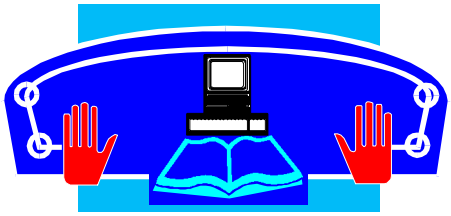

Mackenzie River Bridge Study - Volume I
Date of Report: 1980
Author: Robert Given/yellowknife Chamber Of Commerce
Catalogue Number: 9-5-187

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SUMMARY OF THE BRIDGE STUDY

INTRODUCTIONS

DECLARATION OF OBJECTIVITY

The consultant has produced an unbiased, legitimate analysis from a totally neutral viewpoint.

BACKGROUND - THE PRESENT SITUATION

There is no permanent, all-weather crossing of the Mackenzie River at Fort Providence, N.W.T. Other studies are outdated and neglected various aspects. This study is thorough.

TIME HORIZON CONSIDERATIONS

A 40 year time horizon is examined. Social discount rates, representing the time value of money, investigated are; 5%, 10% and 15%.

FINANCING ALTERNATIVES AND RECOMMENDATIONS

A conservative approach to investigating costs and benefits has been utilized. The Federal Government is the logical financier of the project. They can raise revenues by floating bonds, taxation, or borrowing from a bank; borrowing from or taxing businesses; funding the bridge project in lieu of another project.

Depending on the scenario and financing alternative, the economics Present a mild to strong case for a bridge. Net yearly benefits are in the range of $1,100,000 to $1,500,000.

The project is recommended due to economic and social benefits.

POPULATION CONSIDERATIONS

A bridge would affect: Yellowknife, Rae-Edzo, Fort Providence, Lac La Martre, Snowdrift, Rae Lakes, Detah and Reliance.

Yellowknife's primary industries are government and mining. Both have reasonably healthy futures.

COSTS

CAPITAL COST

Two capital cost studies are included in the appendix. The two cost estimates are $20 million ana $30 million. The $30 million figure is used in this study.

MAINTENANCE COST

Maintenance would cost about $30,000 per year.

ENVIRONMENTAL COST

Environment cost would be minimal.

SOCIAL COSTS

Social costs would be small and manageable.

BENEFITS

FREIGHT BENEFITS

The Big Four trucking companies' responses to a lengthy questionnaire indicated that savings would be about 3.2% of total costs, or $228,000 per year. Savings would result from increased equipment utilization, discontinuation of intermodal transfer, decreased labour and administrative costs and less scheduling disturbances.

BUSINESS BENEFITS

A lengthy questionnaire distributed to 306 businesses was answered by 208 businesses (68%). Business and consumer benefits include: improvement of business activities; labour benefits; less scheduling disturbances; increased availability of goods and services; inventory, warehousing, administration, transportation, and unpredictable costs reduction; increased competition and productivity. Most of the savings of $830,000 -per year could be passed onto consumers.

FERRY COST ELIMINATION

Ferry cost savings of $360,000 per year would escalate greatly with increasing energy costs.

ICE BRIDGE COST ELIMINATION

Savings would be $45,900 per year.

REVENUES AND COSTS OF A TOLL

Although not included in the analysis, a toll of $5.00 per vehicle would generate net revenues of $121,000 per year .

TOURISM BENEFITS

Increase in tourism would be marginal at 3% or a net benefit of $23,000 per year.

MACRO-ECONOMIC BENEFITS

These would include: improvement of the high N.W.T. negative balance of trade, stimulation of the N.W.T. Gross Domestic Product, and facilitation of N.W.T. movement towards provincial status.

SOCIO-ECONOMIC BENEFITS

These would include: increased availability of goods and services, decrease in cost of living, convenience of year round road access, increased physical and political unity with Canada, increased harmony between consumers and business people, isolation and mental health effects, and improvement of turnover.

FUTURE DEVELOPMENT

N.W.T. MINING DEVELOPMENT

Increased mining activity would contribute to a growing Yellowknife population and related increasing benefits.

N.W.T. ENERGY DEVELOPMENT

Energy development mega projects would contribute to Canadian energy self-sufficiency and a growing Yellowknife population and related increasing benefits.

ABBREVIATIONS EMPLOYED IN THE STUDY

a bridge	=	a permanent, all weather crossing of the Mackenzie River at Fort Providence, Northwest Territories
Y.K.	=	the Yellowknife area, Northwest Territories
N.W.T.	=	Northwest Territories
G.N.W.T.	=	Government of the Northwest Territories
Stats. Div.	=	Statistics Division (P & PE)
P & PE	=	Planning and Program Evaluation (G.N.W.T.)
Fed. Gov't.	=	Federal Government
D.I.A.N.D.	=	Department of Indian Affairs and Northern Development (Federal Gov't.)
D.P.W.	=	Department of Public Works (Fed. Gov't.)
N.E.B.	=	National Energy Board
b.p.d.	=	barrels of oil per day
b. & f.	=	breakup and freezeup, the periods when road access to to the Y.K. area is impossible
BCA	=	a benefit-cost analysis
BCR	=	a benefit to cost ratio, i.e. benefits/costs

DECLARATION OF OBJECTIVITY

For full comprehension, this report must be read in full starting here. This study was funded by $5.00 shares sold to the Yellowknife, etc. public, by the Yellowknife Chamber of Commerce Bridge Committee. The study required eight months to complete.

Throughout the research and writing of this study, I, Rob Given, the researcher and consultant, have remained totally objective concerning the various costs and benefits. This was, of course, imperative in order to produce a legitimate, unbiased report.

The opinions and facts discussed in this study are a general consensus of the opinions stated and facts gathered from the correspondingly related individuals

tabled in the appendices, NOT those of the researcher. The researcher is responsible for the entire study (data and opinion gathering and analysis), which was conducted without the aid of a research assistant.

It is important to note that although I was in close contact with many groups and individuals, including the Chamber of Commerce Bridge Committee (which has been promoting their assumption of the need for a bridge), I have not been biased one way or the other by either this committee or any other private or public interest group or individual.

Having been employed in a wide Variety of fields involved in both pro and con development areas and especially through managing the Energy Conservation Information Centre in Yellowknife, the researcher has developed a totally neutral and realistic viewpoint towards development.

The researcher also wishes to make it perfectly clear that he is not a member of the Yellowknife Chamber of Commerce nor involved in any lucrative business activities whatsoever (exclusive of providing consulting services and accepting other wage oriented employment) and that the outcome of the decision of whether or not to build a permanent Mackenzie River crossing will not affect this individual.

Although the researcher has resided in Yellowknife for four years and possesses only affectionate ties with the North, he is unconcerned with the decision of whether or not to build a bridge as well as future possible development. He is merely interested in what is best for the North and Canada.

The only reason the researcher accepted the Bridge Study contract (besides financial remuneration and career oriented experience) was that he desired a legitimate study to be conducted, i.e. he felt that he was the most qualified, available party to perform the study.

Yours sincerely,

Rob Given

February 25th, 1980

Signed and witnessed this 25th day of February, 1980, by

David W. Searle

Notary Public, Yellowknife

BACKGROUND - THE PRESENT SITUATION

Yellowknife, population 10,000, lies at 62.5° north latitude, on the north shore of Great Slave Lake (See also "Population Considerations"). It is the terminus of the gravel Mackenzie Highway Route #3.

About 220 miles via road south-west from Yellowknife, the highway crosses the Mackenzie River at Fort Providence, N.W.T. There is no permanent, all weather crossing - the subject of this study. A ferry enables crossing during the summer, and an ice road, during the winter.

Twice yearly, at breakup and freezeup, there is no road crossing. A permanent all weather crossing (hereafter referred to as a "bridge" for simplification purposes, meaning a permanent crossing in general and not necessarily a structural bridge) would result in the various costs and benefits discussed in this report.

There have been previous attempts to perform an examination of costs and benefits (see Bibliography). However, these attempts were not true cost-benefit analyses, are now very outdated, and also neglected very major aspects of the situation,

This report is an attempt to examine all possible aspects in a thorough manner. Thus, at times, it may appear that there is a seemingly excessive amount of detail. However, this was necessary to achieve thoroughness. For full comprehension, it must be read in full from the start to finish.

TIME HORIZON CONSIDERATIONS

Structural steel bridges last a minimum of between 50 to 70 years, before major repairs are required. A Mackenzie River bridge should last at least that long, considering the very dry climate and its relatively mild weathering effects, assuming engineering precautions are taken to prevent damage due to ice pressure.

Therefore, a conservative bridge life estimate of 40 years will be employed. Although most of the benefits and maintenance costs will continue indefinitely, the present value of future benefits and costs after 40 years becomes relatively small.

Bridge capital cost estimates are in 1979 dollars. Other costs and the researched benefits are also given in 1979 dollars. For simplicity's sake, the bridge construction period is designated as year 0 (say 1979 because estimates are in 1979 dollars). The benefits commence in year 1 (the following year, i.e. 1980 in our example) and will be evaluated to year 40 (2019). Thus the estimated benefits in 1979 dollars (year 0) must be projected for the years 1 through 40 and then discounted to present value, year 0 dollars.

The social discount rate

The benefits and costs of government expenditures may be realized over different time periods, and such differences in time affect evaluations of the desirability of projects. Society is not indifferent between benefits of a public project which are realized immediately and benefits which are realized in some future year. The latter benefits are less valuable because they are not available for immediate consumption or reinvestment. Accordingly, to allow for these welfare costs attributable to the passage of time, discount rates have to be used to convert both benefits and costs into present values in evaluations of public projects. More precisely, costs and benefits occurring in future years are multiplied by a discount factor, $\frac{1}{(1 + i)j}$ where i is the social discount rate per year and j is the index of the year in which the cost or benefit will occur. As j becomes

> larger, that is, the more remote in the future benefits and costs are, the smaller is the discount factor and hence the present value of cost and benefits. Similarly, the larger the social discount rate, i, the smaller is the present value of costs and benefits occurring in any future year. [1]

For this study, three different i values are examined: 5, 10 and 15%. costs and benefits are calculated over the 40 year time horizon where j = 1, 2, . . . 40.

FINANCING ALTERNATIVES, RECOMMENDATIONS, AND SUMMARY TABLES

INTRODUCTION

To fully appreciate the entire issue of a permanent Mackenzie River crossing, the complete report must be read. This section only provides a very brief summary of the methodology utilized.

Before continuing, the author would like to indicate that a very conservative approach has been taken throughout the Report. This follows the principle that if one must err in performing a cost-benefit analysis study, it is best to err on the cautious side. A more middle of the road analysis would probably have yielded greater benefits in the order of an additional 5 to 10%. An optimistic approach could have resulted in higher benefits in the range of the conservative results plus 10 to 20%.

The temperate approach also conforms to the theory that if the benefits of constructing a bridge exceed the costs of doing so, then the argument for a crossing would become even more convincing if either a moderate or an optimistic path were chosen.

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[1] Benefit-Cost Analysis Guide, Planning Branch, Treasury Board Secretariat, 1978, p. 25.

The Treasury Board Benefit-Cost Analysis Guide, 1978, has been employed for guidance throughout this report. It suggests the use of social discount rates of 5, 10 and 15%. However, due to an inflation rate currently close to 10%, the real discount rate is in the range of 0 to 10%. Therefore, although a discount rate of 15% is presented in the tables, it will not be used in the discussion as it is unrealistically high.

The following discussion deals only with the economics of this issue. The evidence presented generally yields favorable support for a bridge. When the unquantifiable economic and social items and possible developmental benefits are added to the debate, the argument becomes more one-sided towards the case for a bridge.

It is essential to remember that we are dealing with a public works project involving the construction of a transportation infrastructure with a lifetime of between 50 to 70 years. Traditionally, public works projects have been very difficult to justify solely with respect to the economic benefit-cost ratio. The financier must also regard unquantifiable and long range developmental aspects with a visionary perspective.

DISCUSSION OF FINANCING ALTERNATIVES

The Federal Government is the logical financier of the bridge project. Therefore, the benefit to cost ratio depends entirely on the opportunity cost, or time value of money, associated with the Federal Government expenditure.

Three alternatives will be discussed: 1) Floating Canadian Government bonds or reducing public expenditures and savings via taxation or borrowing from a bank; 2) Borrowing from or taxing businesses; 3) Funding the bridge project instead of funding another project.

1) Borrowing From The Public Sector Or A Chartered Bank

The Government can collect revenues from the public by either floating bonds or by taxing the public. The nominal rate for the time value of money is about 12%/year in either case, i.e. the Government would be paying the public about 12% interest on bonds, or the public could be investing their money (instead of paying taxes) to earn nominal interest at 12%.

The real rate for the time value of money equals the nominal interest rate divided by the inflation rate. Thus the real rate is about 1.12/1.094 (i.e. a current inflation rate of about 9.4%) which equals 1.024. Therefore the real time value of money is approximately 2.4% under this scenario.

If the Government borrowed from a chartered bank, their real rate would be between 0 and 5%. For example, the average Royal Bank Prime Rate, July 2, 1969 to January 5, 1979 is 7.4%. With an average inflation rate of 9.4% (CPI average, 1971 to 1979), the average real rate equals 1.074/1.094 or 0.982, i.e. less than 0%.

The current one time real rate would equal 1.15 (current Prime Rate of 15%) divided by about 1.094 (inflation rate of about 9.4%) = 1.051 i.e. 5.1%.

Thus, a conservative approximation would be to use a real social discount rate of 5%, which is a rate significantly greater than the average opportunity cost of capital. This yields the following observations.

For Scenario 1A (reported benefits at no growth), the benefit to cost ratio (BCR) is 0.962, i.e. very close to unity. (A BCR greater than one signifies that economic benefits are greater than costs. A BCR less than one indicates that economic costs are greater than benefits.) Therefore, even if current conditions continue as unchanged (i.e. zero growth or no development), there exists a strong case for a bridge.

According to Scenario 2A (reported benefits with freight and business components depressed by 25%, at no growth), the BCR is 0.807, still reasonably favorable support for a bridge.

Employing Scenario 1B (reported benefits at 3% growth, i.e. medium development), the BCR is 1.340, a very strong argument in favour of construction.

Using Scenario 2B (reported benefits with freight and business components depressed by 25%, at 3% growth), the BCR is 1.091; again a strong argument is made for a bridge.

Therefore, in conclusion, if the Government chooses to raise revenues from the public or a chartered bank, the bridge project is economically desireable.

2) Borrowing From The Business Sector

The Gov't. can accumulate revenues from the business sector through taxation, borrowing directly, or by diverting available investment monies away from the private sector (eg. by borrowing from available savings.) In all cases, the alternative yield of money is estimated at 10%, which is the average before tax real rate of return experienced by businesses over the past 25 years. Employing a real discount rate of 10% yields the following observations.

For Scenario 1A, the BCR is 0.556. With Scenario 2A, the BCR is 0.467. These BCRS do not represent a sound economic proposal.

Using Scenario 1B, the BCR is 0.712, not a strong case against a bridge. Scenario 2B BCR is 0.584, again not an economic proposition.

Thus, if the Federal Government's only source of bridge financing is from the private sector, the bridge project does not appear economically attractive when evaluated on a quantifiable basis. Fund raising alternatives one and three represent economically superior choices.

3) Eliminating Another Project in Lieu of the Bridge Project

Alternative #3 assumes that the Government already has at its disposal adequate financing for the bridge, as well as for competing projects. The Government is then in a position to evaluate various projects competing for

the same funds on the basis of various criteria. The criteria involved may be political (the reduction of regional economic disparity or the promotion of regional economic development) or the criteria may be economic. When evaluating competing projects on an economic basis, the most widely utilized criteria is benefit-cost analysis.

It is the usual practice of Government to employ either a 5% or 10% real discount rate to compare alternative projects. It is also essential that they employ the same criteria and rates for evaluating all projects.

Since the author is in no position to weigh political considerations, this study limits itself to economic and social aspects of the bridge project. If the Government employs method #3, they must study the alternatives to decide which projects are most beneficial. [1]

DISCUSSION OF TABLE 5 - YEAR 1 COSTS AND BENEFITS

It is interesting to note that Table 5 Net Year 1 Benefits, depending on the scenario, are in the range of $1,088,900 to $1,518,000, i.e. well over one million dollars per year. This magnitude of yearly net benefits is economically favorable in comparison to a one time capital expenditure of $30 million for an infrastructure facility with a lifetime of between 50 to 70 years.

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[1] An important consideration is that the BCR's of many other Government financed projects (for example, the Dempster Highway and the Hay River Furniture Plant) are less than unity.

SUMMARY TABLES OF COSTS AND BENEFITS

TABLE 1 - SUMMARY TABLE OF ECONOMIC COSTS

Item	Net Cost at Social Discount Rates of:		
	5%	10%	15%
Capital Cost	$28,309,000	$28,309,000	$28,309,000
Maintenance Cost	$ 515,000	$ 293,000	$ 199,900
Loss of Subsidies Cost	Zero Net Cost	Zero Net Cost	Zero Net Cost
Total Costs	$28,824,000	$28,602,000	$28,508,000

TABLE 2 - SUMMARY TABLE OF ECONOMIC BENEFITS - EVENT A

Event A - Maintenance of Status Quo - Post Bridge Without Development

Item	Net Benefit at Social Discount Rates of:		
	5%	10%	15%
Ferry Cost Elimination	$ 8,268,000	$ 4,867,000	$ 3,432,000
Ice Road Cost Elimination	$ 645,000	$ 437,000	$ 297,000
Tourism Benefits	$ 931,000	$ 413.000	$ 238.000
Totals	$ 9,844,900	$ 5,717,000	$ 3,967,000
Freight Benefits - Scenario 1A - Reported Benefits	$ 3,576,000	$ 2,038,000	$ 1,384.000
Business Benefits - Scenario 1A - Reported Benefits	$14,300,000	$ 8,152,000	$ 5,538,000
1A Totals (with Freight & Business Benefits using Scenario 1A	$27,720,000	$15,907,000	$10,889,000
Freight Benefits - Scenario 2A - Reported Benefits Minus 25% Bias	$ 2,682,000	$ 1,528,000	$ 1,038,000
Business Benefits - Scenario 2A - Reported Benefits Minus 25% Bias	$10,725,000	$ 6,114,000	$ 4,154,000
2A Totals (with Freight & Business Benefits using Scenario 2A - Reported Benefits Minus 25% Bias)	$23,251,090	$13,359,009	$ 9,159,000
Net Toll Revenues	$ 4,011,000	$ 1,933,000	$ 1,169,000

TABLE 3 - SUMMARY TABLE OF ECONOMIC BENEFITS - EVENT B

Event B - Future Development - Post Bridge with Development - Contributing to 3% Average Annual Growth

Item	Net Benefit at Social Discount Rates of:		
	5%	10%	15%
Ferry Cost Elimination	$ 8,268,000	$ 4,867,000	$ 3,432,000
Ice Road Cost Elimination	$ 645,000	$ 431,000	$ 297,000
Tourism Benefits	$ 931,000	$ 413,:00	$ 238,000
Totals	$ 9,844,000	$ 5,717,0000	$ 3,967,000
Freight Benefits - Scenario 1B - Reported Benefits	$ 5,759,000	$ 2,845,000	$ 1.,767.000
Business Benefits - Scenario 1B - Reported Benefits	$23,030,000	$11,802,000	$ 7,525,000
Totals (with Freight & Business Benefits using Scenario 1B	$38,633,000	$20,364,000	$13,259,000
Freight Benefits - Scenario 2B - Reported Benefits Minus 25% Bias	$ 4,319,000	$ 2,134,000	$ 1,325,900
Business Benefits - Scenario 2B - Reported Benefits Minus 25% Bias	$17,272,000	$ 8,851,000	$ 5,643,000
Totals (with Freight & Business Benefits using Scenario 2B - Reported Benefits Minus 25% Bias	$31,435,000	$16,702,000	$10,935,000
Net Toll Revenues	$4,011,000	$1,933,000	$1,169,000

TABLE 3 - con't.

IF Northeast Mackenzie District Mining Transportation Infrastructure crosses Mackenzie River at Fort Providence: Savings of $100,000,000 to $200,000,000
IF oil or gas pipeline is located east of Fort Providence, benefit to each pipeline: Savings of $4,000,000 to $8,000,000

TABLE 4 - SUMMARY TABLE OF ECONOMIC COSTS AND BENEFITS

Item	Item at Social Discount Rates Of:		
	5%	10%	15%
Total Costs	$28,824,000	$28,602,000	$28,508,000
Total Benefits, Event A, Zero Growth - Scenario 1A	$27,720,000	$15,907,000	$10,889,000
Event A, Scenario 1A - Benefit/Cost Ratio	0.962	0.556	0.382
Total Benefits, Event A, Zero Growth - Scenario 2A	$23,251,900	$13,359,000	$ 9,159,200
Event A - Scenario 2A - Benefit/Cost Ratio	0.807	0.467	0.321
Total Benefits, Event B, 3% Growth - Scenario 1B	$38,633,000	$20,364,000	$13,259,000
Event B, Scenario 1B - Benefit/Cost Ratio	1.340	0.712	0.465
Total Benefits, Event B, 3% Growth - Scenario 2B	$31,435,000	$16,702,000	$10,935>009
Event B, Scenario 2B Benefit/Cost Ratio	1.091	0.584	0.384

TABLE 5 - SUMMARY TABLE OF YEAR 1 (1980) ECONOMIC COSTS AND BENEFITS

Item	Researched Item Value in 1979 at 1979 Dollars	Projected Item Value in 1980 (Year 1), Discounted to 1979 Dollars at Social Discount Rates Of:		
		5%	10%	15%
Maintenance Cost	$ 30,000	$ 28,571	$ 27,273	$ 26,087
BENEFITS				
Ferry Cost Elimination (O & M only, not residual ferry value)	$ 360,995	$ 358,286	$ 342,900	$ 327,130
Ice Road Cost Elimination	$ 44,700	$ 42,571	$ 40,636	$ 38,870
Tourism Benefits	$ 23,265	$ 23,265	$ 22,207	$ 21,242
Totals	$ 428,960	$ 424,122	$ 404,843	$ 387,242
Freight Benefits - Scenario 1A - Reported Benefits	$ 298,377	$ 198,454	$ 189,434	$ 181,197
Business Benefits - Scenario 1A	$ 833,105	$ 793,433	$ 757,368	$ 724,439
Total Scenario 1A Benefits	$1,470,442	$1,416,009	$1,351,645	$1,292,878
Net (Minus Cost) Scenario 1A Benefits	$1,440,442	$1,387,438	$1,324,372	$1,266,731
Freight Benefits - Scenario 1B Reported Benefits - at 3% Growth	$ 208,377	$ 204,408	$ 195,117	$ 186,633
Business Benefits - Scenario 1B	$ 944,957	$ 918,365	$ 876,621	$ 838,507
Total Scenario 1B Benefits	$1,582,294	$1,546,895	$1,476,581	$1,412,382
Net Scenario 1B Benefits	$1,552,294	$1,518,324	$1,449,308	$1,386,295

TABLE 5 - con't.

Freight Benefits - Scenario 2A - Reported Benefits Minus 25% at No 'Growth	$ 156,283	$ 148,841	$ 142,075	$ 135,898
Business Benefits - Scenario 2A	$ 624,829	$ 595,075	$ 568,026	$ 543,330
Total Scenario 2A Benefits	$1,210,072	$1,168,038	$1,114,944	$1,066,470
Net Scenario 2A Benefits	$1,180,072	$1,139,467	$1,087,671	$1,040,383
Freight Benefits - Scenario 2B -Reported Benefits Minus 25% at 3% Growth	$ 156,283	$ 153,306	$ 146,338	$ 139,975
Business Benefits - Scenario 2B	$ 708,718	$ 688,774	$ 657,466	$ 628,881
Total Scenario 2B Benefits	$1,293,961	$1,266,202	$1,208,647	$1,156,098
Net Scenario 2B Benefits	$1,263,961	$1,237,631	$1,181,374	$1,130,011

TABLE 6 - SUMMARY TABLE OF UNQUANTIFIABLE COSTS AND BENEFITS

Item	Comments
UNQUANTIFIABLE COSTS	
Opportunity Cost	foregone alternative investments/ projects, i.e. bridge must be a priority
Environmental Cost	small and manageable
Social Costs	construction activity effects on Fort Providence, small and manageable
UNQUANTIFIABLE BENEFITS	
Business Benefits of increased Competition and Productivity	should be significant

TABLE 6 - con't.

improvement of N.W.T. Balance of Trade: Imports and Exports	important contribution
stimulation of N.W.T. Gross Domestic Product	should be of major consequence
Facilitation of N.W.T. Movement Towards Provincial Status	spillover outcome from above benefits
Socio-Economic Effects:	
Increased Availability of Goods and Services	
Decrease in Cost of Living	
Convenience of Year Round Road Access	Very valuable consumer and business benefits
Increased Physical and Political Unity with Canada	
Increased Harmony between Consumers and Business People	
Isolation and Mental Health Effects	
Improvement of Turnover	
Time Savings	minor consequence
Military Aspect	small significance

STATISTICAL METHODOLOGY

The various forecasted costs and benefits presented in this report were derived by employing forecasting techniques based upon projecting historical records and using a consensus of the opinions of informed individuals.

Therefore, the stats represent an approximation or order of magnitude of a permanent crossing's effect upon the particular cost or benefit. The original programmable calculator generated stats have been rounded off to "thousands of dollars". Therefore, some subtotals may not add exactly to yield the final total of a particular cost or benefit due to individual rounding.

Also for presentation purposes, tables of future values for 40 years are condensed to present only every fifth year. The original tables, containing 40 years of values to four or more significant figures, are available upon request.

POPULATION CONSIDERATIONS

INTRODUCTION

When one considers construction of infrastructure facilities, such as a permanent crossing, one must examine the population which is affected and how that population will be changing over a long range time horizon.

The area affected by the crossing is shown on the accompanying map. Communities affected are: Yellowknife, Rae-Edzo, Fort providence, Lac La Martre, Snowdrift, Rae Lakes, Detah and Reliance.

A "Historical Population Table - Yellowknife Region" follows (Table 1). A "Yellowknife Population - Historical and Projected Using Linear Regression", Table 2, also follows. It commences in 1941 when the first census was completed. Table 3 contains a "Population Projection - Yellowknife Region".

The linear regression projected Yellowknife population (Table 2) is then compared to yellowknife growth scenarios of 2%, 4%, and 6% in Table 4 which contains a "Population Projection - Yellowknife Region". Other communities are assumed to grow at 1.4% and Yellowknife growth scenarios of 2%, 4% and 6% are tabled.

YELLOWKNIFE REGION AFFECTED BY CROSSING

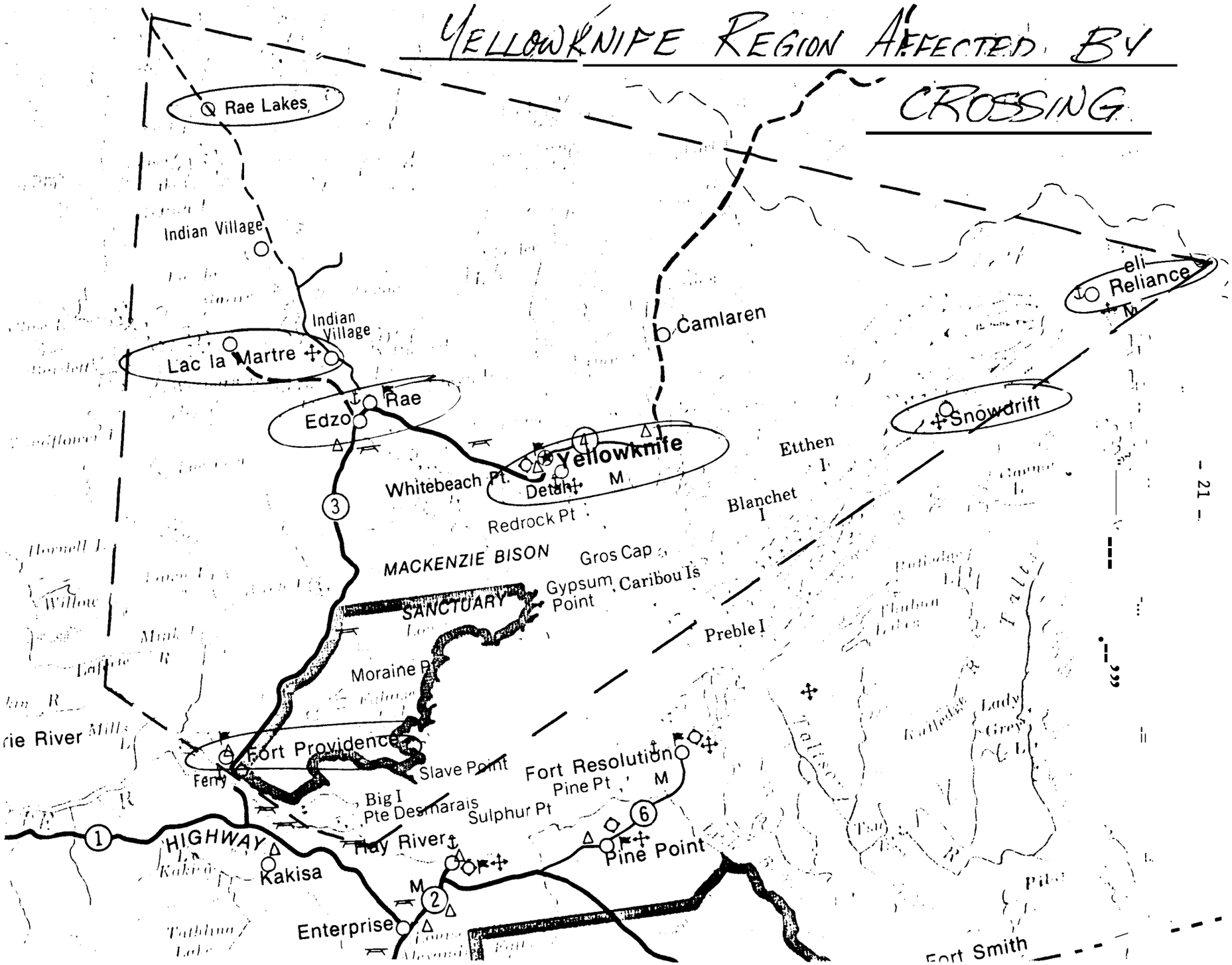

TABLE 1 - HISTORICAL POPULATION TABLE - YELLOWKNIFE REGION

Community	1971 Census [1]	1976 Census [2]	1971-1976 Annual Rate of Change in % [3]	Dec. 1977 [4] Census	Dec. 31 1978, Population [5]	1976-1978 Annual Rate of Change [6]
Detah *				161	162	
Fort Providence				566	556	
Lac La Martre	161	213	+5.8	224	225	+3.2
Rae-Edzo	1,056	1,158	+1.9	1,239	1,269	+4.4
Rae Lakes	73	164	+17.6	171	172	+2.7
Reliance				9	9	
Snowdrift	221	224	+0.3	258	262	+9.3
Yellowknife	6,122	8,256	+6.2	9,969	9,981	+12.6
Unorganized	44	218 *		18	18	
Total Including Yellowknife	7,677	10,233		12,615	12,654	+10.9
Total Excluding Yellowknife	1,555	1,977		2,646	2,673	

1-4 & 6 N.W.T. Population Information, Jan. 1978, Statistics Section, Division of Policy and Evaluation, Department of Planning and Program Evaluation, G.N.W.T.

5 Population Estimates, Methodological Report, N.W.T., Dec. 31, 1978, Stats. Section, P & PE, G.N.W.T.

* Detah was included in the 1976 Yellowknife unorganized total.

TABLE 2 - YELLOWKNIFE POPULATION - HISTORICAL AND PROJECTED USING LINEAR REGRESSION

Year	Population	Average Annual Percent Increase
	Historical	
1941	1,172 [1]	
1951	2,724 [3]	13.2 (1941 to 1951)
1956	3,100 [3]	1.4 (1951 to 1956)
1961	3,245 [3]	0.9 (1956 to 1961)
1964	3,787 [2]	2.8 (1961 to 1964)
1971	6,122 [3]	
1976	8,256 [3]	6.2 (1971 to 1976)
1977	9,969 [4]	
1978	9,981 [4]	12.6 (1976 to 1978)
	Projected	
1980	9,249	
1985	10,452	
1990	11,655	
1995	12,858	
2000	14,061	
2005	15,264	
2010	16,467	
2015	17,670	
2019	18,633	

[1] Robinson, J.L. (1945), Land Use Possibilities in the Mackenzie Dist., N.W.T., Canadian Geographical Journal, Vol. 31, 1945, P. 38.

[2] Municipal Census of Yellowknife, May 1964.

[3] Dominion Bureau of Statistics, Censuses of Canada.

[4] Statistics Division, P & PE, G.N.W.T.

TABLE 3 - POPULATION PROJECTION - YELLOWKNIFE REGION[1]

Community / Year, Dec. 31	Fort Providence	Lac La Martre	Rae / Edzo	Snowdrift	Detah Rae Lakes Reliance Combined	Yellowknife
1978	556	225	1269	262	343	9,981
1979	563	228	1281	265	348	10,451
1980	571	231	1295	269	353	10,922
1981	579	234	1310	272	359	11,395
1982	587	238	1326	276	364	11,869
1983	595	241	1344	280	370	12,343
1984	604	245	1364	283	375	12,819
1985	614	248	1385	287	381	13,296
1986	624	252	1407	291	386	13,772
1987	634	256	1431	295	392	14,249
1988	645	260	1457	299	398	14,725
Percent Growth Total	16.0	15.6	14.8	14.1	16.1	47.5
Percent Growth Average Annual	1.5	1.5	1.4	1.3	1.5*	4.0

[1] Population Projections - Methodological Report (preliminary figures), Aug. 1979, Stats., PPE, G.N.W.T. Based on 1971-1978 historical data projected.

*Assumed by consultant.

TABLE 4 - POPULATION PROJECTION - YELLOWKNIFE REGION

Year	Yellowknife at Historical Linear Regression Projection	Others * at 1.4% Growth	Yellowknife at 2% Growth	Total Y.K. Regio
1978	9,981	2,673	9,981	12,654
1980	9,249	2,748	10,384	13,132
1985	10,452	2,946	11,465	14,411
1990	11,655	3,158	12,658	15,816
1995	12,858	3,386	13,976	17,362
2000	14,061	3,629	15,430	19,059
2005	15,264	3,891	17,036	20,927
2010	16,467	4,171	18,810	22,981
2015	17,670	4,471	20,767	25,238
2019	18,633	4,727	22,479	27,206

* "Others" includes Detah, Fort Providence, Lac La Martre, Rae

YELLOWKNIFE HISTORICAL

Yellowknife was born in 1938 with the opening of the Cominco gold mine. Giant Y.K. Mines opened in 1942. This accounts for an average annual 13.2% increase from 1941 to 1951 (Table 2). Yellowknife continued as a gold mining centre until it became the N.W.T. capital and home of the Territorial Government in 1967. This accounts for the population growth from 3787 in 1964 to 6122 in 1971 (Table 2).

YELLOWKNIFE FUTURE

1) Mining

The future of the two gold mines depends on the world price of gold, future technological advances, and the mines' abilities to discover new reserves.

Cominco officials indicate optimism for the future of their Con gold mine exhibited by their recent investment of $20 million in the Robertson shaft. Present identified ore reserves are 6 1/2 years at current capacity (these are the highest ore reserves in the history of the property), with a minimum predicted life of 10 years and conceivably much greater. Although in existence for 41 years, it is still considered to be a long range operation.

Current Giant Y.K. ore reserves are about 5 years. Since commencing operation in 1942, ore reserves have never been greater than 6 years and are usually 2 to 3 years. If current prices continue, Giant officials are optimistic about a longer lifespan.

The current high world gold prices are naturally favorable for these gold mines. However as these prices are based on speculation partially resulting from world political and economical instability, future price levels are very uncertain.

Yellowknife could be affected by the opening of new N.W.T. mines as outlined in the "Mining Development Scenario."

2) Government

Yellowknife is home of the Territorial Government (since 1967) and some federal departments. There is a present hiring freeze in the Territorial Government. The federal government lifted its hiring freeze in Aug., 1979, however, restraint continues. As Y.K. moves towards responsible government, various programs will be transferred from federal to territorial jurisdiction. Thus the combined civil service will not decrease.

If and when non renewable mineral, oil and gas development proceeds, there could be an increase in government personnel (such as in oil and gas). Depending on the rate and degree to which provincial status is achieved, some of the functions currently handled in Ottawa could be transferred to the N.W.T. along with the staff positions involved.

3) Businesses

To approximate the number of employees involved in business, the following rough calculations were made.

Given:

Individuals 20 years and older = 6345

Females = 2913

- # Unemployed females (Homemakers as derived from the Public Telephone Questionnaire - Question 5) = $\frac{37}{137} \times 2913 = 787$

= # Employed females = 2126

+ # Employed Males = 3432

- # Unemployed = 0 (the number of unemployed may approximate the number of employed less than 20 years old).

Thus :	Total Employees	= 5558
	- Total Non Business Employees	= 2200
	= Total Business Employees	= 3358

There are over 300 businesses in Y.K. (see Business Questionnaire). This results in businesses having an average of 11 employees.

The total employee figure of 5558 (1979) coincides well with the figure of 5372 tax returns (1976) obtained from: Summary of Personal Income Statistics, 1976, P & PE, G.N.W.T. Therefore more than 1/2 (5558/10,000) of Yellowknifers are employed.

SUMMARY TABLE OF YELLOWKNIFE'S MAJOR EMPLOYERS

Employer	Approximate Number of Employees	Approximate Percent
Government of the N.W.T.	1000	18.0
Federal Government	600	10.8
Giant Y.K. Mine	320	5.8
Con Mine	280	5.0
Private Businesses (about 300)	3360	60.4
Total	**5560**	**100.0**

Therefore, Yellowknife currently has 4 major primary employers, two governments and two mines. It is basically a two industry town. Both industries appear to have reasonably healthy futures.

SUMMARY

Future Y.K. population will depend upon economic factors. A recession could result in 2% or less growth. Fair to medium economic development could result in growth between 2% to 4%. Large development could contribute to approximately 4% growth. Massive development could produce growth in the 4% to 6% range.

The best guess scenario is that of fair to medium economic development causing a 2% to 4% growth (see also Mining Development Scenario, Honorable Jake Epp).

ADDENDUM TO SUMMARY

It appears that Y.K. population has actually dropped from 9981 on Dec. 31, 1978 to 9694 (a drop of 2.9%) on Oct. 1979. ("Get It All From the Hall - Population Drops" - Yellowknifer, Oct. 25, 1979).

This population decline is thought to be only a short run phenomenon. Long range growth should occur at a rate between 2% to 4% as outlined earlier.

COSTS

BRIDGE CAPITAL COST

DISCUSSION

Two capital cost studies, C.B.A. Engineering Ltd., updated Oct. 1979, and Public Works Canada, Dec. 1975, are included in the appendix. Correspondence between the consultant and C.B.A. and Dr. Turgut Ersoy (letters #1 to #4) are also included in the appendix.

Further to conversation with Dr. Ersoy and in light of letter #4, a capital cost of $30,000,000 in 1979 dollars will be employed.

A small portion of this expenditure can also be considered to be a benefit for cost-benefit analysis purposes. According to letters #1 and #2, the components of material, labour, equipment and overhead, and corporate before tax profit which will also be a benefit are detailed in the following table.

In addition to resulting in the benefits described in the benefits section, an expenditure of $30 million would help stimulate the Canadian economy via an increase in activities in the following areas.

TABLE OF BRIDGE CAPITAL COST COMPONENTS AND CORRESPONDING BENEFITS

Cost Component	Component cost	Percentage of cost which is also a benefit	Corresponding Dollar Benefit
1) Labour	34% X $25,620,280 =$8,710,895	10%	$871,090
2) Materials	34% X $25,620,280 =$8,710,895	Zero	Zero
3) Equipment and Overhead	21% X $25,620,280 =$5,380,259	10%	$538,026
4) Corporate Profit	11% X $25,620,280 =$2,818,231	10%	$281,823
5) Engineering and Contingencies	$4,379,720	Zero	Zero
TOTALS	$30,000,000	10%	$1,690,939

The component cost percentages (11% to 34%) and percentage of cost which is also a benefit (10%) are derived from letter #2.

Justification for employing a corresponding benefit of 10% for cost components 1, 3 and 4 is as follows.

1) Labour

Expenditures for labour will create jobs for highly, semi and unskilled workers. For cost-benefit analysis purposes, those workers who would have been otherwise unemployed and become employed because of the bridge project are considered to be receiving a benefit. Their after tax wages are benefits to themselves and taxes are benefits to the government.

The percentage of expenditures made on these otherwise unemployed workers will be small, particularly in the highly and semi skilled categories. however, the present economic semi-recession and corresponding high unemployment rates indicate that there would be workers who become employed on the bridge project

who would be unemployed if this project did not take place.

This percentage can only be guesstimated; however, a conservative approximation would be 10%.

2) Equipment and Overhead

Expenditures for equipment and overhead will result in activities among contractors which would not occur without the bridge project. Some of these contractors and their equipment would be inactive otherwise; therefore, their utilization results in a benefit.

The percentage of expenditures also producing a benefit is impossible to determine; however, a conservative guesstimate would be 10%.

3) Corporate Profit

Corporate before tax profit can be considered to be a benefit (after tax profit benefiting the corporation and taxes benefiting the government) if that firm would have been otherwise inactive.

Thus the probability of this taking place is the corresponding benefit. Again, this probability can only be guesstimated, however a conservative approximation would be 1 in 10 or 10%.

The total corresponding benefit is $1,691,000, resulting in a net capital cost, for cost-benefit analysis purposes, of $28,309,000."

MAINTENANCE COST OF BRIDGE

Most bridges are currently constructed of self-weathering steel eliminating the need for painting. Minor damages will result from vehicles colliding with the structure. Some navigational and airplane lighting will be required although long summer days and a frozen river in the winter will minimize this. Some sanding will also be required.

Keith Henry, President, CBA Eng., indicates a ballpark figure of $20,000 per annum. The 1971 DIAND study employs a value of 0.1% of capital costs or $30,000 per year. Fred Harvey (Chief Bridge Eng., Alberta Government) states a ballpark of $10,000 to $30,000. Dr. Turgut Ersoy (Head, Design and Construction, GNWT Highways) cites a figure of $30,000 in terms of 1980 dollars.

In conclusion, a yearly maintenance cost of $30,000 will be employed. This cost experiences no real growth. The 40 year total maintenance cost at social discount rates of 5%, 10% and 15% is $515,000, $293,000, and $199,000, respectively.

OPPORTUNITY COST OF CAPITAL EXPENDITURE

Whenever one considers an expenditure, one must examine the various possible items which that expenditure could purchase, i.e. the opportunity cost of forgone alternatives.

In the case of public works infrastructure projects, various alternative projects can be evaluated by employing a cost-benefit analysis. Comparison of the benefit to cost ratios is used to priorize projects.

Therefore, if the federal government is to consider an expenditure on a permanent Mackenzie River crossing, they must examine competing possible projects nationwide by using the benefit to cost ratios and/or other possible criteria such as regional economic development.

As this study encompasses only the consideration of a permanent Mackenzie crossing, it is outside the limits of this study to examine other possible projects.

ENVIRONMENTAL COST

A bridge could be constructed without resulting in any significant environmental effects.

The bridge should be designed to minimize ice damming and ice pressure on the bridge piers. The bridge design will also incorporate navigational requirements of span between piers and clearance.

No significant wildlife effects should occur as the highway, Fort Providence, and ferry crossing are already present. A bridge (versus a dam, causeway, etc.) also presents the best crossing as far as fish migration is concerned.

If waterway constriction is considered, then ice damming and erosion must be more closely examined. Also, consideration of a combined crossing - dam structure would necessitate an entirely different examination of environmental effects.

SOCIAL COSTS

Construction of a crossing at Fort Providence would result in social cost effects occurring over three time periods; the immediate effects of the influx of personnel to satisfy labour requirements, the post boom period effects, and the long term catalytic effects of a crossing on future development and correspondingly consequential social effects. (Social benefits are discussed in the Benefits Section.)

1) Immediate Effects of Personnel Influx

The construction project would require a maximum labour force of about 20

highly skilled employees for the duration of a 2 year period (Keith Henry, CBA Eng.). Specialized personnel would be necessary for the various stages of construction, therefore a number of crews with a maximum size of 20, would be involved.

About 90% of the labour would be highly skilled, necessitating imported labour. Only about 10% of the labour would be hired locally. Providence's population is about 563 (Statistics Division, GNWT, 1979), therefore an influx of 20 people represents a 3.6% influx.

It appears that this small influx should produce small effects on the population and should be controllable PROVIDED community relations are established. It would be very small relative to a megaproject such as a Mackenzie Valley Pipeline.

If contractors establish sufficient community relations with settlement and band councils, etc., before the influx, Providence could be well prepared. It should be explained to Providencites that employee benefits during construction would be small. This would hopefully prevent resentment from the unemployed in the area.

The contractors must also make efforts to brief their workers to prevent any possible incidents of a criminal nature or disruptions of family life, especially resulting from alcohol abuse.

The imported, highly skilled labour would be experienced in this transitory nature of employment. This should help minimize negative social effects.

Providence has experienced a few large construction projects in the last few years involving an influx of workers. The effects of these projects have been small so there is an indication that another project would produce no large effects on this community as it is already used to construction activity.

There would also be some positive social effects due to the social integration

with the outsiders, especially because of the presence of St. Regis Indians who perform most of the high steel work in North America.

2) Post Boom Period Effects

The project would produce economic benefits for providence, because of the injection of money due to the purchase of goods and services by the new labour force. However, once the project is completed, a mini boom and bust syndrome would occur due to the withdrawal of this capital injection. Hopefully, this negative effect would be minor, due to the small number of employees (20) and dollars involved. Again, Providence has recently experienced other large construction projects and has weathered the bust aspect.

A bridge could result in more transients seeking employment traveling to Yellowknife. Both economic and social costs and benefits would emerge. Economic benefits would result from transients expending funds in Yellowknife. However, if they are unsuccessful in finding employment, an economic cost would occur from the cost of shipping them south. Social costs and benefits should be small as Yellowknife has always experienced a highly transient labour force.

3) Long Term Development

Large future development projects could result in much greater negative social effects than the actual crossing construction. It is hoped that the organizations involved will learn from the Alaska development example and take measures to minimize negative social effects. It is outside the scope of this study to examine developmental social effects. That is the responsibility of the organizers of those potential projects.

LOSS OF SUBSIDIES COST - ALTERATION OF SALARY AND BENEFITS PACKAGE

Conversations were conducted with the related individuals tabled in the appendix (Salary and Benefits Package, Turnover - Related Individuals).

All major employers (GNWT, Federal Government, City Hall, Giant and Con Mines)

indicated that there would be no alteration of the salary and benefits package with one exception.

Bob Hornal (Director, DIAND, Yellowknife) indicated that a bridge "would have the effect of reducing benefits to Federal Public Servants by an amount of $50.00 per single employee or $85 per employee with dependents per year for annual leave travel. This would affect approximately 250 single employees and 500 employees with dependents in the Federal Government in Yellowknife." (Correspondence, June 18, 1979). This represents a reduction of $55,000.

All employers further indicated that the salary and benefits package is reviewed every one to three years with regard to the local cost of living. If a bridge resulted in a major reduction in the cost of living, this would be reflected in the regular examinations of the total remuneration and benefits package.

However, any reduction in the salary and benefits packages would be more than offset by the lowered cost of living.

A reduction in the salary and benefits package (particularly the $55,000 for the Federal employees) represents a cost to the employees, i.e. the recipient of benefits. However, this same reduction also represents an equal benefit to the employer, i.e. the payer of benefits. Therefore, for the purposes of cost-benefit analysis, total costs equal total benefits and negate each other, i.e. the net cost is zero.