopter across the Mackenzie.

Shippers and distributors in Edmonton report additional costs associated with storing and handling extra inventories during the break-up period.

The study team contacted a number of major Yellowknife retailers and derived estimates of the additional costs incurred by those operations in

respect to the disruptions in freight traffic at spring break-up. Some of those businesses also reported lost sales due to the inability to maintain full product supply and selection during the affected period. Those reported losses are not included in the cost-benefit analysis because it is likely that many of those sales would be shifted to other businesses or to the sales periods before or after the traffic disruptions.

Savings Estimates

The costs enumerated for the businesses contacted were extrapolated to the overall retail sector in the Yellowknife region, including the communities mentioned above, yielding an estimated $985,000 in additional warehousing, handling, inventory, and damage costs to businesses by 2006, the expected first year of bridge operation. It has been assumed that these costs will rise in constant dollar terms by 1% per year, the same growth rate applied to the community re-supply projections. Appendix E provides the detailed table.

It is possible that the costs incurred by the Yellowknife companies contacted are not representative of the entire retail sector of the region and that the industry extrapolations might overstate the total costs incurred. At the same time, some companies outside the retail sector, including restaurants, various business services, and distribution and wholesale operations likely incur costs related to the curtailment of ferry and ice bridge traffic during the spring break-up. To the extent that those costs are not recognized, the aggregate cost impacts are understated.

The study team's estimates of potential business savings that would accrue with development of the bridge can be compared to estimates made in an earlier 1980 study of the bridge[13]. In that report, the comparable business costs (adjusted to exclude the direct transportation impacts) were estimated to be about $594,000. Since the time those estimates were developed, the downtime period during which no access is available across the river has been reduced. That would tend to reduce the annual cost impacts. However, during the 22 years that have elapsed since that earlier study, population and traffic have increased substantially and the parallel inflationary escalation in costs over that period would also have materially increased the cost estimates, expressed in 2000 dollar terms. The combination of these

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[13] "Mackenzie River Bridge Study: A Cost-Benefit Analysis of a Permanent Crossing of the Mackenzie River at Fort Providence, Northwest Territories." Robert Given. February, 1980.

factors would suggest that the 1980 estimates adjusted to 2002 would amount to roughly $1.0 to $1.2 million annually. The estimates developed by the study team are not inconsistent with those earlier findings.

3.3.7 Non-Quantified Benefits

There are a number of benefits that will accrue to the NWT if the project goes ahead. These are by their nature difficult to quantify and have not been considered in the calculation of the benefit-cost ratio presented below.

These benefits, which are both economic and social, include:

- increased regional and territorial economic development stimulated by the greater efficiency and reliability of the highway network and reduced transportation costs;
- improved relations between businesses and territorial residents due to improved service and lower transportation costs;
- reduced sense of isolation due to improved connections within the region and between Yellowknife and Edmonton, especially during freeze-up and break-up when the current system is at times unpredictably disrupted;
- improved access to government services and employment opportunities;
- reduced environmental impact on the Deh Cho River, since the bridge would eliminate the need for ongoing ice bridge construction and ferry operation. Disturbance of the river during the construction phase of the bridge would, of course, have to be taken into account in this regard.;
- increased opportunities for Aboriginal training, employment, business development, and equity investment;
- support for the policies and objectives of the Government of the Northwest Territories, including the

Department of Transportation's vision for roads in the Northwest Territories, which is based upon two objectives: 1) creating opportunities for economic development, 2) connecting communities.[14]

To the extent that these additional benefits are economic in nature, they would tend to increase the base economic returns estimated for the project. To the extent that they are social in nature, they would tend to improve the quality of life of territorial residents.

3.4 SUMMARY OF BENEFIT-COST ANALYSIS

The quantified costs and benefits of the project are summarized in Table 3. The costs and benefits are expressed in constant dollars. Bridge construction is assumed to begin in 2003, with completion in 2005 and the first year of operation in 2006.

In undiscounted dollars, the project is shown to generate net benefits over its life of approximately $347 million, with net annual benefits in most years ranging between $4.3 million and $5.8 million.

The comparison of total costs and benefits in undiscounted dollars neglects the time dimension and the fact that resources used and returns earned in early years have a higher value than those that accrue in later years. It is necessary therefore to bring the streams of future costs and benefits to a common denominator. This is done by converting future costs and benefits to a "present value". Discount rates that represent acceptable returns on resources are used. In the context of many Canadian public sector projects, discount rates of between 5% and 10% are generally applied.

Table 3 shows that the present or discounted values of the costs and benefits for the Deh Cho bridge using discount rates of 5% and 10%, respectively. At 5%, the project is shown to generate net benefits of $32 million, and yields a benefit-cost ratio of 1.83. At 10%, the project costs exceed the benefits by $10.7 million (in present-value terms), and the related benefit-cost ratio is 0.79. The economic return for the project -- the discount rate that balances the present value of costs and benefits (i.e., produces a benefit-cost ratio of 1.0) -- is 7.9%. The project is shown to generate net benefits within the normal range of acceptable returns. Appendix E presents the detailed tables.

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[14] Source: "Investing in Roads for People and the Economy: A Highway Strategy for the Northwest Territories," Department of Transportation, Government of the Northwest Territories, November 2000.

Table 3 Summary of Costs and Benefits

	Total (undiscounted)	Net Present Value (5%)	Net Present Value (10%)
Costs ($ million 2002)			
Bridge Capital Cost	55.0	50.2	46.0
Bridge Operating Costs	41.3	9.3	4.1
Total Costs	96.3	59.4	50.1
Benefits ($ million 2002)			
Ferry Salvage Value	1.1	0.9	0.8
Avoided Ferry Operating Costs	105.0	23.6	10.5
Avoided Ferry Capital Costs	5.5	1.2	0.6
Avoided Ice Bridge Operating Cost	10.5	2.4	1.1
Cost Savings Non-Commercial Traffic	80.1	15.7	6.5
Cost Savings Commercial Traffic	139.4	28.1	11.8
Other Business Savings	101.5	19.8	8.2
Total Benefits	443.2	91.7	39.4
Net Benefit ($ million 2002)	346.9	32.3	-10.7
Benefit Cost Ratio	3.60	1.83	0.83

Non-Quantified Costs and Benefits

As discussed earlier in Section 3.1, some potential benefits and costs of the bridge have not been quantified. These include the broad regional and territorial economic benefits that would derive from the greater dependability and continuity of the NWT's transportation system with the development of the bridge. These additional benefits would serve to increase the base economic return estimated for the project.

The environmental effects of the bridge, if quantified, might also affect the project returns. Construction of the bridge may imply some negative environmental impacts but those potential costs would need to be balanced against the possible ongoing environmental effects associated with continued operation of the ferry and ice bridge.

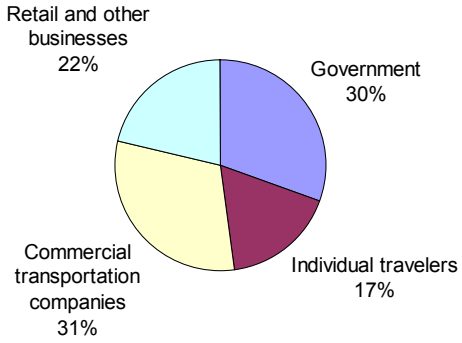
Distribution of Economic Benefits

The quantified economic benefits of the Deh Cho project are distributed across a number of sectors within the NWT, as summarized in Table 4 and shown graphically in Figure 1. The GNWT will receive an estimated 30% of the direct benefits, non-commercial travellers, 17%, commercial transportation firms, 31%, and various other NWT businesses, 22%.

Table 4 Distribution of Total Project Benefits (Net Present Value @ 5%)

Sector	Portion of Project Benefits
Government	30%
Individual travelers	17%
Commercial transportation companies	31%
Retail and other businesses	22%
TOTAL	100%

FIGURE 1 Distribution of Project Benefits



The benefits that accrue to commercial transportation companies through reduced travel times and vehicle operating costs may be shared in some part with other NWT businesses through reduced shipping rates and ultimately with final users through reduced product prices. Similarly, some of the benefits realized by individual travelers, as reflected in the estimated savings to non-commercial traffic, may also flow to NWT businesses and government in respect of that portion related to business rather than personal travel.

3.5 SENSITIVITY ANALYSIS

The results of the economic evaluation have been tested by adjusting particular costs and benefits to reflect potential risks and uncertainties in the underlying assumptions and projections.

Table 5 shows the results of the various sensitivity analyses carried out. It varies the key cost and benefit assumptions and indicates the effect of that change on the internal rate of return (IRR). As expected higher construction costs and lower traffic counts all lower the IRR but none to a level as to place the economic viability of the project in doubt. Lower construction costs and higher traffic counts increase the IRR.

Table 5 Economic Sensitivity Analysis

Sensitivity Analysis	Internal Rate of Return
Bridge Construction Costs +25%	6.5
Bridge Construction Costs -10%	8.7
Bridge Operating Costs at 0.5% of capital	8.3
Average Annual Traffic Growth 1.6%	8.4
Other Business Savings Growth +25%	8.3
Other Business Savings Growth -25%	7.5

A particularly relevant scenario relates to the assumption of 1.6% per annum population and traffic growth versus the 1% rate used in the base case. If these higher projections hold true, the economic return of the project would rise from 7.9% to 8.4%.

The conclusion that can be drawn from the sensitivity analyses is that the project economic returns remain within an acceptable range under a generally wide range of conditions.

4. ECONOMIC IMPACT ANALYSIS

Section 3 of the report addresses the economic efficiency of the Deh Cho bridge project. This section examines the project's employment and income effects.

4.1 PROJECT CONSTRUCTION

Table 6 presents the estimated breakdown of bridge construction costs, as derived from information provided by the DOT, the Gamble & Associates report, and other sources.

These estimates are of a preliminary nature and will be refined as additional engineering work is conducted.

Table 6 Bridge Construction Costs by Major Element

Cost Element	Cost $000	% of Total
Construction[1]	28,660	52%
Structure[2,3]	20,910	38%
Engineering/Supervision[4]	5,430	10%
Total	55,000	100%

1. Includes earthwork, foundations, and bridge deck concrete
2. Steel bridge structure assumed to be manufactured off site
3. Includes detailed bridge structure engineering design.
4. Includes overall project engineering, site supervision, and contract management

4.1.1 Income Impacts

The extent to which the construction expenditures will accrue to the NWT is critically dependent on the contracting approach of the proponent. The proponent may choose to enter into a design and build contract with an Alberta or elsewhere-based firm, in which case relatively modest share of the construction impacts will accrue to the NWT. More likely, however, is that the proponent will rely on NWT-based resources where possible or enter into a design-build contract with a joint venture firm with significant northern participation.

Some bridge construction expenditures, however, will likely accrue to the contractors, suppliers, and workers outside the NWT. For example, the bridge superstructure will likely be built in part in Alberta or elsewhere.

Table 7 presents a geographic breakdown of the construction costs. It assumes that the project contracting strategy will maximize the local content and is based in part on comments from the GNWT Department of Transportation regarding local contracting and engineering capabilities.

The table identifies the major project cost components and where the different components are likely to be sourced. Overall, more than one-half of the project expenditures will likely accrue outside the NWT. This result is driven mostly by the fact that the design and construction of the steel bridge superstructure will likely take place outside the Territories. The superstructure accounts for almost 40% of the total project costs.

Table 7 Construction Costs by Geographic Region

	Local	Other NWT	Other Canada	Total	% of Total
	$000				
Labour (construction/structural)	860	7,740	6,270	14,870	27%
Structural Design	-	-	4,180	4,180	8%
Construction Engineering/Supervision	-	1,500	2,245	3,745	7%
Equipment Rental	780	12,890	6,520	20,190	37%
Materials	-	570	11,430	12,000	22%
Total	1,640	22,700	30,645	55,000	100%
% of Total	3%	41%	56%	100%	

Totals may not add due to rounding.

Equipment rental and construction-related labour constitute the major project expenditures that will accrue to the NWT and constitute income for NWT-based companies and workers. In the case of equipment rental, much of these expenditures may well flow out of the NWT indirectly in the form of equipment lease payments.

It is assumed that as much as 40% of construction engineering and supervision could be provided by NWT-based engineering firms.

It is estimated that $8.6 million or about 16% of the total project cost will be earned by skilled NWT-based workers. An additional $1.5 million in project expenditures may flow to NWT-based engineers and contract supervisors. The combined expenditures on NWT skilled and

professional labour would exceed $10 million. That amount can be translated into household income by netting out overheads and employer costs, such as contributions to Employment Insurance and Worker Compensation. The resulting estimate of increased household income is $6.9 million. That income will accrue to NWT households over the three-year construction period.

4.1.2 Employment Impacts

The Deh Cho Bridge project will create an estimated 250 person-years of employment, roughly divided as follows:

- 200 person-years of employment for skilled workers, such as equipment operators, steel workers, and concrete workers; and
- 60 person-years of engineering, site supervision, and contract management.

Based on the information presented in Table 7, much of that employment will be generated outside of the NWT in the fields of project engineering and steel superstructure design and fabrication. It is estimated that a total of 125 person-years of direct employment will accrue to NWT-based workers: 115 person-years to skilled workers involved in earthworks, foundations, and bridge deck construction, and the balance to engineers and contract supervisors.

No detailed information is available about the local availability of skilled workers in the Fort Providence area. However, labour force statistics for the community indicate that there are approximately 75 workers in trades and transportation occupations, suggesting that in the order of 10% of the construction labour component (or 11 person-years) could be sourced locally.

4.2 PROJECT OPERATIONS

The operation and maintenance of the Deh Cho bridge implies the need for fewer workers than does the continued operation of the ferry and ice bridge. The ferry and ice bridge provide seasonal employment for a total of 21 people as shown in Table 8. The table also shows that an estimated 17 of these workers are from the local area, with the balance resident elsewhere in the NWT.

All of the employment involved in the ferry and ice bridge operations is of a seasonal nature. The ferry crew works for eight months per year and the other crews for two months or less. This seasonal employment translates into about 8 person-years of employment per year.

Table 8 Ferry/Ice Bridge: Number of Workers

	Local NWT	Other NWT	Total	Comment
	Number of Workers			
Ferry	6	3	9	8 months per year
Support Equipment	2	0	2	Occasional[1]
Ice bridge	4	0	4	2 months per year
Ferry Refit	5	1	6	1.5 months per year
Total	17	4	21	

1. Support equipment is in occasional use over the eight-month ferry operation period

The potential decline in operational employment associated with the bridge as compared to the ferry/ice bridge operations may be reduced by the operation of a toll booth facility and highway commercial enterprises at the bridge.

4.2.1 Income Impacts

The household income associated with the current ferry/ice bridge employment is estimated to be $350,000 per year, of which about $220,000 accrues to households in Fort Providence and the balance to other communities in the NWT. That employment income would be discontinued if the bridge is developed.

To the extent that the bridge operations include a toll facility, some new and offsetting employment may be created. This issue is discussed in more detail in Section 5. Another potential offset could arise from the local economic development fund that is proposed if the bridge proceeds. It is unclear at this time what kinds of business activities might be sponsored by that fund and the extent of new employment and household income that might arise from its operation.

The construction of the bridge will generate periodic maintenance and rehabilitation work, such as deck replacement and steel structure painting. However, much of that work is of an irregular nature and would likely be executed on a contract basis.

4.2.2 Employment Impacts

As discussed earlier in Section 4.2, the employment associated with the current ferry/ice bridge operations accounts for about 8 person-years of employment per year, of which three-quarters accrues to individuals in the local area. That employment would not continue if the bridge is built.

The operation of the bridge itself will provide the need for little ongoing employment. Periodic maintenance and rehabilitation work would likely be executed by contractors, but the specialized nature of that work suggests that much of the occasional employment required will accrue to workers outside the local area. It is estimated that on-going bridge maintenance would generate the full-time equivalent of one employment position. As mentioned earlier, the potential operation of a bridge toll facility could provide some additional local employment.

5. FINANCIAL IMPACT ANALYSIS

This study encompasses primarily an economic evaluation of the proposed Deh Cho bridge. Financial analyses related to such matters as project financing, toll structures and associated toll costs and revenues, and the project costs and revenues of various participants including government and bridge developers and operators, lie outside the scope of this study.

However, within the context of the economic findings described in Sections 3 and 4, the study team is in a position to comment on a number of potential financial impacts that may accrue to various stakeholder groups and sectors, depending on the bridge financing policies and mechanisms that may be adopted.

5.1 DISCONTINUANCE OF THE FERRY AND ICE BRIDGE

As summarized in Table 6, among the key economic benefits of the bridge would be the avoided ferry and ice bridge operating costs. Those benefits will be realized by government in the form of the reduced annual outlays required to maintain the NWT transportation system. Those financial benefits extend to the NWT as a whole, but an important component of those savings derives from reduced local household and business incomes in the Fort Providence area. In the absence of offsetting employment related to bridge toll collection and the potential development of a new local economic fund, the longer-term financial impacts to the community would be negative.

5.2 BRIDGE TOLLS

Consideration is being given to the possible adoption of bridge tolls to assist in financing the proposed bridge. These tolls may be confined to commercial traffic. The economic analyses in Section 3 provide an indication of the savings that would be generated to commercial users and businesses through the development of the new bridge. It is clear that the expected savings are greatest in respect to traffic diverted from the ferry as compared to the ice bridge. It is estimated that the economic savings of diverted ferry traffic are equal to about $3.80 per tonne versus approximately $2.00 (mine re-supply) to $2.30 (community re-supply) per tonne for traffic diverted from the ice bridge. Tolls set at levels below those savings would imply that trucking companies would

gain financially, although those gains might in turn be passed on to customers through lower freight rates. Tolls set above the expected savings may result in higher freight rates and end-user costs. A standard level of tariffs set for all commercial traffic would convey differential impacts to community re-supply versus mining re-supply transport. The latter traffic component relies primarily on the ice bridge and would not benefit to the same degree as would community re-supply traffic that relies on both ferry and ice bridge access.

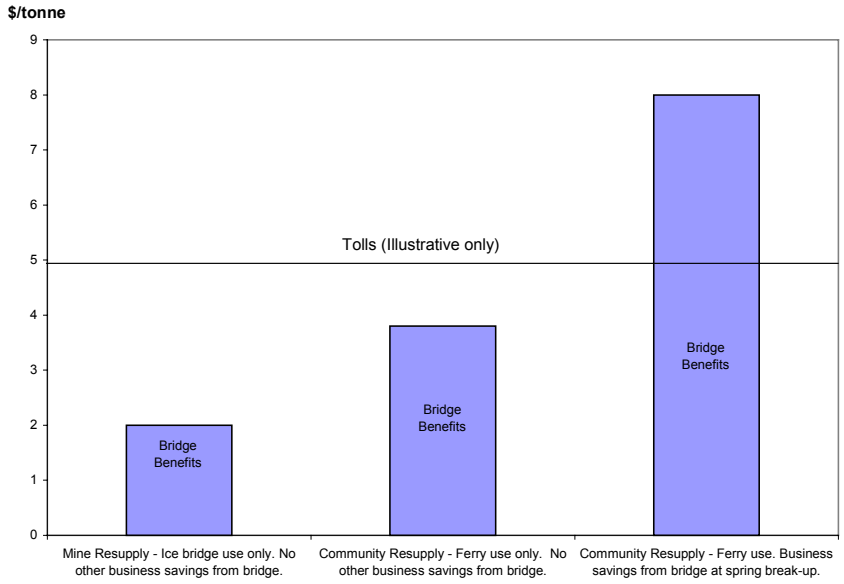
Some businesses in the Yellowknife region will, as quantified in Section 3, realize benefits from the bridge through the avoided disruptions to traffic during spring break-up. For those businesses that currently face added costs during that period, bridge tolls in excess of actual transportation savings may be acceptable, even if manifested in higher freight rates, because they might be more than offset by other cost reductions associated with extra handling, warehousing, inventory carrying, and other expenses now incurred during the spring break-up period.

Other businesses, however, may not incur those same inventory handling costs. For them, tolls set in excess of transportation savings that reflect themselves in higher freight costs would tend to reduce profitability or increase the prices of the goods or services they provide.

Figure 2 provides a graphical illustration of the issue.

FIGURE 2

Bridge Benefits and Potential Tolls



The level of benefits generated by the bridge is shown to be different for various user groups. Depending on the tolls, some users may see their potential benefits erased -- or more than erased -- with implications to their own financial circumstances. For example, a bridge toll of $5 per tonne would more than outweigh the savings that would accrue to mine resupply traffic, which is largely able to utilize the ice bridge during the winter period. The higher net costs likely would be borne by the mining industry.

Over time, it would be expected that competitive forces would have the effect of passing on the net transport costs and savings to the ultimate users -- the mines, businesses and consumers. On an overall basis, the proposed bridge will generate average cost savings on freight transported of about $5.90 per tonne. With an assumed tariff of $5.00 per tonne, users on average would realize residual benefits equal to about $0.90 per tonne, although as discussed some users would realize net benefits much higher than that while others would bear tolls exceeding their savings.

Appendix A
Traffic Estimates and Projections
(one-way vehicle trips)

Appendix A Traffic Estimates and Projections (one-way vehicle trips)

		Non-Commercial Traffic [1]			Commercial Traffic [2]									Total Traffic		
					Mine Resupply [3]			Community Resupply [3]			Total Commercial					
Calendar Year	Bridge Year	Ferry	Ice Bridge	Total	Ferry	Ice Bridge	Total	Ferry	Ice Bridge	Total	Ferry	Ice Bridge	Total	Non-Commercial	Commercial	Total
2000		38,000	12,000	50,000	-	7,918	7,918	13,800	5,000	18,800	13,800	12,918	26,718	50,000	26,718	76,718
2001		38,380	12,120	50,500	-	16,180	16,180	13,938	5,050	18,988	13,938	21,230	35,168	50,500	35,168	85,668
2002		38,764	12,241	51,005	-	15,470	15,470	14,077	5,101	19,178	14,077	20,571	34,648	51,005	34,648	85,653
2003		39,151	12,364	51,515	-	12,000	12,000	14,218	5,152	19,370	14,218	17,152	31,370	51,515	31,370	82,885
2004		39,543	12,487	52,030	-	12,000	12,000	14,360	5,203	19,563	14,360	17,203	31,563	52,030	31,563	83,594
2005		39,938	12,612	52,551	-	12,000	12,000	14,504	5,255	19,759	14,504	17,255	31,759	52,551	31,759	84,309
2006	1	40,338	12,738	53,076	-	12,000	12,000	14,649	5,308	19,957	14,649	17,308	31,957	53,076	31,957	85,033
2007	2	40,741	12,866	53,607	-	12,000	12,000	14,795	5,361	20,156	14,795	17,361	32,156	53,607	32,156	85,763
2008	3	41,149	12,994	54,143	-	12,000	12,000	14,943	5,414	20,358	14,943	17,414	32,358	54,143	32,358	86,501
2009	4	41,560	13,124	54,684	-	12,000	12,000	15,093	5,468	20,561	15,093	17,468	32,561	54,684	32,561	87,246
2010	5	41,976	13,255	55,231	-	12,000	12,000	15,244	5,523	20,767	15,244	17,523	32,767	55,231	32,767	87,998
2011	6	42,395	13,388	55,783	-	12,000	12,000	15,396	5,578	20,975	15,396	17,578	32,975	55,783	32,975	88,758
2012	7	42,819	13,522	56,341	-	12,000	12,000	15,550	5,634	21,184	15,550	17,634	33,184	56,341	33,184	89,526
2013	8	43,248	13,657	56,905	-	12,000	12,000	15,706	5,690	21,396	15,706	17,690	33,396	56,905	33,396	90,301
2014	9	43,680	13,794	57,474	-	12,000	12,000	15,863	5,747	21,610	15,863	17,747	33,610	57,474	33,610	91,084
2015	10	44,117	13,932	58,048	-	12,000	12,000	16,021	5,805	21,826	16,021	17,805	33,826	58,048	33,826	91,875
2016	11	44,558	14,071	58,629	-	12,000	12,000	16,182	5,863	22,044	16,182	17,863	34,044	58,629	34,044	92,673
2017	12	45,004	14,212	59,215	-	12,000	12,000	16,343	5,922	22,265	16,343	17,922	34,265	59,215	34,265	93,480
2018	13	45,454	14,354	59,807	-	12,000	12,000	16,507	5,981	22,488	16,507	17,981	34,488	59,807	34,488	94,295
2019	14	45,908	14,497	60,405	-	12,000	12,000	16,672	6,041	22,712	16,672	18,041	34,712	60,405	34,712	95,118
2020	15	46,367	14,642	61,010	-	12,000	12,000	16,839	6,101	22,940	16,839	18,101	34,940	61,010	34,940	95,949
2021	16	46,831	14,789	61,620	-	12,000	12,000	17,007	6,162	23,169	17,007	18,162	35,169	61,620	35,169	96,789
2022	17	47,299	14,937	62,236	-	12,000	12,000	17,177	6,224	23,401	17,177	18,224	35,401	62,236	35,401	97,636
2023	18	47,772	15,086	62,858	-	12,000	12,000	17,349	6,286	23,635	17,349	18,286	35,635	62,858	35,635	98,493
2024	19	48,250	15,237	63,487	-	12,000	12,000	17,522	6,349	23,871	17,522	18,349	35,871	63,487	35,871	99,358
2025	20	48,732	15,389	64,122	-	12,000	12,000	17,698	6,412	24,110	17,698	18,412	36,110	64,122	36,110	100,231
2026	21	49,220	15,543	64,763	-	12,000	12,000	17,875	6,476	24,351	17,875	18,476	36,351	64,763	36,351	101,114
2027	22	49,712	15,699	65,410	-	12,000	12,000	18,053	6,541	24,594	18,053	18,541	36,594	65,410	36,594	102,005
2028	23	50,209	15,855	66,065	-	12,000	12,000	18,234	6,606	24,840	18,234	18,606	36,840	66,065	36,840	102,905
2029	24	50,711	16,014	66,725	-	12,000	12,000	18,416	6,673	25,089	18,416	18,673	37,089	66,725	37,089	103,814
2030	25	51,218	16,174	67,392	-	12,000	12,000	18,600	6,739	25,340	18,600	18,739	37,340	67,392	37,340	104,732
2031	26	51,730	16,336	68,066	-	12,000	12,000	18,786	6,807	25,593	18,786	18,807	37,593	68,066	37,593	105,659
2032	27	52,248	16,499	68,747	-	12,000	12,000	18,974	6,875	25,849	18,974	18,875	37,849	68,747	37,849	106,596
2033	28	52,770	16,664	69,435	-	12,000	12,000	19,164	6,943	26,107	19,164	18,943	38,107	69,435	38,107	107,542
2034	29	53,298	16,831	70,129	-	12,000	12,000	19,356	7,013	26,368	19,356	19,013	38,368	70,129	38,368	108,497
2035	30	53,831	16,999	70,830	-	12,000	12,000	19,549	7,083	26,632	19,549	19,083	38,632	70,830	38,632	109,462
2036	31	54,369	17,169	71,538	-	12,000	12,000	19,745	7,154	26,898	19,745	19,154	38,898	71,538	38,898	110,437
2037	32	54,913	17,341	72,254	-	12,000	12,000	19,942	7,225	27,167	19,942	19,225	39,167	72,254	39,167	111,421
2038	33	55,462	17,514	72,976	-	12,000	12,000	20,141	7,298	27,439	20,141	19,298	39,439	72,976	39,439	112,415
2039	34	56,017	17,689	73,706	-	12,000	12,000	20,343	7,371	27,714	20,343	19,371	39,714	73,706	39,714	113,420
2040	35	56,577	17,866	74,443	-	12,000	12,000	20,546	7,444	27,991	20,546	19,444	39,991	74,443	39,991	114,434
2041	36	57,143	18,045	75,188	-	12,000	12,000	20,752	7,519	28,271	20,752	19,519	40,271	75,188	40,271	115,458
2042	37	57,714	18,225	75,939	-	12,000	12,000	20,959	7,594	28,553	20,959	19,594	40,553	75,939	40,553	116,493
2043	38	58,291	18,408	76,699	-	12,000	12,000	21,169	7,670	28,839	21,169	19,670	40,839	76,699	40,839	117,538
2044	39	58,874	18,592	77,466	-	12,000	12,000	21,381	7,747	29,127	21,381	19,747	41,127	77,466	41,127	118,593
2045	40	59,463	18,778	78,241	-	12,000	12,000	21,594	7,824	29,418	21,594	19,824	41,418	78,241	41,418	119,659
2046	41	60,057	18,966	79,023	-	12,000	12,000	21,810	7,902	29,713	21,810	19,902	41,713	79,023	41,713	120,736
2047	42	60,658	19,155	79,813	-	12,000	12,000	22,028	7,981	30,010	22,028	19,981	42,010	79,813	42,010	121,823
2048	43	61,265	19,347	80,611	-	12,000	12,000	22,249	8,061	30,310	22,249	20,061	42,310	80,611	42,310	122,921
2049	44	61,877	19,540	81,417	-	12,000	12,000	22,471	8,142	30,613	22,471	20,142	42,613	81,417	42,613	124,030
2050	45	62,496	19,736	82,232	-	12,000	12,000	22,696	8,223	30,919	22,696	20,223	42,919	82,232	42,919	125,151
|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
2080	75	62,496	19,736	82,232	-	12,000	12,000	22,696	8,223	30,919	22,696	20,223	42,919	82,232	42,919	125,151

Appendix B
Economic Savings
Non-Commercial Traffic

Appendix B Economic Savings: Non-Commercial Traffic

		Traffic Shifted From Ferry					Traffic Shifted From Ice Bridge									
								Travel Time Savings			Operating Costs Savings				
Calendar Year	Bridge Year	Number of Vehicles	Passengers per Vehicle	Travel time Saving per Vehicle (hours)	Value per Passenger Hour ($)	Travel Time Savings ($)	Number of Vehicles	Passenger per Vehicle	Travel time Saving per Vehicle (hours)	Value per Passenger Hour ($)	Travel Time Savings ($)	Reduced Travel Distance (km)	Vehicle Operating Cost per km ($) [1]	Vehicle Operating Savings ($)	Total Ice Bridge Savings ($)	Total Savings: Non-Commercial ($)
2000		38,000					12,000								-	-
2001		38,380					12,120								-	-
2002		38,764					12,241								-	-
2003		39,151					12,364								-	-
2004		39,543					12,487								-	-
2005		39,938					12,612								-	-
2006	1	40,338	2	0.5	15	605,066	12,738	2	0.210	15	80,251	15	0.485	92,671	172,922	777,988
2007	2	40,741	2	0.5	15	611,117	12,866	2	0.210	15	81,053	15	0.485	93,597	174,651	785,768
2008	3	41,149	2	0.5	15	617,228	12,994	2	0.210	15	81,864	15	0.485	94,533	176,397	793,626
2009	4	41,560	2	0.5	15	623,401	13,124	2	0.210	15	82,683	15	0.485	95,479	178,161	801,562
2010	5	41,976	2	0.5	15	629,635	13,255	2	0.210	15	83,509	15	0.485	96,434	179,943	809,578
2011	6	42,395	2	0.5	15	635,931	13,388	2	0.210	15	84,345	15	0.485	97,398	181,742	817,673
2012	7	42,819	2	0.5	15	642,290	13,522	2	0.210	15	85,188	15	0.485	98,372	183,560	825,850
2013	8	43,248	2	0.5	15	648,713	13,657	2	0.210	15	86,040	15	0.485	99,356	185,395	834,109
2014	9	43,680	2	0.5	15	655,200	13,794	2	0.210	15	86,900	15	0.485	100,349	187,249	842,450
2015	10	44,117	2	0.5	15	661,752	13,932	2	0.210	15	87,769	15	0.485	101,353	189,122	850,874
2016	11	44,558	2	0.5	15	668,370	14,071	2	0.210	15	88,647	15	0.485	102,366	191,013	859,383
2017	12	45,004	2	0.5	15	675,054	14,212	2	0.210	15	89,533	15	0.485	103,390	192,923	867,977
2018	13	45,454	2	0.5	15	681,804	14,354	2	0.210	15	90,429	15	0.485	104,424	194,852	876,656
2019	14	45,908	2	0.5	15	688,622	14,497	2	0.210	15	91,333	15	0.485	105,468	196,801	885,423
2020	15	46,367	2	0.5	15	695,508	14,642	2	0.210	15	92,246	15	0.485	106,523	198,769	894,277
2021	16	46,831	2	0.5	15	702,463	14,789	2	0.210	15	93,169	15	0.485	107,588	200,757	903,220
2022	17	47,299	2	0.5	15	709,488	14,937	2	0.210	15	94,101	15	0.485	108,664	202,764	912,252
2023	18	47,772	2	0.5	15	716,583	15,086	2	0.210	15	95,042	15	0.485	109,750	204,792	921,375
2024	19	48,250	2	0.5	15	723,749	15,237	2	0.210	15	95,992	15	0.485	110,848	206,840	930,589
2025	20	48,732	2	0.5	15	730,986	15,389	2	0.210	15	96,952	15	0.485	111,956	208,908	939,894
2026	21	49,220	2	0.5	15	738,296	15,543	2	0.210	15	97,921	15	0.485	113,076	210,997	949,293
2027	22	49,712	2	0.5	15	745,679	15,699	2	0.210	15	98,901	15	0.485	114,207	213,107	958,786
2028	23	50,209	2	0.5	15	753,136	15,855	2	0.210	15	99,890	15	0.485	115,349	215,238	968,374
2029	24	50,711	2	0.5	15	760,667	16,014	2	0.210	15	100,888	15	0.485	116,502	217,391	978,058
2030	25	51,218	2	0.5	15	768,274	16,174	2	0.210	15	101,897	15	0.485	117,667	219,565	987,838
2031	26	51,730	2	0.5	15	775,957	16,336	2	0.210	15	102,916	15	0.485	118,844	221,760	997,717
2032	27	52,248	2	0.5	15	783,716	16,499	2	0.210	15	103,946	15	0.485	120,032	223,978	1,007,694
2033	28	52,770	2	0.5	15	791,553	16,664	2	0.210	15	104,985	15	0.485	121,233	226,218	1,017,771
2034	29	53,298	2	0.5	15	799,469	16,831	2	0.210	15	106,035	15	0.485	122,445	228,480	1,027,949
2035	30	53,831	2	0.5	15	807,464	16,999	2	0.210	15	107,095	15	0.485	123,669	230,765	1,038,228
2036	31	54,369	2	0.5	15	815,538	17,169	2	0.210	15	108,166	15	0.485	124,906	233,072	1,048,610
2037	32	54,913	2	0.5	15	823,694	17,341	2	0.210	15	109,248	15	0.485	126,155	235,403	1,059,097
2038	33	55,462	2	0.5	15	831,931	17,514	2	0.210	15	110,340	15	0.485	127,417	237,757	1,069,688
2039	34	56,017	2	0.5	15	840,250	17,689	2	0.210	15	111,444	15	0.485	128,691	240,135	1,080,384
2040	35	56,577	2	0.5	15	848,652	17,866	2	0.210	15	112,558	15	0.485	129,978	242,536	1,091,188
2041	36	57,143	2	0.5	15	857,139	18,045	2	0.210	15	113,684	15	0.485	131,278	244,961	1,102,100
2042	37	57,714	2	0.5	15	865,710	18,225	2	0.210	15	114,821	15	0.485	132,590	247,411	1,113,121
2043	38	58,291	2	0.5	15	874,367	18,408	2	0.210	15	115,969	15	0.485	133,916	249,885	1,124,252
2044	39	58,874	2	0.5	15	883,111	18,592	2	0.210	15	117,128	15	0.485	135,255	252,384	1,135,495
2045	40	59,463	2	0.5	15	891,942	18,778	2	0.210	15	118,300	15	0.485	136,608	254,908	1,146,850
2046	41	60,057	2	0.5	15	900,862	18,966	2	0.210	15	119,483	15	0.485	137,974	257,457	1,158,318
2047	42	60,658	2	0.5	15	909,870	19,155	2	0.210	15	120,678	15	0.485	139,354	260,031	1,169,901
2048	43	61,265	2	0.5	15	918,969	19,347	2	0.210	15	121,884	15	0.485	140,747	262,632	1,181,600
2049	44	61,877	2	0.5	15	928,159	19,540	2	0.210	15	123,103	15	0.485	142,155	265,258	1,193,416
2050	45	62,496	2	0.5	15	937,440	19,736	2	0.210	15	124,334	15	0.485	143,576	267,911	1,205,351
2080	75	62,496	2	0.5	15	937,440	19,736	2	0.210	15	124,334	15	0.485	143,576	267,911	1,205,351

Appendix C
Economic Savings
Commercial Traffic (Mine Re-Supply)

Appendix C Economic Savings: Commercial Traffic (Mine Re-Supply)

		Traffic Shifted From Ice Bridge						
Calendar Year	Bridge Year	Number of Vehicles	Tonnes per Load	Total Tonnes	Travel time savings per vehicle (hours)	Operating Savings per Hour ($)	Total Operating Savings	Total Savings per Tonne
2000		7,918					-	
2001		16,180					-	
2002		15,470					-	
2003		12,000					-	
2004		12,000					-	
2005		12,000					-	
2006	1	12,000	33	198,000	0.300	110	396,000	2.00
2007	2	12,000	33	198,000	0.300	110	396,000	2.00
2008	3	12,000	33	198,000	0.300	110	396,000	2.00
2009	4	12,000	33	198,000	0.300	110	396,000	2.00
2010	5	12,000	33	198,000	0.300	110	396,000	2.00
2011	6	12,000	33	198,000	0.300	110	396,000	2.00
2012	7	12,000	33	198,000	0.300	110	396,000	2.00
2013	8	12,000	33	198,000	0.300	110	396,000	2.00
2014	9	12,000	33	198,000	0.300	110	396,000	2.00
2015	10	12,000	33	198,000	0.300	110	396,000	2.00
2016	11	12,000	33	198,000	0.300	110	396,000	2.00
2017	12	12,000	33	198,000	0.300	110	396,000	2.00
2018	13	12,000	33	198,000	0.300	110	396,000	2.00
2019	14	12,000	33	198,000	0.300	110	396,000	2.00
2020	15	12,000	33	198,000	0.300	110	396,000	2.00
2021	16	12,000	33	198,000	0.300	110	396,000	2.00
2022	17	12,000	33	198,000	0.300	110	396,000	2.00
2023	18	12,000	33	198,000	0.300	110	396,000	2.00
2024	19	12,000	33	198,000	0.300	110	396,000	2.00
2025	20	12,000	33	198,000	0.300	110	396,000	2.00
2026	21	12,000	33	198,000	0.300	110	396,000	2.00
2027	22	12,000	33	198,000	0.300	110	396,000	2.00
2028	23	12,000	33	198,000	0.300	110	396,000	2.00
2029	24	12,000	33	198,000	0.300	110	396,000	2.00
2030	25	12,000	33	198,000	0.300	110	396,000	2.00
2031	26	12,000	33	198,000	0.300	110	396,000	2.00
2032	27	12,000	33	198,000	0.300	110	396,000	2.00
2033	28	12,000	33	198,000	0.300	110	396,000	2.00
2034	29	12,000	33	198,000	0.300	110	396,000	2.00
2035	30	12,000	33	198,000	0.300	110	396,000	2.00
2036	31	12,000	33	198,000	0.300	110	396,000	2.00
2037	32	12,000	33	198,000	0.300	110	396,000	2.00
2038	33	12,000	33	198,000	0.300	110	396,000	2.00
2039	34	12,000	33	198,000	0.300	110	396,000	2.00
2040	35	12,000	33	198,000	0.300	110	396,000	2.00
2041	36	12,000	33	198,000	0.300	110	396,000	2.00
2042	37	12,000	33	198,000	0.300	110	396,000	2.00
2043	38	12,000	33	198,000	0.300	110	396,000	2.00
2044	39	12,000	33	198,000	0.300	110	396,000	2.00
2045	40	12,000	33	198,000	0.300	110	396,000	2.00
2046	41	12,000	33	198,000	0.300	110	396,000	2.00
2047	42	12,000	33	198,000	0.300	110	396,000	2.00
2048	43	12,000	33	198,000	0.300	110	396,000	2.00
2049	44	12,000	33	198,000	0.300	110	396,000	2.00
2050	45	12,000	33	198,000	0.300	110	396,000	2.00
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2080	75	12,000	33	198,000	0.300	110	396,000	2.00

Appendix D
Economic Savings
Commercial Traffic (Community Re-Supply)

Appendix D Economic Savings: Commercial Traffic (Community Re-Supply)

		Traffic Shifted From Ferry						Traffic Shifted From Ice Bridge						Traffic Shifted From Alternate Modes		
Calendar Year	Bridge Year	Number of Vehicles	Tonnage	Travel time savings per vehicle (hours)	Operating Savings per Hour ($)	Total Value of Time Savings	Savings per Tonne ($)	Number of Vehicles	Tonnage	Travel time savings per vehicle (hours)	Value of Time Savings per Hour ($)	Total Operating Savings	Savings per Tonne ($)	Tonnes	Total Savings ($)	Total Savings: All Community Resupply Traffic ($)
2000		13,800	150,144					5,000	54,400				-	500		-
2001		13,938	151,645					5,050	54,944				-	500		-
2002		14,077	153,162					5,101	55,493				-	500		-
2003		14,218	154,694					5,152	56,048				-	505		-
2004		14,360	156,240					5,203	56,609				-	510		-
2005		14,504	157,803					5,255	57,175				-	515		-
2006	1	14,649	159,381	0.50	83.33	610,350	3.83	5,308	57,747	0.300	83.33	132,685	2.30	520	322587	1,065,622
2007	2	14,795	160,975	0.50	83.33	616,453	3.83	5,361	58,324	0.300	83.33	134,012	2.30	526	325813	1,076,278
2008	3	14,943	162,584	0.50	83.33	622,618	3.83	5,414	58,907	0.300	83.33	135,352	2.30	531	329071	1,087,041
2009	4	15,093	164,210	0.50	83.33	628,844	3.83	5,468	59,496	0.300	83.33	136,705	2.30	536	332362	1,097,911
2010	5	15,244	165,852	0.50	83.33	635,132	3.83	5,523	60,091	0.300	83.33	138,072	2.30	541	335686	1,108,890
2011	6	15,396	167,511	0.50	83.33	641,484	3.83	5,578	60,692	0.300	83.33	139,453	2.30	547	339042	1,119,979
2012	7	15,550	169,186	0.50	83.33	647,898	3.83	5,634	61,299	0.300	83.33	140,847	2.30	552	342433	1,131,179
2013	8	15,706	170,878	0.50	83.33	654,377	3.83	5,690	61,912	0.300	83.33	142,256	2.30	558	345857	1,142,491
2014	9	15,863	172,587	0.50	83.33	660,921	3.83	5,747	62,531	0.300	83.33	143,679	2.30	563	349316	1,153,916
2015	10	16,021	174,313	0.50	83.33	667,530	3.83	5,805	63,157	0.300	83.33	145,115	2.30	569	352809	1,165,455
2016	11	16,182	176,056	0.50	83.33	674,206	3.83	5,863	63,788	0.300	83.33	146,566	2.30	575	356337	1,177,109
2017	12	16,343	177,816	0.50	83.33	680,948	3.83	5,922	64,426	0.300	83.33	148,032	2.30	580	359900	1,188,880
2018	13	16,507	179,594	0.50	83.33	687,757	3.83	5,981	65,070	0.300	83.33	149,512	2.30	586	363499	1,200,769
2019	14	16,672	181,390	0.50	83.33	694,635	3.83	6,041	65,721	0.300	83.33	151,008	2.30	592	367134	1,212,777
2020	15	16,839	183,204	0.50	83.33	701,581	3.83	6,101	66,378	0.300	83.33	152,518	2.30	598	370806	1,224,905
2021	16	17,007	185,036	0.50	83.33	708,597	3.83	6,162	67,042	0.300	83.33	154,043	2.30	604	374514	1,237,154
2022	17	17,177	186,887	0.50	83.33	715,683	3.83	6,224	67,713	0.300	83.33	155,583	2.30	610	378259	1,249,525
2023	18	17,349	188,755	0.50	83.33	722,840	3.83	6,286	68,390	0.300	83.33	157,139	2.30	616	382042	1,262,020
2024	19	17,522	190,643	0.50	83.33	730,068	3.83	6,349	69,074	0.300	83.33	158,710	2.30	622	385862	1,274,641
2025	20	17,698	192,549	0.50	83.33	737,369	3.83	6,412	69,764	0.300	83.33	160,298	2.30	629	389721	1,287,387
2026	21	17,875	194,475	0.50	83.33	744,743	3.83	6,476	70,462	0.300	83.33	161,901	2.30	635	393618	1,300,261
2027	22	18,053	196,420	0.50	83.33	752,190	3.83	6,541	71,167	0.300	83.33	163,520	2.30	641	397554	1,313,264
2028	23	18,234	198,384	0.50	83.33	759,712	3.83	6,606	71,878	0.300	83.33	165,155	2.30	648	401529	1,326,396
2029	24	18,416	200,368	0.50	83.33	767,309	3.83	6,673	72,597	0.300	83.33	166,806	2.30	654	405545	1,339,660
2030	25	18,600	202,371	0.50	83.33	774,982	3.83	6,739	73,323	0.300	83.33	168,474	2.30	661	409600	1,353,057
2031	26	18,786	204,395	0.50	83.33	782,732	3.83	6,807	74,056	0.300	83.33	170,159	2.30	667	413696	1,366,587
2032	27	18,974	206,439	0.50	83.33	790,559	3.83	6,875	74,797	0.300	83.33	171,861	2.30	674	417833	1,380,253
2033	28	19,164	208,503	0.50	83.33	798,465	3.83	6,943	75,545	0.300	83.33	173,579	2.30	681	422011	1,394,056
2034	29	19,356	210,589	0.50	83.33	806,450	3.83	7,013	76,300	0.300	83.33	175,315	2.30	687	426232	1,407,996
2035	30	19,549	212,694	0.50	83.33	814,514	3.83	7,083	77,063	0.300	83.33	177,068	2.30	694	430494	1,422,076
2036	31	19,745	214,821	0.50	83.33	822,659	3.83	7,154	77,834	0.300	83.33	178,839	2.30	701	434799	1,436,297
2037	32	19,942	216,970	0.50	83.33	830,886	3.83	7,225	78,612	0.300	83.33	180,627	2.30	708	439147	1,450,660
2038	33	20,141	219,139	0.50	83.33	839,195	3.83	7,298	79,398	0.300	83.33	182,434	2.30	715	443538	1,465,167
2039	34	20,343	221,331	0.50	83.33	847,587	3.83	7,371	80,192	0.300	83.33	184,258	2.30	723	447974	1,479,818
2040	35	20,546	223,544	0.50	83.33	856,062	3.83	7,444	80,994	0.300	83.33	186,101	2.30	730	452453	1,494,616
2041	36	20,752	225,779	0.50	83.33	864,623	3.83	7,519	81,804	0.300	83.33	187,962	2.30	737	456978	1,509,563
2042	37	20,959	228,037	0.50	83.33	873,269	3.83	7,594	82,622	0.300	83.33	189,841	2.30	744	461548	1,524,658
2043	38	21,169	230,318	0.50	83.33	882,002	3.83	7,670	83,448	0.300	83.33	191,740	2.30	752	466163	1,539,905
2044	39	21,381	232,621	0.50	83.33	890,822	3.83	7,747	84,283	0.300	83.33	193,657	2.30	759	470825	1,555,304
2045	40	21,594	234,947	0.50	83.33	899,730	3.83	7,824	85,126	0.300	83.33	195,594	2.30	767	475533	1,570,857
2046	41	21,810	237,296	0.50	83.33	908,727	3.83	7,902	85,977	0.300	83.33	197,549	2.30	775	480288	1,586,565
2047	42	22,028	239,669	0.50	83.33	917,815	3.83	7,981	86,837	0.300	83.33	199,525	2.30	782	485091	1,602,431
2048	43	22,249	242,066	0.50	83.33	926,993	3.83	8,061	87,705	0.300	83.33	201,520	2.30	790	489942	1,618,455
2049	44	22,471	244,487	0.50	83.33	936,263	3.83	8,142	88,582	0.300	83.33	203,535	2.30	798	494842	1,634,640
2050	45	22,696	246,932	0.50	83.33	945,625	3.83	8,223	89,468	0.300	83.33	205,571	2.30	806	499790	1,650,986
|	|	|	|	|	|	|	|	|	|	|	|	|	|	|	|
2080	75	22,696	246,932	0.50	83.33	945,625	3.83	8,223	89,468	0.300	83.33	205,571	2.30	806	499790	1,650,986

Appendix E
Project Cost-Benefit Summary

Appendix E Project Cost-Benefit Summary

		Cost			Benefit								Cost-Benefit		
Calendar Year	Bridge Year	Bridge Capital Costs	Bridge Operating Costs	Total Costs	Ferry Salvage Cost	Avoided Ferry Operating Costs	Avoided Ferry Operating Costs	Avoided Ice Bridge Operating Cost	Transportation Cost Savings Non-Commercial Traffic	Transportation Cost Savings Commercial Traffic	Other Business Savings-Avoided Break	Total Benefit	Net Benefit	Present Value of Net Benefit at 5 %	Present Value of Net Benefit at 10 %
2003		16.5		16.50								-	(16.50)	(15.71)	(15.00)
2004		27.5		27.50								-	(27.50)	(24.94)	(22.73)
2005		11.0		11.00								-	(11.00)	(9.50)	(8.26)
2006	1		0.55	0.55	1.125	1.40	0.074	0.14	0.78	1.46	0.985	5.96	5.41	4.45	3.698
2007	2		0.55	0.55		1.40	0.074	0.14	0.79	1.47	0.995	4.87	4.32	3.38	2.681
2008	3		0.55	0.55		1.40	0.074	0.14	0.79	1.48	1.005	4.90	4.35	3.24	2.453
2009	4		0.55	0.55		1.40	0.074	0.14	0.80	1.49	1.015	4.92	4.37	3.11	2.245
2010	5		0.55	0.55		1.40	0.074	0.14	0.81	1.50	1.025	4.95	4.40	2.98	2.054
2011	6		0.55	0.55		1.40	0.074	0.14	0.82	1.52	1.036	4.98	4.43	2.86	1.880
2012	7		0.55	0.55		1.40	0.074	0.14	0.83	1.53	1.046	5.01	4.46	2.74	1.721
2013	8		0.55	0.55		1.40	0.074	0.14	0.83	1.54	1.057	5.04	4.49	2.63	1.575
2014	9		0.55	0.55		1.40	0.074	0.14	0.84	1.55	1.067	5.07	4.52	2.52	1.441
2015	10		0.55	0.55		1.40	0.074	0.14	0.85	1.56	1.078	5.10	4.55	2.42	1.319
2016	11		0.55	0.55		1.40	0.074	0.14	0.86	1.57	1.089	5.14	4.59	2.32	1.207
2017	12		0.55	0.55		1.40	0.074	0.14	0.87	1.58	1.099	5.17	4.62	2.22	1.105
2018	13		0.55	0.55		1.40	0.074	0.14	0.88	1.60	1.110	5.20	4.65	2.13	1.012
2019	14		0.55	0.55		1.40	0.074	0.14	0.89	1.61	1.122	5.23	4.68	2.04	0.926
2020	15		0.55	0.55		1.40	0.074	0.14	0.89	1.62	1.133	5.26	4.71	1.96	0.847
2021	16		0.55	0.55		1.40	0.074	0.14	0.90	1.63	1.144	5.29	4.74	1.88	0.776
2022	17		0.55	0.55		1.40	0.074	0.14	0.91	1.65	1.156	5.33	4.78	1.80	0.710
2023	18		0.55	0.55		1.40	0.074	0.14	0.92	1.66	1.167	5.36	4.81	1.73	0.650
2024	19		0.55	0.55		1.40	0.074	0.14	0.93	1.67	1.179	5.39	4.84	1.66	0.595
2025	20		0.55	0.55		1.40	0.074	0.14	0.94	1.68	1.191	5.43	4.88	1.59	0.545
2026	21		0.55	0.55		1.40	0.074	0.14	0.95	1.70	1.202	5.46	4.91	1.52	0.499
2027	22		0.55	0.55		1.40	0.074	0.14	0.96	1.71	1.214	5.50	4.95	1.46	0.457
2028	23		0.55	0.55		1.40	0.074	0.14	0.97	1.72	1.227	5.53	4.98	1.40	0.418
2029	24		0.55	0.55		1.40	0.074	0.14	0.98	1.74	1.239	5.57	5.02	1.34	0.383
2030	25		0.55	0.55		1.40	0.074	0.14	0.99	1.75	1.251	5.60	5.05	1.29	0.350
2031	26		0.55	0.55		1.40	0.074	0.14	1.00	1.76	1.264	5.64	5.09	1.24	0.321
2032	27		0.55	0.55		1.40	0.074	0.14	1.01	1.78	1.276	5.67	5.12	1.19	0.294
2033	28		0.55	0.55		1.40	0.074	0.14	1.02	1.79	1.289	5.71	5.16	1.14	0.269
2034	29		0.55	0.55		1.40	0.074	0.14	1.03	1.80	1.302	5.75	5.20	1.09	0.246
2035	30		0.55	0.55		1.40	0.074	0.14	1.04	1.82	1.315	5.79	5.24	1.05	0.225
2036	31		0.55	0.55		1.40	0.074	0.14	1.05	1.83	1.328	5.82	5.27	1.00	0.206
2037	32		0.55	0.55		1.40	0.074	0.14	1.06	1.85	1.342	5.86	5.31	0.96	0.189
2038	33		0.55	0.55		1.40	0.074	0.14	1.07	1.86	1.355	5.90	5.35	0.92	0.173
2039	34		0.55	0.55		1.40	0.074	0.14	1.08	1.88	1.368	5.94	5.39	0.89	0.158
2040	35		0.55	0.55		1.40	0.074	0.14	1.09	1.89	1.382	5.98	5.43	0.85	0.145
2041	36		0.55	0.55		1.40	0.074	0.14	1.10	1.91	1.396	6.02	5.47	0.82	0.133
2042	37		0.55	0.55		1.40	0.074	0.14	1.11	1.92	1.410	6.06	5.51	0.78	0.122
2043	38		0.55	0.55		1.40	0.074	0.14	1.12	1.94	1.424	6.10	5.55	0.75	0.111
2044	39		0.55	0.55		1.40	0.074	0.14	1.14	1.95	1.438	6.14	5.59	0.72	0.102
2045	40		0.55	0.55		1.40	0.074	0.14	1.15	1.97	1.453	6.18	5.63	0.69	0.093
2046	41		0.55	0.55		1.40	0.074	0.14	1.16	1.98	1.467	6.22	5.67	0.66	0.086
2047	42		0.55	0.55		1.40	0.074	0.14	1.17	2.00	1.482	6.26	5.71	0.64	0.078
2048	43		0.55	0.55		1.40	0.074	0.14	1.18	2.01	1.497	6.31	5.76	0.61	0.072
2049	44		0.55	0.55		1.40	0.074	0.14	1.19	2.03	1.512	6.35	5.80	0.59	0.066
2050	45		0.55	0.55		1.40	0.074	0.14	1.21	2.05	1.527	6.39	5.84	0.56	0.060
⋮	⋮		⋮	⋮		⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2080	75		0.55	0.55		1.40	0.074	0.14	1.21	2.05	1.527	6.39	5.84	0.13	0.003
											Total benefit		346.91	32.30	(10.72)