NATIONAL HIGHWAY POLICY FOR CANADA

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Steering Committee Report on Phase 2

Council of Ministers Responsible for Transportation and Highway Safety

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1.0 INTRODUCTION

Canada ranks second in geographic area of all countries in the world. This geographic size and the population settlement patterns that have emerged in Canada make the efficient transportation of people and goods of prime concern to the nation. The highway transportation mode is of particular importance to all regions of Canada. Personal mobility and travel, tourism, trade and commerce all rely to some extent on the existence of adequate and efficient highway transportation. As Canada's existing highway infrastructure ages, decisions regarding its preservation and improvement must be made to ensure that the nation's highway networks continue to provide an effective transportation function into the next century.

Recognizing that decisions about highway viability made today in the various regions of Canada will influence the performance of the Canadian highway system as a whole well into the next century, the Roads and Transportation Association of Canada Board of Directors resolved in 1987 to:

> ***... recommend that the provinces and territories request that the Government of Canada join with them in examining the establishing of a national highways policy for a designated national highway network, incorporating foreseen needs and long term funding alternatives and that this matter be brought to the attention of the Council of Ministers Responsible for Transportation and Highway Safety.***

Establishing a national highways policy was viewed by the Board of Directors as an appropriate way to ensure that all regions of Canada will be provided with adequate and required levels of service, safety and efficiency in highway transportation. In this way a national highway network which could safely serve interprovincial and international trade and travel in both east-west and north-south directions into the next century would be assured. By considering and incorporating current and longer term needs, a national highway policy could help in preserving the very substantial capital already invested by all levels of government in what constitutes the backbone of the Canadian highway system.

Providing proper emphasis and support for a designated highway network of national significance at a time of growing regional transportation needs requires a high level of cooperation among senior levels of government with a fiscal priority of reducing deficits. The crucial role of different levels of government in meeting national highway transportation objectives is the dominant consideration when seeking to attain a consensus for a national highway policy. A fundamental concern for the long term viability of the highway system in Canada rests with the division of jurisdictional responsibility for transportation. Those jurisdictions with direct responsibility for the construction and operation of the highway system must establish investment priorities consistent with the economic and development needs and objectives of their jurisdiction. In the absence of a sustained federal role in highway transportation, an effective mechanism for identifying and addressing highway transportation needs at a national level remains a pressing requirement.

In September, 1987, The Council of Ministers Responsible for Transportation and Highway Safety recognized the potentially detrimental implications for national trade and travel resulting from the current state of highway infrastructure in Canada and outlined a direction for addressing these implications by agreeing to create and sponsor a National Highway Policy Study for Canada which would:

- **Establish future needs and define standards for the Canadian primary highway system**
- **Establish benefits and costs of meeting these needs**
- **Establish funding alternatives for meeting those costs with a view towards recommending adoption of this policy by their governments**

As a result of this agreement by Canada's Ministers of Transportation, representatives of each provincial and territorial government as well as Transport Canada were appointed to a Steering Committee and work on a National Highway Policy Study for Canada began in early 1988. Three broad objectives for the national highways policy study were established:

- **To ensure that all regions of Canada are provided with adequate and equal levels of service, safety and efficiency in highway transportation so as to serve interprovincial and international trade and travel and enhance Canadian economic competitiveness.**
- **To bring cohesiveness, prestige and uniformity of standards to the major highway transportation linkages of national significance in Canada.**
- **To provide proper emphasis and support by all levels of government to a highway network of national significance at a time of growing regional transportation needs.**

To achieve these broad policy objectives the Committee outlined three principal goals for a multi-phased study which could result in agreement by the federal, provincial and territorial governments and be used in guiding policy development. These goals were to establish:

- **Criteria which will identify highways which serve national transportation needs**
- **Minimum standards of design, operation and service which should be provided by these highways**
- **A funding mechanism or mechanisms which could ensure that the needs of a national highway transportation system are met.**

This report reviews the results of the first phase of the study and outlines the progress made through the second phase in reaching the policy goals and objectives.

2.0 THE NATIONAL HIGHWAY SYSTEM

In September, 1988, the results of the first phase of the National Highway Policy Study were presented to and approved by the Council of Ministers Responsible for Transportation and Highway Safety. This phase resulted in agreement on criteria for identifying highways whose functions or characteristics warrant recognition in the national context. The criteria were applied to the Canadian highway network to identify approximately 25,000 km of highways deemed of national significance (less than 3% of the total 840,000 km Canadian road and street infrastructure). This phase also reached a consensus on appropriate minimum design and operational standards for the identified national network. The minimum standards were compared with existing conditions which indicated that approximately 38% of the identified network was currently operating below at least one of the standards.

2.1 Criteria for Route Selection and System Selection

For the purposes of the National Highway Policy Study, the criteria adopted to select the national highway network were outlined as:

- A national highway is any existing, primary route that provides for interprovincial and international trade and travel by connecting as directly as possible a capital city or major provincial population/commercial centre in Canada with
  - another capital city or major provincial population or commercial centre
  - a major port of entry or exit to the USA highway network
  - another transportation mode served directly by the highway mode

The application of the criteria to Canada's existing highway system identified a 24,449 km network of highways of national significance. The length of the adopted national highway network in each jurisdiction is outlined in Table 1. Appendix A and the accompanying map further detail these routes.

2.2 Travel on the National Highway System

To appreciate the significance of the identified national highway system to Canada, travel on the system is illustrated in Table 2. It can be seen that **approximately 26% (48.5 billion vehicle kilometres) of all vehicle travel in Canada takes place on the national system.** The largest share of the remaining travel (approximately 64.5%) takes place in urban areas. While some urban travel is represented in these statistics, the national highway system carries the majority of intercity, interprovincial and international vehicle travel in Canada.

Table 1 – Length of the National Highway System by Jurisdiction

Province/ Territory	National System (km)	% of System	Trans Canada Length (km)	1986 Population x 000
British Columbia	5,503	22.5	985	2,889
Alberta	3,580	14.6	579	2,375
Saskatchewan	2,114	8.6	650	1,010
Manitoba	861	3.5	498	1,071
Ontario	4,928	20.1	1,909	9,114
Quebec	2,874	11.7	600	6,540
New Brunswick	961	3.9	620	710
Nova Scotia	916	3.8	445	873
Prince Edward Island	116	0.5	116	127
Newfoundland & Labrador	941	3.8	904	568
Yukon	1,093	4.7	—	24
Northwest Territories	562	2.3	—	52
Total	24,449	100	7,306	25,354

Table 2 – National Highway System: Travel (1986)

Jurisdiction	Travel on National System as % of Total Travel	Billion veh-km
British Columbia	26	6.83
Alberta	26	7.30
Saskatchewan	24	2.53
Manitoba	14	1.23
Ontario	28	18.84
Quebec	23	5.35
New Brunswick	30	2.06
Nova Scotia	23	1.93
Prince Edward Island	20	0.18
Newfoundland & Labrador	45	1.83
Yukon	65	0.30
Northwest Territories	60	0.12
Canada	26	48.52

2.3 Standards for Design, Construction and Operation

The first phase of the study concluded with agreement on four minimum standards which should be respected for the design and operation of the national highway system. A fifth standard was adopted as a geometric design funding cap, recognizing that those instances where this standard was exceeded would reflect local needs beyond national highway transportation needs. The standards were to provide adequate levels of safety, operational efficiency and regional equity for a national highway system. The following standards were recommended and accepted in September, 1988:

Geometric Design Minimum

Two lane arterial undivided with full shoulders and a 100 km/h design speed (minimum of 0.8 m paved shoulder). RAU 100.

Geometric Design Maximum (Funding Cap)

Four-lane rural divided arterial (full access control) with a 130 km/h design speed. RAD 130.

Serviceability (Capacity)

The highway should provide a minimum operating speed of 90 km/h.

Structural Adequacy (Strength)

The highway should be capable of providing all weather service (no seasonal load restrictions) and be capable of carrying the national standards for vehicle weights and dimensions.

Rideability (Comfort)

The highway should provide a riding comfort index (RCI) of 6.0 or greater or the equivalent rating using other measurement systems.

2.4 Current Condition of the National Highway System

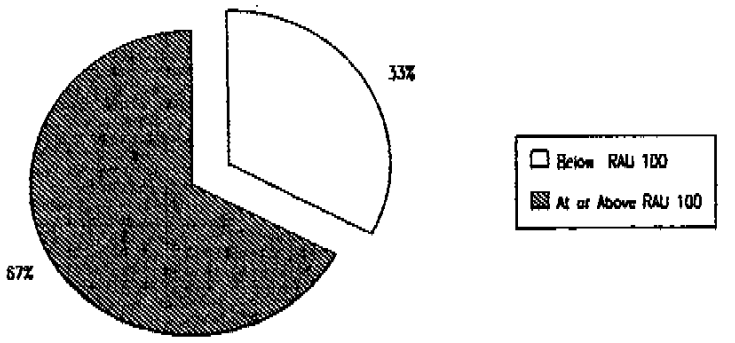
The identified national highway system was then compared against the minimum standards to provide an assessment of current condition and deficiencies. The intent of this exercise was to develop a uniform needs assessment in each region of Canada using similar measures and warrants, recognizing that regional terrain and travel patterns often result in different local highway engineering practices. The regional deficiencies were then aggregated to describe deficiencies for the system as a whole.

In total, 38% of the national highway system was discovered to be inadequate against minimum geometric design, serviceability (based on a ten year projection of traffic), structural strength or riding comfort. Additionally, of the 3,534 bridges on the system, 790 were identified as requiring major strengthening or rehabilitation within the next five years. Graphically, the results of the comparison between standards and existing conditions are presented in Figure 1.

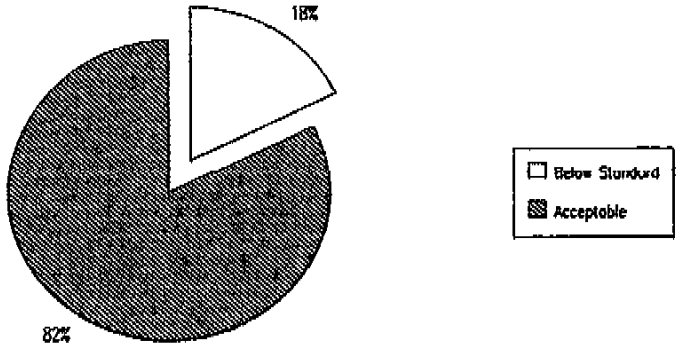
2.5 Resource and Recreation Routes

At the completion of the first phase in 1988, the Council of Ministers requested that the National Highway Policy Study identify principal resource and recreation routes that link directly to the national system in each jurisdiction. While primary arterial routes can be recognized in the national context by the application of appropriate population, economic activity or transportation function criteria, the emerging importance of routes to major resource and recreation areas should be considered within a highway policy study. These resource and recreation routes currently provide a transportation service of sizeable regional significance and can be expected to play a major role in the nation's economic development.

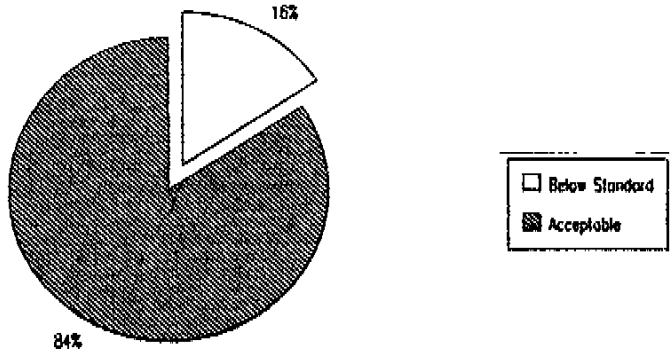
Geometric Design Deficiencies



Serviceability Deficiencies



Pavement Strength or Rideability Deficiencies



Bridge Deficiencies

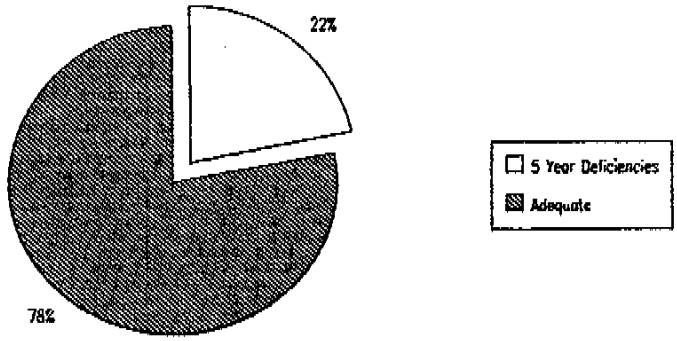


Figure 1 – Existing Conditions and Deficiencies – National Highway System

To recognize the significance of these routes within the national highways study, each provincial and territorial jurisdiction identified a principal, publicly-owned route that serves resource-based industries of forestry, mineral extraction, fisheries, agriculture or energy production or that serves as a primary recreational route. All routes connect with the national highway system.

These resource and recreation routes are outlined by jurisdiction in Table 3. The identified routes serve to link resource or recreation regions to the national highway system in every jurisdiction in Canada. It was recommended and approved by the Council of Ministers Responsible for Transport-

Table 3 – Resource/Recreation Routes

Jurisdiction	Route Description	Length (km)	More than 2 Lane Paved (km)	2 Lane Paved (km)	2 Lane Gravel (km)
British Columbia	Hwy 19 Nanaimo to Port Hardy	392	50	342	—
Alberta	Hwy 63 Edmonton – Fort McMurray	600	35	440	125
Saskatchewan	Hwys 11, 2, 102, 905 Saskatoon - Prince Albert - Points North Landing	839	18	387	434
Manitoba	Hwy 6, 101 Winnipeg - Thompson	754	12	742	–
Ontario	Hwy 11 Crown Hill to North Bay	237	127	110	–
Quebec Hwy 389	Baie Comeau - Labrador (*)	564	–	315	249
	Hwy 132 Rivière-du-Loup-Gaspé	991	63	928	–
New Brunswick	Hwy 11 - Shediac - Campbellton	414	3	411	–
Nova Scotia	Hwy 103 - Halifax to Yarmouth	294	–	294	–
Prince Edward Island	Hwy 1A, 2 Chartlottetown - Summerside - Borden	71	–	71	–
Newfoundland/ Labrador	TransLabrador Highway Quebec- Goose Bay	570	–	20	550
Yukon	Dempster (5) Dawson - NWT border	465	–	–	465
	N. Klondike (2) Whitehorse - Dawson	527		508	19
Northwest Territories	Mackenzie Valley/Fort Smith Hwy	779	–	–	779
	Demptster (8) Yukon border - Inuvik (**)	268			268
Total		**7765**	**308**	**4568**	**2909**

(*) continues TransLabrador Highway to connect to National Highway System in Quebec
(**) continues Dempster Highway from Yukon to Inuvik in NWT

tion and Highway Safety that these resource routes serve as the prime candidates for any future system expansion.

2.6 Summary of Phase 1

The work undertaken for phase 1 of the National Highway Policy Study established a concensus among federal, provincial and territorial transportation agencies in Canada on the need to recognize the important role played by highways in the national context. The first phase of the study resulted in the identification of a Canadian highway network of national significance comprised of key highway linkages within the existing Canadian highway transportation system. Minimum design and service standards desirable for this National Highway System were established and needs were identified.

Based on this work and the resulting agreement on highway selection criteria and standards, the Council of Ministers endorsed the following principles:

1. **That there exists a network of key interprovincial and international highway routes which are of vital significance to the national transportation system and the Canadian economy.**

2. **That these routes will collectively constitute the National Highway System.**

3. **That in the interests of enhancing the safety and efficiency of the National Highway System, the routes on the system should meet the minimum standards for design, construction and operation.**

4. **That the resource and recreation routes identified not be included in the National Highway System at present but be prime candidates for consideration should the Council of Ministers Responsible for Transportation and Highway Safety expand the system in future.**

2.7 Phase 2 Outline

After approval of the results of the first phase of the study, the Council of Ministers of Transportation and Highway Safety instructed the National Highway Policy Study Committee to proceed with a second phase in October, 1988. The second phase of the study sought to complete four tasks in addition to the resource/recreation route identification. The specific tasks outlined were:

- **Five Year Review of Road-Related Revenues and Expenditures and Apportioning of Revenues and Expenditures to the National Highway System.**

- **Cost of Improvements to Meet the Standards on the National Highway System and Costs of Completing a Continuous, Four Lane Route across Canada.**

- **Estimate Highway User Benefits Resulting from Proposed Program of National Highway System Improvements.**

- **Estimate Economic Impacts of Proposed National Highways System Improvements.**

The results of each of these tasks is reviewed briefly in the following sections of the report.

3.0 TOTAL FEDERAL AND PROVINCIAL ROAD-RELATED EXPENDITURES AND REVENUES 1983 – 1987

To provide the context of existing levels of federal and provincial road-related revenues and expenditures with which the cost estimates developed during this phase of the study could be compared, road-related revenues and expenditures for five fiscal years (1983/84 – 1987/88) were examined. Government revenues derived from fuel taxes, drivers licenses, vehicle operating permits, vehicle registrations and highway tolls were categorized as road-related revenues. Capital, operations, maintenance and road grants were included as road-related expenditures. At the time of the study, 1983-88 represented the most current five year period for which full information was available.

3.1 Expenditures

The National Highway Policy Study assembled the expenditure data from each jurisdiction by surveying federal, provincial and territorial transportation departments. The survey used the highway expenditure categories of capital, operations and maintenance, and specific road transfer payments or grants to junior governments. Expenditures for public transit, ferries, policing and enforcement were excluded from the survey.

Survey results indicate a **five year (1983-87) total road related expenditure in actual dollars of approximately $24.4 billion. The provincial and territorial share of these expenditures is $23.2 billion (95%). The federal expenditure of approximately $1.2 billion accounts for the remaining share (5%).** Of this federal expenditure, $376 million was comprised of provincial road transfer payments with the remainder being direct expenditures on federal jurisdiction roads.

The composition of these expenditures over the five years is summarized in Table 4 and the corresponding Figure 2. The results indicate a gradual increase in provincial and territorial expenditures caused principally by an increase in operations and maintenance spending. A sharp increase in capital expenditures for 1985-86 is perceivable. This increase is primarily the result of large projects in British Columbia (Annacis and Coquihalla). Road-related expenditure summaries by jurisdiction are provided in Appendix B.

Table 4 – Federal and Provincial Expenditures on Roads (1983-87) ($ Actual, Millions)

	83-84	84-85	85-86	86-87	87-88
Capital	2349	2339	2649	2485	2388
Operations and Maintenance	1453	1555	1621	1650	1720
Grants and Transfers	778	783	821	863	911
Total	4580	4677	5091	4998	5019

Note: Federal transfers for road and highway projects are accounted for in provincial capital expenditures. Transfer expenditures here refer only to municipal/county transfer payments from provincial or territorial governments. Numbers do not correspond exactly with Appendices because of rounding.

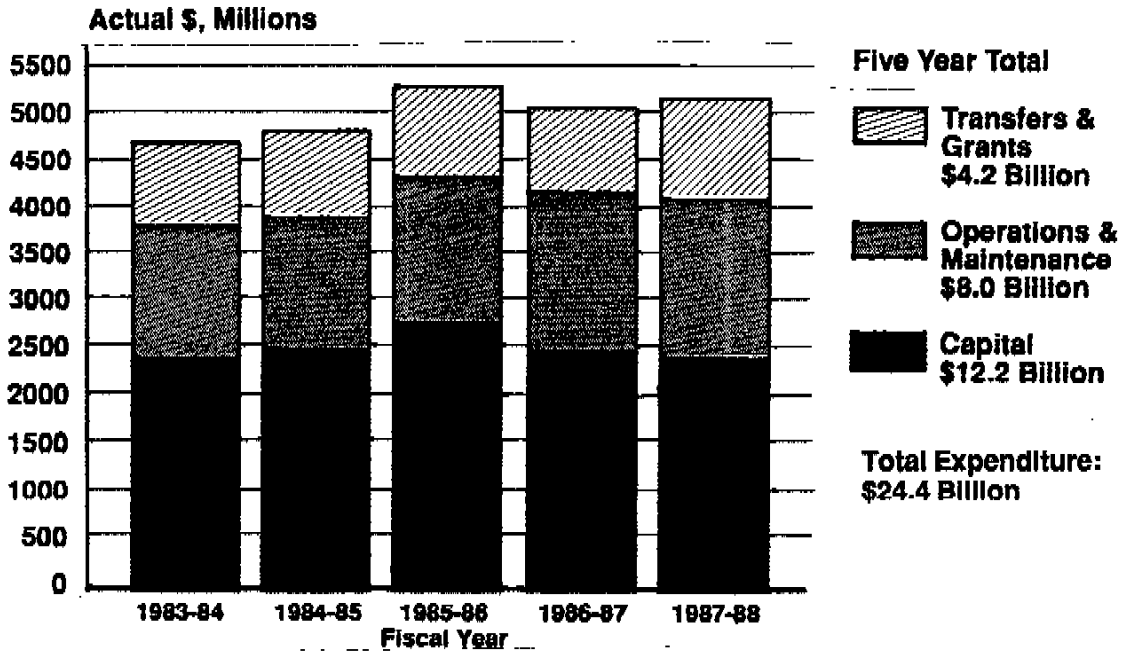


Figure 2 – Road Related Expenditure Composition

3.2 Revenues

Any treatment of road related revenues raises a number of methodological, accounting and philosophical questions which largely arise as a result of traditional fiscal practice and general revenue accounting used by governments in Canada. As a consequence, no attempt was made to link the magnitude of revenues collected by any jurisdiction to the resources allocated to roads and highways. Except for some recent initiatives, no basis can be identified in the Canadian fiscal tradition to support such an analysis.

Furthermore, it should be recognized that all levels of government must fund a number of important programs that, although not reported here as highway expenditures, are nevertheless clearly related to road and highway usage. The financing of public transportation by provincial governments as a substitute for increases in highway capacity in major urban centres is a prime example. Other examples include the financing of ferry services by provincial and federal governments or enforcement activities by federal, provincial and municipal agencies.

The intent of this task was simply to examine and report the magnitude of revenues generated from road use fuel taxes, vehicle registrations and permits, and, where appropriate, provincial highway tolls. Revenues from vehicle sales tax were also estimated using published Statistics Canada information and are reported in Appendix B but are not included in the tabulations for this report.

The revenue data were compiled by each transportation department. The non-highway use fuel taxes were removed from the total fuel taxes in each jurisdiction. Vehicle registrations, licenses and special permits were grouped together and the three jurisdictions that used highway tolls during the survey period (partially in British Columbia and Quebec, all five years in Nova Scotia), provided toll revenues. In total for the five survey years, **road related revenues in actual dollars were approximately $33.3 billion. Of this revenue, approximately 66% was to provincial and territorial governments, 34% was federal government revenue from sales and excise taxes on fuels.** A summary of total road related revenues is presented in Table 5 and the composition of these revenues is represented in Figure 3. Detailed road related- revenue information by jurisdiction is provided in Appendix B.

Federal road revenues derived from fuel taxes have more than doubled between 1983 and 1987, although provincial revenues derived from fuel taxes remain fairly constant over the survey period with some growth occurring in the last year (1987-88). This slight increase is largely attributable to the introduction of fuel taxes during the year by Alberta and Saskatchewan. As indicated in Figure 3, fuel tax revenues continue to form the bulk of road related revenues (83%) while registration, license and permit fees represent approximately 17% of all road revenues. Less than 1% of revenues is derived from highway tolls. Revenues derived from taxes on gasoline account for approximately 84% of all fuel tax revenues with the remaining 16% derived from diesel fuel taxes.

By simply subtracting expenditures from revenues the survey results indicate road-related revenues exceeded expenditures by nearly $8.9 billion during the five year survey period. This difference between expenditures and revenues occurs largely at the federal level and in the most populated provinces of Ontario and Quebec as illustrated in Figure 4.

Table 5 – Federal and Provincial Road Revenues from Primary Sources ($ Actual, Millions)

	83-84	84-85	85-86	86-87	87-88
Fuel					
Provincial	3177	3103	3171	3196	3702
Federal	1536	1679	2057	2735	3238
Licenses, Registration, Permits, etc.					
Provincial	944	1042	1050	1182	1302
Tolls (1)					
Provincial	73	68	24	20	24
Total	**5730**	**5892**	**6302**	**7133**	**8266**

(1) Tolls here include only toll highway facilities. Toll bridges and ferries have been excluded from this table.

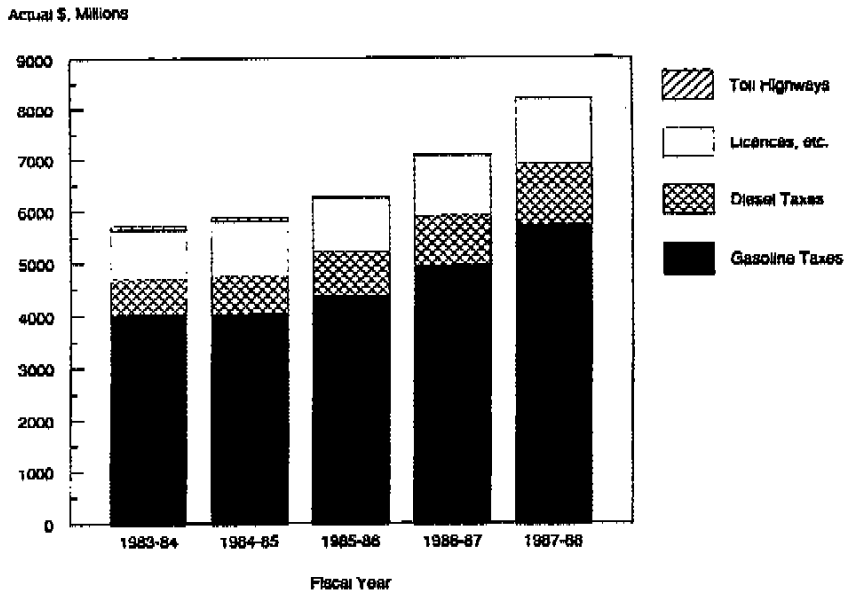


Figure 3 – Road Related Revenue Composition

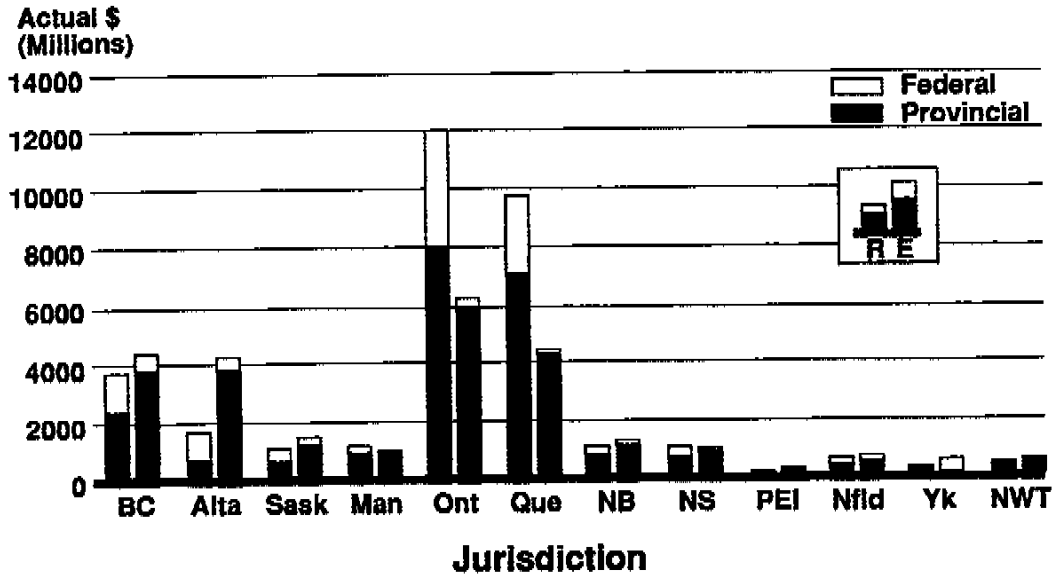


Figure 4 – Road Related Revenues and Expenditures by Jurisdiction (1983-87)

4.0 EXPENDITURES AND REVENUES APPORTIONED TO THE NATIONAL HIGHWAY SYSTEM, 1983 - 1987

4.1 Expenditures

Expenditure information for the national highway system was obtained from records of work on the system in each jurisdiction over the five survey years. As indicated in Figure 5, **expenditures over the five year period total $4.6 billion. For all jurisdictions these expenditures are composed of $3.2 billion for capital and $1.4 billion for operations and maintenance. The sustained investment in the national highway system represents approximately $600 million annually in capital projects and $280 million annually in operations and maintenance.** This annual level of investment must be remembered when the improvement program costs for the national system are considered in the next chapter of the report. More detailed revenues and expenditures by jurisdiction for the national highway system are provided in Appendix C.

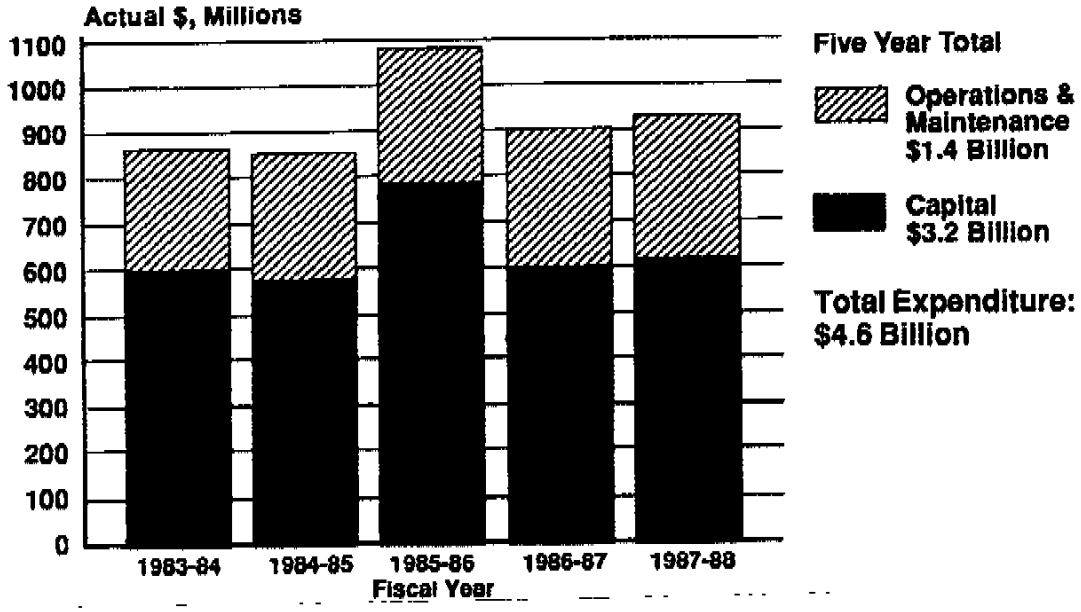


Figure 5 – National Highway System Expenditure Composition

4.2 Revenues

Two methodologies yielding approximately the same results were used to estimate the road related revenues on the national highway system. Where jurisdictions had available traffic counts and travel distances for both the national highway system and the entire system including urban areas, it was possible to provide a reasonably accurate estimate of the revenues derived from the national highway system in their jurisdiction as a percentage of total revenues. Where total travel for the jurisdiction was not known precisely, total litres of fuel consumed for road purposes was used as

a surrogate measure of total travel. Travel on the national highway system in that jurisdiction was then converted to litres of fuel consumed using available Statistics Canada information on passenger car and truck fuel consumption surveys. The percentage of fuel consumed on the national highway system was then used to estimate fuel revenues from the system. Registration, license and permit fees could then be pro-rated for the national system based on travel. For all jurisdictions, five year revenues totalled approximately $8.6 billion for the national highway system.

The results of apportioning revenues and expenditures for each jurisdiction to the national highway system are represented in Figure 6. As illustrated, when the five survey years are combined and totalled, revenues exceed expenditures by approximately $1.4 billion provincially and $2.8 federally for Canada's prime highway routes. The revenue composition and distribution reflects the revenue composition for all roads, in that fuel taxes remain the largest component.

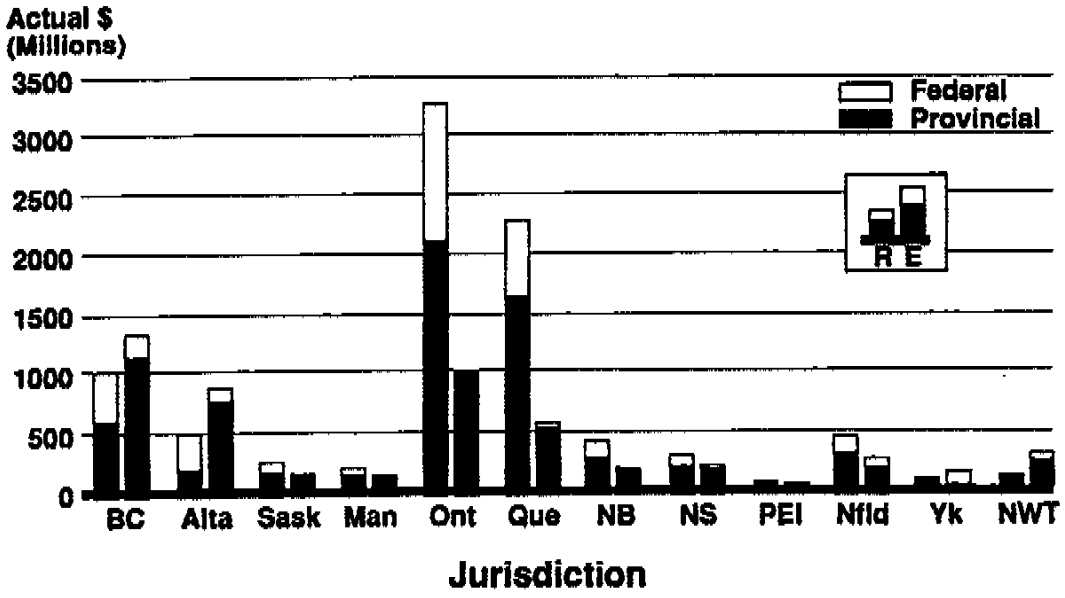


Figure 6 – National Highway System Revenues and Expenditures by Jurisdiction

5.0 COST ESTIMATES TO ACHIEVE STANDARDS ON THE NATIONAL HIGHWAY SYSTEM

As presented in Figure 1 earlier, the first phase of the study described the current condition of the identified national highway network indicating that, in aggregate, 38% of the system was currently operating below at least one minimum design or operational standard. Cost estimates for restoring this 38% to an appropriate standard were undertaken in Phase 2. The incremental costs of completing a continuous four-lane route across Canada were also estimated in this task.

Based on the highway deficiencies identified earlier, each provincial and territorial transportation department provided estimates for correcting the deficiencies for every route on the national highway system located within its jurisdiction. These estimates were provided in 1989 dollars. After reviewing each estimate, the total capital costs of the proposed highway improvements were arrived at by combining the costs required to bring each jurisdiction's highways to the appropriate standard. Two highway improvement scenarios were used for completing this task.

5.1 Scenario A: Improvements to Meet Minimum Standards

Scenario A consisted of required expenditures for identified pavement, structural or serviceability deficiencies on the National Highway System and upgrading where necessary to the appropriate design standard of a minimum two-lane paved rural highway with partially paved shoulders and a maximum of four-lane divided highway with full access control. Where design or serviceability measures were required, specific highway improvements were based on a ten year projection of traffic in each jurisdiction. **Under this scenario, the capital costs for highway improvements on the national system totalled $12.7 billion.**

This total cost was estimated using standard worktypes which could be undertaken in every jurisdiction. The worktypes included:

1. *Resurfacing:* overlay of existing pavements.
2. *Road Upgrading or Reconstruction:* improving existing roadway by strengthening, minor widening, new shoulders, passing or truck climbing lanes, etc.
3. *New Two-Lane Construction:* any new construction of intersections or two-lane bypasses, but excluding any four-lane construction.
4. *Twinning and New Four-Laning:* all work resulting in a four lane divided highway whether four new lanes are constructed or existing two lanes are twinned.
5. *Interchanges:* construction of grade separated interchanges.
6. *New Structure Construction or Structure Rehabilitation:* all new bridges or overpasses or all major improvements including strengthening or widening to bridges or overpasses.

Apportioning the $12.7 billion total costs into these worktypes results in the Scenario A illustrated in Figure 7.

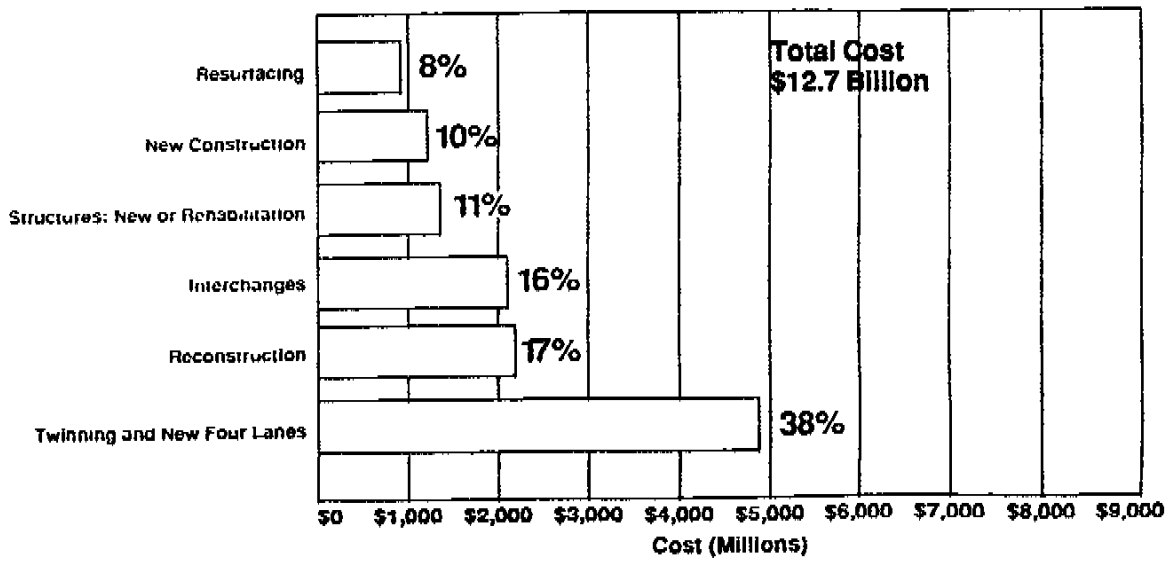


Figure 7 – Improvements by Work Type – Scenario A

To provide a summary of the types of improvements required in each jurisdiction in order to meet the national highway policy standards and the relative costs of this work, disaggregated costs for each jurisdiction are summarized in Appendix D. This Appendix provides a tabular description of each worktype, the specific highway deficiencies addressed by the remedial measures and an indication of the highway policy objectives for the improvement. However, the general scope of the Scenario A program in each jurisdiction is described here.

British Columbia: The improvement proposals consist of approximately $210 million for resurfacing, $590 million for reconstruction and $1 billion for new construction. The scale of the resurfacing program closely reflects the province's proportion of the national highway system length. The extensive road reconstruction and structure rehabilitation proposals indicate recognition of the need to redress the serious deterioration of the road and bridge infrastructure. The new road and bridge construction proposals are modest relative to the size of the network.

Alberta: In Alberta, highway work in and around the larger urban areas is estimated to cost about $1 billion (one-half of Alberta's total). The remainder is required equally for four laning and interchanges in rural areas, and, for correcting serviceability deficiencies on rural and smaller community links as well as for resurfacing projects to meet rideability standards.

Saskatchewan: The majority of the $600 million proposed improvements consists of pavement resurfacing on various sections of the National Highway System and twinning of selected portions of Highway No. 1 (TransCanada Highway) and Highway No. 16 (Yellowhead Highway) to meet serviceability standards.

Manitoba: In Manitoba, the four-laning of the TransCanada Highway is 87%complete. Twinning of Highway 75 from Winnipeg to the U.S. border is well underway. Completion of the twinning of the TransCanada and Highway 75 along with the provision of interchanges to eliminate

currently signalized major intersections represent the largest components of the $549 million program. The resurfacing, reconstruction and new construction proposals are relatively modest.

Ontario: Of the $2.2 billion in improvement costs estimated for Ontario roads, approximately $1.4 billion is for twinning and new four lanes to meet the serviceability requirements. Twinning and new four-laning is required on Highway 69 between Waubaushene and Sudbury, Highway 17 east of Sault Ste Marie and Highway 17 east and west of Thunder Bay. The $453 million proposed new construction relates significantly to Highway 416 between Ottawa and Highway 401. The estimated $274 million resurfacing costs are distributed throughout the provincial National Highway System.

Quebec: Major improvements required in the $1.3 billion proposal include: the reconstruction, rehabilitation or resurfacing of over 1,800 km of existing highways, including structures, in order to provide for adequate capacity and serviceability; and the twinning of a number of existing two lane highways, including the TransCanada Highway from Rivière-du-Loup to the New Brunswick border.

New Brunswick: Approximately 75% of the National Highway System in New Brunswick will have to be upgraded by 1998 to meet the standard established for serviceability . A recent study to develop an improvement plan for the TransCanada Highway through the province has established that in consideration of the traffic volumes, development along the highway and projected traffic growth, the required corrective measure is a four-lane divided, fully access controlled highway. This implies twinning where possible but approximately 60% of the Trans-Canada Highway will be new four lane construction. These requirements form the bulk of the estimated $2 billion proposal for New Brunswick. Other routes on the national highway system in the province require some twinning to meet serviceability standards or resurfacing to meet rideabilty standards.

Nova Scotia: The $751 million cost of the work proposed for inclusion on the National Highway System in Nova Scotia is principally composed of four laning those portions of the system below the established serviceability standard and upgrading the remainder of the system to a two lane limited access system. The latter will involve the construction of interchanges where there are intersections with trunk highways or major entrances to adjacent towns.

Prince Edward Island: The most significant element of work required to achieve the standards established for the National Highway System is construction of a new alignment for the Trans-Canada Highway to bypass the city of Charlottetown. The estimated cost of highway construction, interchanges, intersections and bridges for the by-pass highway are in the order of $56 million. The remaining $32 million addresses design, structural and operating deficiencies on other portions of the TransCanada Highway.

Newfoundland and Labrador: The entire National Highway System in the province needs to brought up to the minimum RAU 100 standard. Reconstruction of significant sections is required for purposes of pavement rehabilitation and some community bypasses with associated new structures are necessary to meet serviceability requirements. These deficiencies are addressed in the $278 million proposal.

Yukon: The projected expenditures of $394 million in the Yukon are predominantly for reconstruction of the 958 km section of the Alaska Highway located in the Yukon.

Northwest Territories: 430 km or 75% of the national highway system in the Northwest Territories is a two lane gravel highway. Achievement of the national highway standards costing in the order of $239 million will see this paved. The existing ferry crossing of the Mackenzie River near Fort Providence on the road to Yellowknife which is subject to interruption from ice formation will also be replaced by a bridge providing all weather road access to the territorial capital.

Federal: The $320 million expenditures directly within the federal jurisdiction are for the reconstruction of the Alaska Highway in northern British Columbia and the Trans-Canada Highway in Terra Nova National Park in Newfoundland.

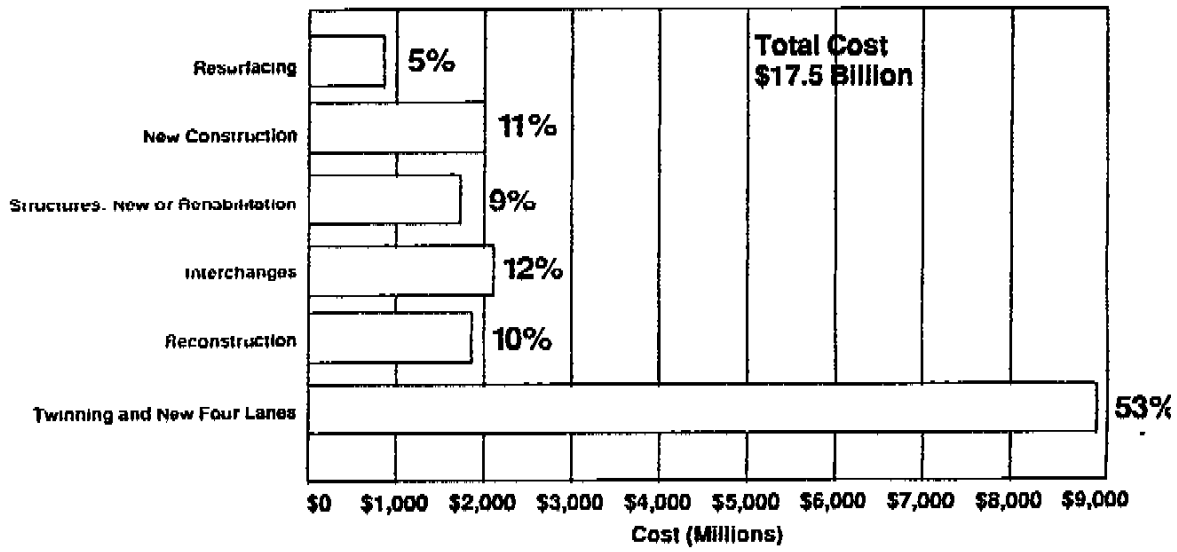


Figure 8 – Improvements by Work Type – Scenario B

5.2 Scenario B: Improvements to Meet Minimum Standards and Completion of Continuous Four Lane, Cross Canada Route

Scenario B consists of the total costs of Scenario A with the addition of the estimated costs to complete a continuous four lane route across Canada, (largely the TransCanada Highway). Currently almost 40% of this cross Canada route is at four lanes or better. The total estimated cost of this scenario is $17.5 billion or approximately a $4.8 billion increment from Scenario A.

The components of this program by worktype are presented in Figure 8. Again, cost estimates by jurisdiction are summarized in Appendix C. Neither the Yukon nor the NWT included the four-lane route in their proposals but highways through several National Parks (Banff, Terra Nova, Yoho, Glacier, Revelstoke) were included in the four lane estimate. Significant elements of Scenario B are proposed in Ontario where the twinning and new four-laning of portions of the TransCanada Highway around Lake Superior are considered as well as in Quebec where the construction of a new freeway around the heavily congested Montreal urban area is contemplated.

For the purposes of providing a complete four lane cost estimate, the entire TransCanada Highway in Newfoundland and sections of the TransCanada Highway through difficult terrain in British Columbia have also been included in Scenario B. Costs for Scenario A and Scenario B by highway jurisdiction are illustrated in Figure 9.

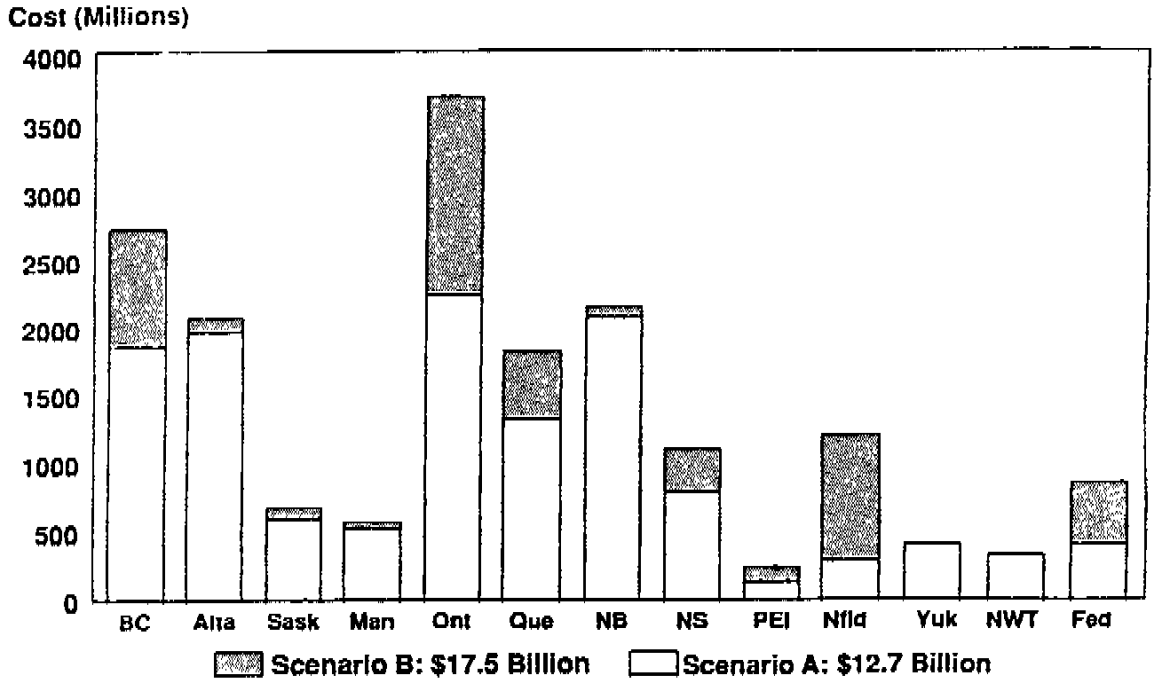


Figure 9 – Cost of National Highway System Improvements by Province

6.0 IMPACTS AND BENEFITS

Implementation of the highway improvement scenarios outlined in the previous chapter would represent doubling the current level of capital expenditures on the national highway system. This increased level of highway expenditure would result in achieving cohesive national highway standards and eliminating serious existing deficiencies on national highways. Additionally some degree of regional equity in highway transportation could be attained. Beyond these immediate returns, wider benefits and economic impacts can be anticipated.

Improvements in highway safety, vehicle operating costs and travel times would be achieved. Significant productivity gains resulting from a highway network constructed and operating at the national standards could be expected for business sectors sensitive to transportation costs. Canadian trade competitiveness could be improved, tourism could be affected and environmental considerations should be raised. Government treasuries which must finance highway expenditures would be effected. To provide some scope for these impacts and benefits, the National Highway Policy Study commissioned three investigations: National Highway Policy User Benefits Assessment, National and Provincial Economic Impact of a National Highway Policy, and, An Environmental Overview of the National Highway Policy. Complete reports of these investigations are available from RTAC at nominal cost. The findings of these commissioned studies are summarized in this chapter.

6.1 Highway User Benefits

The direct beneficiaries of a program of highway improvements are the people and industries that use highway transportation. Fewer accidents, reductions in vehicle operating costs and travel time savings would result from undertaking a sustained program of capital improvements on the national highway system. Annual highway user benefits resulting from implementing Scenario A are presented in Table 6.

The magnitude of the user benefits for the national highway system was conservatively estimated by analyzing in detail a series of typical highway improvement case studies and using the results to calibrate the range of user benefits derived from all similar improvement projects on the national system. Existing analytical models (principally Transport Canada's Highway User Benefit Assessment Model - HUBAM) were used in calculating these estimates. A twenty-five year planning horizon was used to capture benefits since highway user benefits continue indefinitely well after the construction of the improvement. The residual values remaining in the improvements after twenty-five years were estimated to be approximately $800 million (5% social discount) to $94 million (10% social discount rate). All highway maintenance and resurfacing costs over the twenty-five years have been removed from the highway user benefits. The methodology and principal results of the highway user benefits analysis are provided in Appendix E and outlined here.

Safety

Reductions in highway accidents and fatalities are a principal objective for making highway improvements. The proposed improvements to the national highway system directly affecting safety such as capacity improvements and interchanges would result in 160 less highway fatalities per year in Canada (approximately 4% of highway fatalities) and 2,300 fewer personal

injury accidents. Added to these accident reductions are the reduced costs of property damage highway accidents estimated at approximately $20 million (1989$) annually.

Vehicle Operating Savings

The vehicle operating savings for a completed national highway system would be in the order of $360 million (1989$) annually. These vehicle operating savings are comprised of reduced fuel and oil expenses as well as reductions in expenditures for tires and vehicle maintenance for both private and commercial vehicles. Vehicle operating costs are typically reduced by projects which improve pavement surface condition or shorten distances resulting in less vehicle wear and decreased fuel consumption.

Travel Time Savings

For a completed national highway system, total travel time savings are estimated at approximately $717 million (1989$) annually. The value of reductions in travel time is calculated for the type of vehicle (commercial or personal) and the trip purpose (business or pleasure). Typically all highway improvement projects which shorten distances and/or reduce running speed restrictions such as bypasses and interchanges improve travel time for highway users.

Table 6 – Annual Highway User Benefits

Safety	
– Property Damage Savings	$20.0 million
– Personal Injury Reductions	2,300 persons
– Fatalities Reductions	160 persons
Vehicle Operating Savings	
– Trucks	$160 million
– Business Autos	$100 million
– Private Autos	$100 million
Travel Time Savings	
– Trucks	3 million person hours
– Business Autos	16 million person hours
– Private Autos	27 million person hours

When these user benefits are placed within a highway planning horizon of twenty-five years, **the total present value for Scenario A exceeds $17 billion (1989$) using a 5% social discount rate and $10 billion (1989$) using a 10% social discount rate.** The incremental benefits derived from implementing Scenario B range from $963 million (5% social discount) to $591 million (10% social discount).

6.2 Economic Impacts

The cost implications of the national highway improvement program raise some broader questions concerning economic impacts not specifically addressed by a highway user benefit review. The potential economic consequences of financing the highway program through increased government capital expenditures would effect:

- **national and regional economic growth**
- **provincial and federal government treasuries**

- **employment in the highway construction and transportation services sector**
- **transportation cost, productivity and international competitiveness of Canadian industry**
- **tourism and the hospitality industries**

To provide a frame of reference for estimating these impacts, a set of large econometric models of the national and provincial economies was used. These models are designed to assess the interrelationships between detailed demands on the economy, output and employment of producers, and prices for producers, as well as prices faced by households, investors and governments. The models simulated two highway improvement scenarios (Scenario A: $1.3 billion/year; Scenario B: $1.7 billion/year) implemented over a ten year period beginning in 1990. While financing and productivity impacts could be extended beyond a ten year period, as was done in the highway user benefits study, the ten year horizon was used to capture the impacts of increased expenditures on the national highway system during implementation of the improvement scenarios.

General Macroeconomic Impacts

The costs of implementing the national highway improvement scenarios are substantial for Canadian highway agencies. But the ten year implementation period reduces the impact on the Canadian economy.

The results of the simulations using conventional, general revenue financing sources (personal taxes, fuel taxes, corporate taxes and borrowing) indicate little disturbance to a slowly growing economy. **Increased expenditures for highway construction would add to the gross domestic product, or in other words, produce a larger economy. The impact on government treasuries that carry the burden of the highway expenditures are negative. These negative impacts can be offset somewhat by increased employment and are dependant on financing mechanisms and taxes used to implement the highway program. Real personal disposable income is little affected in the short or longer term. Trade competitiveness is enhanced over the longer term from reduced costs to commercial road users and transportation productivity gains. Further, evidence exists that public investment in transportation infrastructure is not only a source of domestic demand but plays a more important role in economic growth. Government investment in infrastructure is an important factor in the growth of productivity with the age and quality of the infrastructure stock being at least as important as its quantity.**

Consequently, a major road improvement program of this size, well managed and financed, carried out over a decade, would cause little disturbance to the national and provincial economies with the possible exceptions of New Brunswick and the Territories where the program proposals are large relative to the local economies. A summary of these macroeconomic results is provided in Appendix F.

Canadian Competitiveness and Productivity

A national highway system operating at higher standards would improve market access within Canada and the US thereby benefitting Canadian firms attempting to operate more efficiently on a world scale. Better highways would reduce transportation costs for many Canadian industries. **Reductions in highway transportation costs would enhance the competitiveness of Canadian industries. This should improve Canadian exports and reduce price levels.** While better market integration would be achieved, the precise magnitude of the competitive gains

to Canadian industry and consumers will be influenced by the mechanisms employed to finance the highway program.

Employment

There are employment gains from the highway improvement proposals across all industries and very strong gains for the highway construction sector. Although it is possible to estimate rather large employment gains using a simulation without reference to financing, a more realistic assessment using general revenue financing suggests **additional employment in the highway construction sector and related supplier industries at 146,000 person years (Scenario A) and 205,000 person years (Scenario B) over the ten year construction period.**

As the competitive benefits of a more efficient national highway transportation system are realized, some reductions in employment opportunities in the transportation services sector to reflect productivity gains would occur. Nevertheless, net employment increases remain over the ten year period.

Tourism

An improved national highway system would likely attract increased foreign, mainly American, tourists to travel in Canada. As well, some Canadians who might otherwise travel in the United States, could be prompted to increase their travel in Canada. The impacts of increased tourism on the Canadian hospitality industry could be substantial. These impacts will reflect financing methods adopted to implement the highway program. For example, should fuel taxes be raised substantially to offset program costs, less tourist travel by automobile could be anticipated.

6.3 Environmental Overview

The national highway improvement scenarios outlined in the previous chapter remain at a conceptual level rather than a project specific level. Consequently, it is prudent to outline those broad natural environmental elements most susceptible to impact as a result of improvements to the national highway system. The natural environment elements judged to be significant would then be examined in detail at a project and environment specific level. It should also be remembered that existing provincial and federal environmental policies would have to be respected by any highway program.

Because the national system is composed primarily of existing highway alignments, environmental impacts from resurfacing projects, interchange construction and bridge rehabilitation would be minimal. These same projects would result in positive social, safety and economic impacts. **New construction projects whether two lanes or four lanes are built, provide significant economic and social benefits in the form of increased labour productivity, improved accessibility and reductions in the consumption of non-renewable energy. However, these same projects could potentially produce some impact on surface water, vegetation, terrestrial wildlife and land use patterns. In a few cases, wetlands could be effected.** As a result these projects would be subject to environmental scrutiny during project planning. The principal results of the environmental overview are provided in Appendix G.

7.0 SUMMARY

The work undertaken for the National Highway Policy Study has established a consensus among federal, provincial and territorial transportation agencies in Canada on the need to recognize the important role played by highways in the national context. The first phase of the study resulted in the identification of a Canadian highway network of national significance comprised of key highway linkages within the existing Canadian highway transportation system. Minimum design and service standards desirable for the national highway system were established and needs were identified.

The second phase of the study has advanced the discussion of a national highway system further through an examination of the cost implications of achieving the minimum standards on the identified network. These implications have been placed both within a review of past and current commitments by highway agencies to the expansion and maintenance of the highway system in Canada as well as in a wider economic benefit and impact context.

The principal findings of the second phase include:

- **Road-related revenues from fuel taxes, licenses and registrations and highway tolls for the 1983-88 survey period were approximately $32.9 billion.**

- **Road-related expenditures for capital improvements, operations and maintenance, and road-specific transfer payments for the 1983-1988 survey period were approximately $24.4 billion.**

- **Provincial government revenues from fuel taxes have remained relatively constant over the same period ($3.1 billion in 1983-84 to $3.6 billion in 1987-88).**

- **Federal government revenues from fuel taxes have doubled over the five year period from $1.5 billion in 1983-84 to $3.2 billion in 1987-88.**

- **Expenditures on the National Highway System over the survey period amounted to $4.6 billion and were shown to average $600 million annually on capital projects, $280 million annually on maintenance and operations.**

- **Government revenues attributable to use of the National Highway System totalled approximately $11.4 billion for the five year survey period.**

- **The costs of bringing all the current deficiencies on the National Highway System to the national standards (Scenario A) were estimated at $12.7 billion dollars (1989$).**

- **If undertaken over a ten year period, the Scenario A program would require doubling the current level of capital expenditures to $1.3 billion annually.**

- **The incremental costs for completing a four lane cross Canada route (Scenario B) after completing the improvements of Scenario A were estimated at $4.8 billion (1989$). $1.7 billion annually for ten years would be required to implement both Scenarios.**

- **The benefits to highway users of an improved National Highway System were estimated to range between $10 billion and $17 billion in present values (1989$) using a twenty-five year highway planning framework.**

- **If a four lane cross Canada route was provided, benefits to highway users were estimated to be an additional $561 million to $863 million using the same twenty-five year planning horizon.**

- **It was estimated that the highway safety improvements would result in a reduction of 160 fatal accidents per year and 2300 personal injury accidents per year.**

- **The Canadian economy is enlarged during the highway improvement construction period as a result of the increased level of highway expenditure. Nationally, per capita income of Canadians is little affected by the highway improvement program.**

- **Productivity gains, especially in the highway transportation sector, resulting from reduced vehicle operating costs and travel time savings were estimated at $360 million annually in vehicle operating savings and 46 million person hours of travel time per year for Scenario A.**

- **Improved market accessibility for Canadian industry as a result of an improved highway system is achieved in both east-west and north-south directions. Improved market access combined with transportation productivity gains would enhance Canadian trade competitiveness.**

- **Regionally, the highway improvement programs have the strongest impact in Atlantic Canada and the northern Territories where the costs of the highway improvement programs are large relative to the size of the local economies.**

- **Employment gains in the highway construction and related sectors are estimated at between 146,000 person years (Scenario A) and 205,000 person years (Scenario B) during a ten year construction phase.**

- **Where public investment in infrastructure contributes to private productivity, greater economic growth can be anticipated. This is of particular significance where a maturing highway system is replaced or restored.**

- **Disruptions to the social and natural environment can be minimized by using existing highway alignments. New construction projects of two or four lanes will require project-specific investigations of natural and social environmental impacts.**

In summary the second phase of the study concluded that with effective pre-planning, good management and careful financing, a national highway program could be successfully implemented in Canada.

8.0 REMAINING PHASES OF THE NATIONAL HIGHWAY POLICY STUDY

Following the completion of the second phase of the National Highway Policy Study, a third study phase was proposed and approved by the Council of Ministers Responsible for Transportation and Highway Safety. This phase would be used to solicit comments from a broad base of Canadian public and private sectors on the elements of Phase 2, focussing on the impacts and benefits of a national highway policy on different sectors of the Canadian economy. These comments would be used in considering policy options and recommendations.

Additionally, the third phase of the policy study will be used to examine national highway policy, highway funding and financing mechanisms as well as government roles and responsibilities in the provision of highways in several Organisation for Economic Cooperation and Development (OECD) countries that have some similarity with Canada. The countries tentatively identified for review include USA, France, Great Britain, West Germany, Italy, Spain and Australia. The results of this survey will then be compared with the Canadian situation and can be used to provide the background for the development of policy options and recommendations.

Appendix A

Routes on the National Highway System

Jurisdiction	Highway Number	From	To
Newfoundland	1	St. John's	Port-aux-Basques
	100	Trans-Canada Highway	Argentia
Nova Scotia	104	New Brunswick border	Port Hastings
	106	Alma (104)	Caribou
	104, 4	Port Hastings	Sydney River
	125, 105	Sydney River	North Sydney
	102, 111, 118	Truro	Halifax-Dartmouth
	101, 1	Halifax-Dartmouth	Yarmouth
	303	Digby (101)	Ferry Terminal
Prince Edward Island	1	Borden	Wood Islands
New Brunswick	2	Nova Scotia border	Quebec border
	1	St. Stephen (US border)	Sussex
	7	Saint John	Fredericton
	16	Aulac (Hwy. 2)	Cape Tormentine
	15	Moncton	Port Elgin
	95	Woodstock	US border
Québec	20	Ontario border	Rivière-du-Loup
	185	Rivière-du-Loup	New Brunswick border
	40	Ontario border	Québec
	175	Québec	Chicoutimi
	138	Québec	Sept Iles
	73	Québec	Charlesbourg
	15	US border	Ste. Agathe
	117	Ste. Agathe	Ontario border
	10	Montreal	Sherbrooke
	35	Autoroute 10	Iberville
	133	US border	Iberville
	25	Longueuil (Hwy. 20)	Anjou (Hwy. 40)
	55, 755, 155	Trois Rivières	Sherbrooke
Ontario	401	Quebec border	Windsor (US border)
	417	Quebec border	Ottawa
	17	Ottawa	Manitoba
	402	London	Sarnia(US border)
	QEW	Toronto	Fort Erie (US border)
	400	Orillia	Toronto
	69	Sudbury	Orillia
	427	Toronto (Hwy. 401)	QEW
	11	North Bay	Nipigon
	61	Thunder Bay	US border

Jurisdiction	Highway Number	From	To
Ontario (cont'd)	71	Kenora	Fort Frances (US border)
	416	Ottawa	Prescott (US border)
	66	Quebec border	Kirkland Lake
Manitoba	1	Ontario border	Saskatchewan border
	16	Portage-la-Prairie	Saskatchewan border
	75, 29	Winnipeg	Emerson (US border)
Saskatchewan	1	Manitoba border	Alberta border
	16	Manitoba border	Alberta border
	7	Saskatoon	Alberta border
	11	Regina	Saskatoon
	6, 39	Regina	Estavan (US border)
Alberta	1	Saskatchewan border	British Columbia border
	16	Saskatchewan border	British Columbia border
	2	Edmonton	Fort Macleod
	3	Medicine Hat	British Columbia border
	4	Lethbridge	US border
	9	Calgary	Saskatchewan border
	43	Edmonton (Hwy. 16)	Valleyview
	34, 2	Valleyview	British Columbia border
	34, 2, 35	Valleyview	Northwest Territories border
British Columbia	1	Alberta border	Victoria
	2	Alberta border	Dawson Creek
	3	Alberta border	Hope
	5	Tete Jaune Cache	Hope
	16	Alberta border	Prince Rupert
	17	Victoria	Swartz Bay Ferry Terminal
	97	Cache Creek	Yukon border
	99	Vancouver	US border
	Carcross Road	Yukon border	Alaska border (to Whitehorse)
Yukon	1	British Columbia border	Alaska border
	2	Whitehorse	Alaska border (through B.C.)
Northwest Territories	2	Alberta border	Hay River
	3	Enterprise	Yellowknife

APPENDIX B

Expenditure and Revenue Tables

List of Tables

TABLE B-1

Summary Table – Total Road Expenditures, 1983-1987

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	670.6	675.6	1026.6	879.9	685.9
Alberta	744.6	697.6	794.3	756.4	696.0
Saskatchewan	269.5	272.0	275.4	281.1	261.8
Manitoba	178.4	193.1	192.1	187.5	191.5
Ontario	1071.0	1091.3	1112.0	1246.4	1359.9
Quebec	869.9	875.4	886.6	798.7	876.2
New Brunswick	186.4	217.1	243.3	222.3	259.1
Nova Scotia	199.6	222.4	197.8	172.7	203.3
Prince Edward Island	40.8	46.1	64.5	53.0	61.6
Newfoundland	131.7	148.0	158.2	168.1	169.9
Yukon	37.0	45.2	40.8	51.6	46.6
Northwest Territories	20.5	21.6	23.2	37.1	36.7
Federal (1)	160.5	171.1	158.0	143.7	161.9
Total	4580.0	4676.5	5172.8	4998.5	5010.4

(1) Note that federal transfer payments to provinces for road and highway construction have been removed from federal expenditures. Federal transfer payments for roads are as follows:

80.9	80.6	83.2	47.0	84.5

These federal transfer payments are reported in the appropriate provincial or territorial expenditures.

TABLE B-2

Expenditures on Roads by Jurisdiction by Fiscal Year
Capital (including design)

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	439.0	406.2	747.6	592.5	387.9
Alberta	514.8	469.7	544.8	520.1	458.7
Saskatchewan	88.6	93.3	99.0	101.1	95.9
Manitoba	101.6	102.2	99.6	97.5	100.3
Ontario	340.1	327.2	311.8	370.4	441.4
Quebec	440.2	453.0	439.5	375.2	414.7
New Brunswick	112.6	138.7	158.4	133.2	169.0
Nova Scotia	102.7	109.0	85.3	67.1	82.8
Prince Edward Island	18.8	20.5	33.5	24.7	31.6
Newfoundland	62.7	79.1	85.4	83.1	82.0
Yukon	9.7	14.9	13.0	22.0	15.9
Northwest Territories	10.0	10.6	11.6	19.1	19.0
Federal	108.0	114.2	101.6	79.0	89.0
	2348.8	2338.6	2731.1	2485.0	2388.2

TABLE B-3

Expenditures on Roads by Jurisdiction by Fiscal Year
Operations and Maintenance

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	228.8	267.8	276.8	284.2	294.9
Alberta	108.1	109.6	112.6	109.3	106.3
Saskatchewan	112.0	117.0	115.5	116.5	110.0
Manitoba	61.5	65.6	67.7	69.0	69.9
Ontario	232.1	249.1	269.5	285.8	283.1
Quebec	366.8	370.9	389.9	371.6	405.0
New Brunswick	73.8	78.4	84.9	89.1	90.1
Nova Scotia	88.8	104.1	104.9	99.4	112.7
Prince Edward Island	21.8	25.4	30.8	28.1	29.8
Newfoundland	69.0	68.9	72.8	85.0	87.9
Yukon	27.3	30.3	27.8	29.6	30.7
Northwest Territories	10.5	11.0	11.6	18.0	17.7
Federal	52.5	56.9	56.4	64.7	72.9
	1453.0	1555.0	1621.2	1650.3	1711.0

TABLE B-4

Expenditures on Roads by Jurisdiction by Fiscal Year
Municipal and county transfers or grants from provinces (excluding transit)(1)
Provincial transfers from federal government

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	2.8	1.6	2.2	3.2	3.1
Alberta	121.7	118.3	136.9	127.0	131.0
Saskatchewan	68.9	61.7	60.9	63.5	55.9
Manitoba	15.3	25.3	24.8	21.0	21.3
Ontario	498.8	515.0	530.7	590.2	635.4
Quebec (2)	62.9	51.5	57.2	51.9	56.5
New Brunswick	0	0	0	0	0
Nova Scotia	7.6	9.3	7.6	6.2	7.8
Prince Edward Island	0.2	0.2	0.2	0.2	0.2
Newfoundland	0	0	0	0	0
Federal	80.9	80.6	83.2	47.0	84.5
	859.1	863.5	903.7	910.2	995.7

(1) The municipal and county transfer payments reported here are incomplete. Many of the provincial governments make unconditional grants to municipalities and counties through various provincial government departments. Portions of these grants are used for road and street work but are not reported here.

(2) Quebec assumes direct provincial responsibilities for many municipal roads and these expenditures are reported as direct capital and operations expenditures.

TABLE B-5

Summary Table – Total Primary Source Road Related Revenues, 1983-1987

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	532.0	592.5	536.3	513.5	601.1
Alberta	72.5	104.4	82.0	79.3	288.3
Saskatchewan	54.2	54.3	60.3	61.2	190.9
Manitoba	141.9	149.2	164.2	169.0	177.5
Ontario	1492.3	1560.6	1610.8	1716.2	1805.4
Quebec	1527.3	1358.0	1373.7	1444.6	1541.4
New Brunswick	116.9	123.2	132.3	136.2	134.1
Nova Scotia	142.7	152.1	160.6	154.9	159.7
Prince Edward Island	21.2	22/4	21.7	21.8	21.9
Newfoundland	82.1	85.2	91.1	87.2	92.3
Yukon	5.3	5.9	5.7	6.0	6.9
Northwest Territories	6.2	6.2	6.9	8.6	8.4
Federal	1536.4	1679.2	2057.1	2735.0	3238.2
	5731.0	5893.2	6302.7	7138.9	8266.1

TABLE B-6

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Fuel Taxes Collected by Provincial and Territorial Governments

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	421.0	468.3	420.0	373.4	449.5
Alberta (1)	0	0	0	0	182.0
Saskatchewan	0	0	0	0	123.0
Manitoba	110.7	116.0	130.5	131.9	139.4
Ontario	1148.5	1187.4	1219.4	1254.3	1325.0
Quebec	1208.6	1024.8	1074.4	1132.2	1172.0
New Brunswick	92.8	98.4	107.0	100.2	99.7
Nova Scotia	105.2	114.1	121.7	111.3	115.0
Prince Edward Island	18.2	19.1	18.3	17.8	17.8
Newfoundland	64.2	66.3	71.2	65.3	68.3
Yukon	3.7	4.2	3.9	3.8	4.3
Northwest Territories	4.6	4.7	5.0	6.2	5.8
Total	3177.5	3103.3	3171.4	3196.4	3701.8

(1) Fuel taxes in Alberta were introduced in 1987 and so revenues reported are for a ten month period.

TABLE B-7

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Fuel Taxes Collected by Provincial and Territorial Governments – Gasoline

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	370.5	411.9	354.7	317.9	380.9
Alberta (1)	0	0	0	0	139.7
Saskatchewan	0	0	0	0	96.0
Manitoba	89.8	93.2	104.4	106.0	109.2
Ontario	932.5	961.4	977.2	988.8	1034.0
Quebec	1002.1	838.4	873.8	944.5	971.6
New Brunswick	71.6	76.0	83.3	74.2	75.1
Nova Scotia	90.0	96.0	100.7	90.1	91.4
Prince Edward Island	15.8	16.5	15.9	14.3	15.0
Newfoundland	51.5	53.1	56.5	51.0	53.0
Yukon (2)	3.7	4.2	3.9	3.8	4.3
Northwest Territories	1.6	1.7	1.9	1.7	1.8
	2629.1	2552.4	2572.3	2592.3	2972.0

(1) Fuel taxes in Alberta were introduced in 1987 and so revenues reported are for a ten month period.

(2) Yukon – gasoline and diesel derived revenues are reported together.

TABLE B-8

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Fuel Taxes Collected by Provincial and Territorial Governments – Diesel

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	50.5	56.4	65.2	55.5	68.6
Alberta (1)	0	0	0	0	42.3
Saskatchewan	0	0	0	0	27.0
Manitoba	20.0	21.6	24.8	24.5	28.9
Ontario	216.0	226.0	242.0	265.5	291.0
Quebec	182.3	165.9	179.2	165.0	176.9
New Brunswick	21.2	22.4	23.7	26.0	24.6
Nova Scotia	15.1	18.0	20.9	21.0	23.4
Prince Edward Island	2.3	2.5	2.3	2.1	2.7
Newfoundland	12.7	13.2	14.6	14.3	15.3
Yukon (2)	–	–	–	–	–
Northwest Territories	3.0	3.0	3.0	4.4	4.0
	523.1	529.0	575.7	578.3	704.7

(1) Fuel taxes in Alberta were introduced in 1987 and so revenues reported are for a ten month period.

(2) Yukon – gasoline and diesel derived revenues are reported together for gasoline.

TABLE B-9

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Sales and Excise Fuel Taxes Collected by Federal Government

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	184.2	196.3	236.0	317.4	369.3
Alberta	177.2	202.5	251.7	327.0	385.9
Saskatchewan	62.9	72.7	89.9	117.0	139.1
Manitoba	64.1	68.6	84.4	110.4	126.4
Ontario	564.6	616.8	757.1	1014.3	1192.6
Quebec	343.9	369.3	453.3	604.6	725.1
New Brunswick	46.7	52.1	61.9	83.2	102.5
Nova Scotia	51.7	56.4	68.9	92.2	110.9
Prince Edward Island	7.8	8.4	10.2	13.8	16.1
Newfoundland	27.0	29.0	34.9	46.1	55.8
Yukon	3.3	3.9	4.5	6.1	7.0
Northwest Territories	3.0	3.2	4.3	2.9	7.5
Total	1536.4	1679.2	2057.1	2735.0	3238.2

TABLE B-10

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Sales and Excise Fuel Taxes Collected by Federal Government – Gasoline

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	164.5	173.5	203.4	273.1	310.9
Alberta	157.5	173.6	212.0	273.1	316.4
Saskatchewan	56.4	62.1	75.7	99.7	116.1
Manitoba	57.6	61.7	75.3	99.7	115.5
Ontario	516.6	555.1	674.4	900.8	1044.6
Quebec	305.3	320.6	383.5	505.8	587.6
New Brunswick	41.2	44.9	52.5	70.3	84.5
Nova Scotia	46.7	50.3	60.3	79.9	93.4
Prince Edward Island	7.3	7.8	9.4	12.7	14.7
Newfoundland	24.0	25.4	30.3	40.1	47.3
Yukon	2.3	2.6	3.1	4.2	5.0
Northwest Territories	1.9	1.7	1.9	1.6	3.5
Total	1381.3	1479.3	1781.8	2361.0	2739.5

TABLE B-11

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Fuel Taxes Collected by Federal Government – Diesel

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	18.7	21.1	30.5	41.1	54.6
Alberta	18.7	27.4	37.8	50.6	65.3
Saskatchewan	6.3	10.1	13.5	16.4	22.0
Manitoba	6.2	6.3	8.4	9.8	10.0
Ontario	45.7	56.8	77.1	105.6	138.3
Quebec	38.2	47.7	68.6	96.8	134.6
New Brunswick	5.5	7.0	9.3	12.7	17.6
Nova Scotia	4.9	5.9	8.4	12.0	17.1
Prince Edward Island	0.5	0.5	0.8	1.0	1.4
Newfoundland	3.0	3.5	4.5	6.0	8.4
Yukon	1.0	1.3	1.4	1.9	1.9
Northwest Territories	1.1	1.5	2.3	1.3	4.0
Total	149.8	189.1	262.6	355.2	475.2

TABLE B-12

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Licenses, Registrations, Permits and Operating Authorities

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	111.0	124.2	116.3	129.0	136.8
Alberta	72.5	104.4	82.0	79.3	106.3
Saskatchewan	54.2	54.3	60.3	61.2	67.9
Manitoba	31.2	33.2	33.7	37.1	38.1
Ontario	343.8	373.2	391.4	461.9	480.4
Quebec	253.2	272.9	283.4	312.4	369.4
New Brunswick	24.1	24.8	25.3	36.0	34.4
Nova Scotia	30.0	30.1	30.7	35.1	35.8
Prince Edward Island	3.0	3.3	3.4	4.0	4.1
Newfoundland	17.9	18.9	19.9	21.9	24.0
Yukon	1.6	1.7	1.8	2.2	2.6
Northwest Territories	1.6	1.5	1.9	2.4	2.6
Total	944.1	1042.5	1050.1	1182.5	1302.4

TABLE B-13

Primary Source Road-Related Revenues by Jurisdiction by Fiscal Year
Tolls

(Actual $, Millions) (1)

	83-84	84-85	85-86	86-87	87-88
British Columbia	0	0	0	11.1	14.8
Quebec	65.5	60.3	15.9	0	0
Nova Scotia	7.5	7.9	8.2	8.5	8.9
Total	73.0	68.2	24.1	19.6	23.7

(1) These totals include toll highway facilities only. Toll bridges and ferries are excluded.

TABLE B-14

Total Secondary Source Road-Related Revenues by Year
Sales Tax for New and Used Motor Vehicles,
Garages and Automobile Parts and Accessories Stores

(Actual $, Millions)

	1983	1984	1985	1986	1987
British Columbia	120.6	135.4	161.8	187.1	252.2
Alberta	–	–	–	–	–
Saskatchewan	52.9	51.1	60.2	62.9	74.5
Manitoba	72.0	81.0	86.0	101.0	106.0
Ontario	479.7	613.1	747.4	828.8	931.8
Quebec	521.6	545.5	605.8	648.8	746.1
New Brunswick	69.6	82.2	100.6	109.1	125.5
Nova Scotia	77.5	89.7	108.9	115.8	129.5
Prince Edward Island	16.9	19.2	20.8	23.1	23.7
Newfoundland	41.3	50.2	51.4	57.6	64.5
Sub-total	**1452.1**	**1667.4**	**1942.9**	**2134.2**	**2453.8**
Federal Motor Vehicle Sales Tax					
	630	784	978	1072	1139
Total	**2082.1**	**2451.4**	**2920.9**	**3206.2**	**3592.8**

APPENDIX C

Expenditure and Revenue Tables – National Highway System

List of Tables

TABLE C-1

Expenditures on National Highway System by Jurisdiction by Fiscal Year
Capital (including design)

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	81.2	152.0	339.3	218.5	134.0
Alberta	147.1	101.6	125.0	104.6	124.1
Saskatchewan	24.8	19.2	13.8	14.0	16.6
Manitoba	15.5	17.3	9.2	14.5	16.3
Ontario	133.4	132.3	104.1	105.1	149.6
Quebec	92.1	80.8	59.6	56.1	65.9
New Brunswick	9.8	15.5	24.8	15.0	21.1
Nova Scotia	17.6	13.4	12.6	3.8	1.3
Prince Edward Island	0.3	0.6	3.4	1.7	1.5
Newfoundland	23.4	38.4	27.3	33.6	36.1
Yukon (1)	1.5	2.5	1.5	3.2	5.3
Northwest Territories (2)	20.5	21.6	23.2	37.1	36.8
Federal (3)	50.7	51.5	48.5	27.4	33.1
Total	617.9	646.7	792.1	634.6	641.7

(1) includes DIAND engineering services agreement

(2) includes operations and maintenance

(3) figures are exclusive of any provincial transfer payments from federal government for projects on the national highway system since these are accounted for in provincial totals.

TABLE C-2

Expenditures on National Highway System by Jurisdiction by Fiscal Year Operations and Maintenance

(Actual $, Millions)

	83-84	84-85	85-86	86-87	87-88
British Columbia	35.8	39.0	46.7	49.9	58.1
Alberta	32.2	32.7	33.8	34.0	33.5
Saskatchewan	10.6	10.6	9.7	9.9	11.1
Manitoba	5.2	6.0	5.9	6.5	6.5
Ontario	63.5	68.3	78.7	77.1	80.2
Quebec	41.6	45.5	44.2	42.5	46.4
New Brunswick	9.2	10.0	10.9	11.3	11.5
Nova Scotia	16.8	20.2	18.2	16.6	16.8
Prince Edward Island	0.9	0.9	1.1	1.0	0.7
Newfoundland	7.8	8.1	8.3	8.6	9.1
Yukon (1)	11.5	11.8	9.6	10.3	10.6
Northwest Territories (2)	–	–	–	–	–
Federal	27.1	39.6	25.8	24.5	27.4
	262.2	292.7	229.9	292.2	311.9

(1) includes Alaska Highway Agreement.

(2) operations and maintenance included in capital expenditures

TABLE C-3

National Highway System Revenues and Expenditures by Fiscal Year (Actual $, Millions)

	1983-84	1984-85	1985-86	1986-87	1987-88
British Columbia					
Revenues					
(P)	108.3	141.5	124.3	118.0	136.7
(F)	48.6	51.8	62.3	83.8	97.5
Expenditures					
(P)	117.0	191.0	386.0	268.5	192.1
(F)	30.6	28.6	23.7	18.3	30.1
Alberta					
Revenues					
(P)	18.8	27.1	21.3	20.7	74.9*
(F)	46.1	52.6	65.4	85.0	100.3
Expenditures					
(P)	179.3	134.3	158.8	138.6	157.6
(F)	13.6	18.2	16.0	6.2	9.2
Saskatchewan					
Revenues					
(P)	13.2	13.8	14.5	14.7	45.9*
(F)	15.1	17.4	21.6	28.1	33.4
Expenditures					
(P)	35.4	29.8	23.4	23.9	27.8
(F)	0	0	0	0	0.3
Manitoba					
Revenues					
(P)	19.7	20.6	22.6	23.5	24.7
(F)	9.9	10.6	13.0	17.1	19.5
Expenditures					
(P)	20.6	23.4	15.1	21.1	27.8
(F)	0	0	0	0	1.8
Ontario					
Revenues					
(P)	361.4	395.2	428.8	472.7	507.9
(F)	136.6	156.0	201.4	278.9	335.1
Expenditures					
(P)	196.9	200.6	182.8	182.2	229.8
(F)	0	0	0	0	0

* both Alberta and Saskatchewan introduced fuel taxes in 1987-88.

National Highway System Revenues and Expenditures by Fiscal Year (Actual $, Millions) cont'd

	1983-84	1984-85	1985-86	1986-87	1987-88
Quebec					
Revenues					
(P)	357.4	317.8	321.5	338.3	360.7
(F)	80.5	86.4	106.1	141.5	169.7
Expenditures					
(P)	133.7	126.3	103.8	98.6	112.3
(F)	4.9	0	3.8	3.8	0
New Brunswick					
Revenues					
(P)	39.2	47.6	52.3	44.8	49.8
(F)	14.0	15.6	18.6	25.0	30.7
Expenditures					
(P)	16.7	21.7	29.9	25.7	28.0
(F)	2.3	3.9	5.8	0.7	4.5
Nova Scotia					
Revenues					
(P)	34.8	37.2	39.2	37.9	39.3
(F)	11.7	12.7	15.6	20.8	25.1
Expenditures					
(P)	33.5	30.9	30.9	24.9	27.4
(F)	6.5	4.6	5.8	1.2	0.4
Prince Edward Island					
Revenues					
(P)	4.0	4.2	4.1	4.1	4.1
(F)	1.5	1.6	1.9	2.6	3.1
Expenditures					
(P)	1.2	1.4	1.8	2.6	2.2
(F)	0.4	0	1.9	0.1	0
Newfoundland / Labrador					
Revenues					
(P)	55.5	60.9	64.1	65.1	70.6
(F)	12.1	13.0	15.7	20.7	25.1
Expenditures					
(P)	30.8	46.1	35.3	42.0	44.9
(F)	13.4	4.5	7.8	12.7	16.4

National Highway System Revenues and Expenditures by Fiscal Year (Actual $, Millions) cont'd

	1983-84	1984-85	1985-86	1986-87	1987-88
Yukon					
Revenues					
(T)	3.4	3.9	3.7	4.3	5.1
(F)	2.2	2.5	2.9	4.0	4.5
Expenditures					
(T)	0.7	1.1	1.1	1.8	2.2
(F)	24.4	27.0	27.1	18.1	19.5
Northwest Territories					
Revenues					
(T)	6.2	6.2	6.8	8.5	8.4
(F)	1.8	1.9	2.2	3.2	3.2
Expenditures					
(T)	20.5	21.6	23.2	37.1	36.8
(F)	7.0	7.5	7.6	8.0	10.3

(P) – provincial – provided by provincial governments

(T) – territorial – provided by territorial governments

(F) – federal – provided by federal government

Note: 75% of reported federal expenditures are direct expenditures on federal jurisdiction highways on the national highway system. 25% are indirect expenditures through provincial transfer payments for projects on the national highway system.

APPENDIX D

Scenario A and B Costs

Costing of Improvements – Scenario A

work type	1 resurfacing	2 reconstruction	3 new construction	4 twinning and new 4 lanes	5 interchanges	6 structures: new or major rehabilitation	totals
description	overlay	strengthening, alignment, widening shoulders, passing lanes, etc.	2 lane: intersections, bypasses	new 4 lanes or twinning	grade separated interchanges	new bridges or overpasses or major structural maintenance	
deficiency addressed	rutting, strengthening, riding comfort index	structural adequacy, serviceability, geometric design	accident rate, serviceability geometric design	accident rate, serviceability	accident rate, serviceability, geometric design	structural adequacy	
policy objectives	RCI of 6 or greater, comfort, vehicle operating costs	all weather service at 90 km/hr, safety, national weight standards	operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	all weather service for national weight standards, safety, operating speed of 90 km/hr	
BC	210.8	526.4	83.8	582.6	172.0	311.8	1,887.4
Alta	61.4	6.9	338.6	523.6	850.8	210.4	1,991.7
Sask	137.4	58.7	32.0	238.1	99.0	43.5	608.7
Man	43.0	34.8	9.3	139.2	262.8	60.3	549.3
Ont	274.0	2.5	453.4	1360.5	0	114.8	2,205.2
Que	77.4	589.8	180.9	300.8	101.6	79.6	1,330.1
NB	11.7	0	0	1354.0	376.7	279.6	2,022.0
NS	1.0	18.0	1.6	441.2	141.4	148.4	751.6
PEI	3.9	6.3	25.3	0	14.6	38.4	88.5
Nfld	0	174.7	76.8	0	0	27.0	278.5
Yukon	7.8	340.9	27.4	0	0	18.4	394.5
NWT	145.0	94.1	0	0	0	50.0	289.1
Federal	0	316.0	0	0	0	3.8	319.8
Total	973.4	2169.1	1229.1	4940.0	2018.9	1385.9	12,716.4

Correct all deficiencies to minimum appropriate standards (1989 $, millions), includes property and pre-engineering costs.

Costing of Improvements – Scenario B

work type	1 resurfacing	2 reconstruction	3 new construction	4 twinning and new 4 lanes	5 interchanges	6 structures: new or major rehabilitation	totals
description	overlay	strengthening, alignment, widening shoulders, passing lanes, etc.	2 lane: intersections, bypasses	new 4 lanes or twinning	grade separated interchanges	new bridges or overpasses or major structural maintenance	
deficiency addressed	rutting, strengthening, riding comfort index	structural adequacy, serviceability, geometric design	accident rate, serviceability, geometric design	accident rate, serviceability	accident rate serviceability, geometric design	structural adequacy	
policy objectives	RCI of 6 or greater, comfort, vehicle operating costs	all weather service at 90 km/hr, safety, national weight standards	operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	all weather service for national weight standards, safety, operating speed of 90 km/hr	
BC	205.9	430.1	850.4	742.1	172.0	317.2	2,717.7
Alta	61.4	6.9	338.9	561.0	865.5	215.5	2,049.2
Sask	137.4	58.7	32.0	279.1	99.0	46.4	652.6
Man	43.0	34.8	9.3	154.7	262.8	60.3	564.9
Ont	214.8	0.7	453.4	2932.3	0	98.2	3699.4
Que	77.4	589.8	180.9	529.6	101.6	269.9	1749.2
NB	11.7	0	0	1412.5	384.5	258.1	2066.8
NS	1.0	19.2	1.6	699.7	184.9	215.6	1122.0
PEI	3.9	6.3	85.6	6.5	27.5	56.8	186.6
Nfld	0	0	0	1190.3	0	30.0	1220.3
Yukon	7.8	340.9	27.4	0	0	18.4	394.5
NWT	145.0	94.1	0	0	0	50.0	289.1
Federal	0	316.0	0	474.9	0	3.7	794.6
Total	909.3	1897.5	1979.5	8982.7	2097.8	1640.1	17,506.9

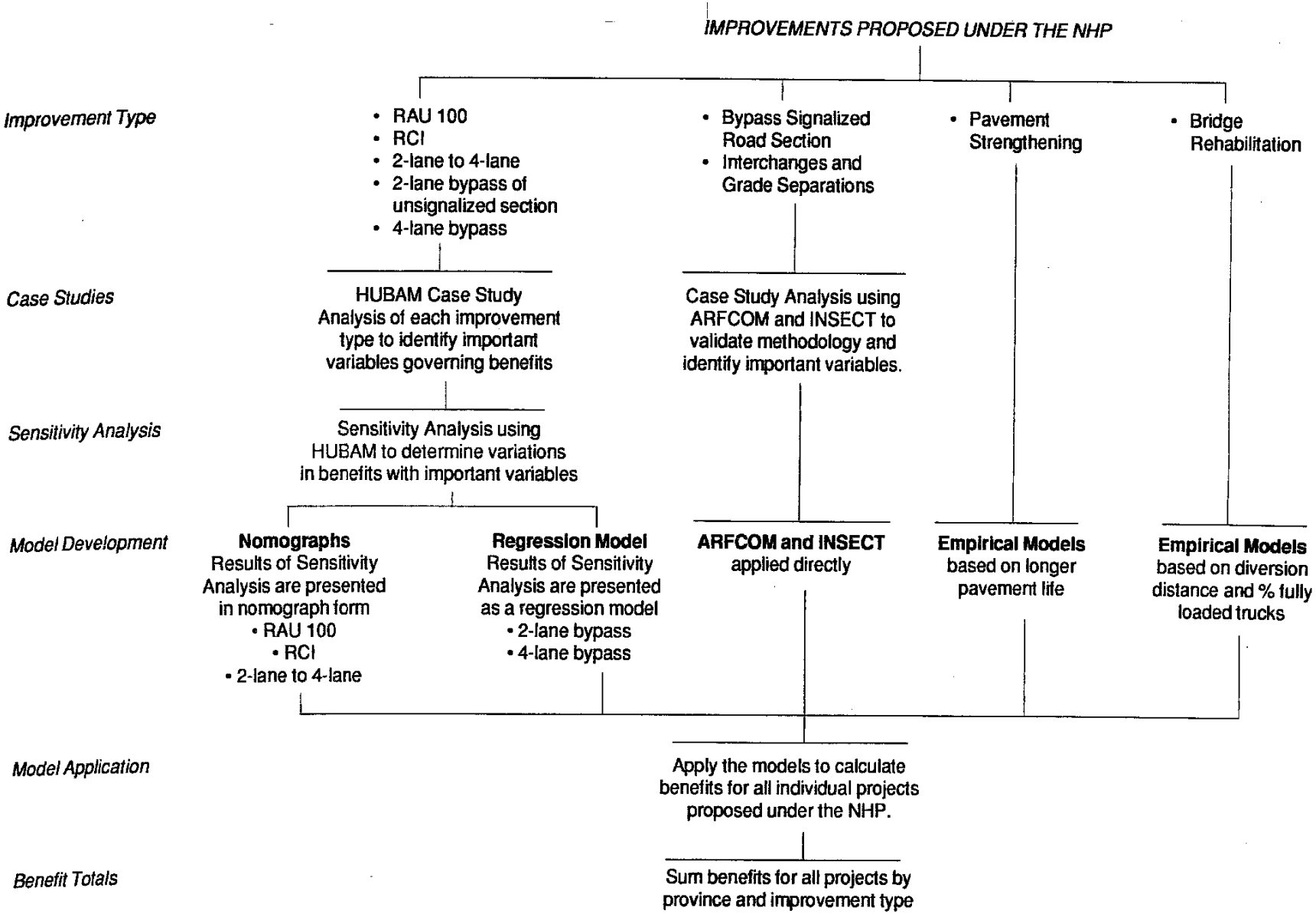
Correct all deficiencies to minimum appropriate standards and provide continuous 4 lane cross Canada route (1989 $, millions), includes property and pre-engineering costs.

APPENDIX E

Highway User Benefits Summary Tables

TABLE E-1

Outline of General Approach to Study



For the purposes of providing a complete four lane cost estimate, the entire TransCanada Highway in Newfoundland and sections of the TransCanada Highway through difficult terrain in British Columbia have also been included in Scenario B. Costs for Scenario A and Scenario B by highway jurisdiction are illustrated in Figure 9.

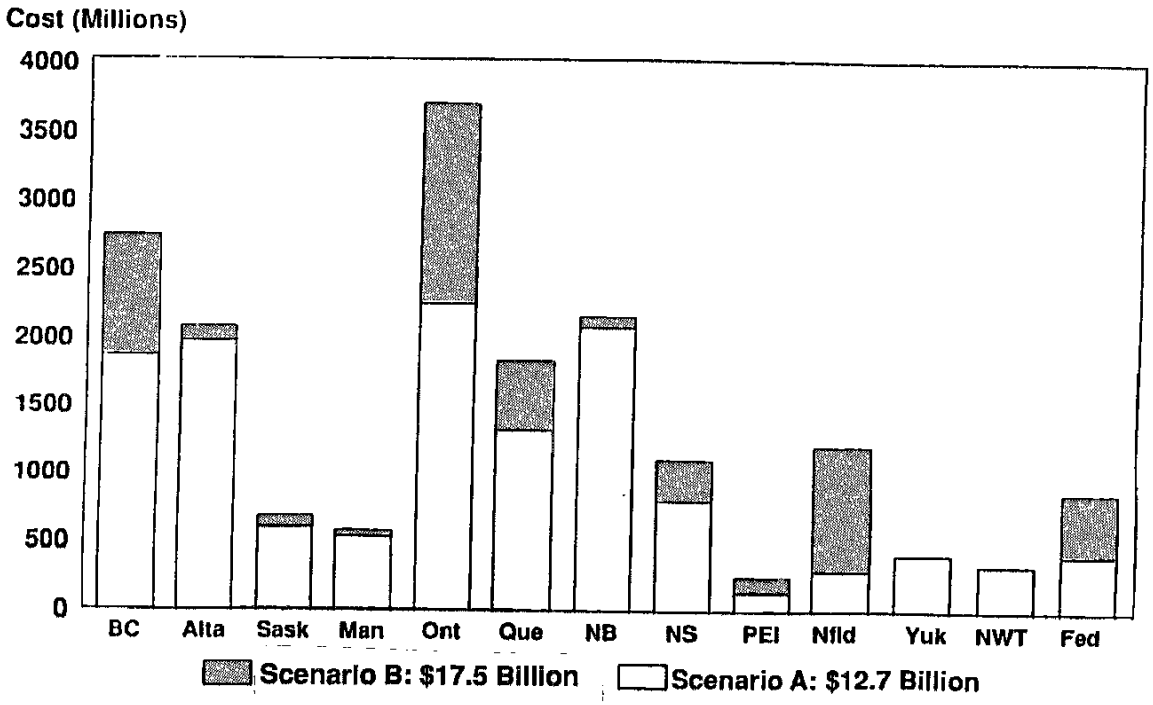


Figure 9 – Cost of National Highway System Improvements by Province

TABLE E-2

Distribution of User Benefits Scenario A – 5% Social Discount Rate

(Millions 1989 $)

Improvement Type	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
RAU100	206	26	42	N/A	N/A	140	N/A	N/A	2	77	43	2	536
RCI < 6	409	188	175	49	554	1,023	16	N/A	12	64	26	9	2,524
2 to 4 Lane	290	333	90	13	388	77	310	356	N/A	31	N/A	N/A	1,888
2 Lane Bypass of Low Posted Speed Section	8	20	67	75	N/A	72	7	6	10	73	N/A	N/A	338
4 Lane Bypass For Congestion	N/A	66	N/A	43	355	118	867	222	N/A	0	N/A	N/A	1,670
Bypass of Spot Speed Restriction	325	656	40	N/A	N/A	N/A	N/A	14	35	4	N/A	N/A	1,073
Interchanges	567	634	324	75	N/A	458	401	48	N/A	N/A	N/A	N/A	2,507
Pavement Strengthening	N/A	N/A	68	25	N/A	1,326	15	N/A	N/A	30	1	0	1,464
Bridge Rehabilitation	35	N/A	62	253	3,467	1,225	8	N/A	N/A	24	N/A	4	5,078
TOTAL	1,839	1,922	867	533	4,765	4,439	1,623	647	58	303	70	15	17,080

Note: Alberta and British Columbia figures do not include Alaska Highway or National Parks.
Totals may not agree due to rounding

TABLE E-3

Distribution of User Benefits Scenario A – 10% Social Discount Rate

(Millions 1989 $)

Improvement Type	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
RAU100	122	12	25	N/A	N/A	83	N/A	N/A	1	46	25	1	314
RCI < 6	274	132	114	33	385	620	10	N/A	7	41	19	6	1,641
2 to 4 Lane	161	178	37	5	211	42	174	201	N/A	17	N/A	N/A	1,026
2 Lane Bypass of Low Posted Speed Section	5	13	44	49	N/A	47	5	4	7	48	N/A	N/A	221
4 Lane Bypass For Congestion	N/A	43	N/A	28	232	77	567	145	N/A	0	N/A	N/A	1,092
Bypass of Spot Speed Restriction	201	405	25	N/A	N/A	N/A	N/A	8	22	3	N/A	N/A	662
Interchanges	316	339	175	37	N/A	251	194	24	N/A	N/A	N/A	N/A	1,335
Pavement Strengthening	N/A	N/A	42	15	N/A	812	9	N/A	N/A	15	1	0	894
Bridge Rehabilitation	21	N/A	38	155	2,126	751	5	N/A	N/A	15	N/A	3	3,113
TOTAL	1,099	1,121	498	322	2,954	2,682	964	383	37	183	46	9	10,297

Note: Alberta and British Columbia figures do not include Alaska Highway or National Parks.
Totals may not add due to rounding

Costing of Improvements – Scenario A

work type	1 resurfacing	2 reconstruction	3 new construction	4 twinning and new 4 lanes	5 interchanges	6 structures: new or major rehabilitation	totals
description	overlay	strengthening, alignment, widening shoulders, passing lanes, etc.	2 lane: intersections, bypasses	new 4 lanes or twinning	grade separated interchanges	new bridges or overpasses or major structural maintenance	
deficiency addressed	rutting, strengthening, riding comfort index	structural adequacy, serviceability, geometric design	accident rate, serviceability geometric design	accident rate, serviceability	accident rate, serviceability, geometric design	structural adequacy	
policy objectives	RCI of 6 or greater, comfort, vehicle operating costs	all weather service at 90 km/hr, safety, national weight standards	operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	all weather service for national weight standards, safety, operating speed of 90 km/hr	
BC	210.8	526.4	83.8	582.6	172.0	311.8	1,887.4
Alta	61.4	6.9	338.6	523.6	850.8	210.4	1,991.7
Sask	137.4	58.7	32.0	238.1	99.0	43.5	608.7
Man	43.0	34.8	9.3	139.2	262.8	60.3	549.3
Ont	274.0	2.5	453.4	1360.5	0	114.8	2,205.2
Que	77.4	589.8	180.9	300.8	101.6	79.6	1,330.1
NB	11.7	0	0	1354.0	376.7	279.6	2,022.0
NS	1.0	18.0	1.6	441.2	141.4	148.4	751.6
PEI	3.9	6.3	25.3	0	14.6	38.4	88.5
Nfld	0	174.7	76.8	0	0	27.0	278.5
Yukon	7.8	340.9	27.4	0	0	18.4	394.5
NWT	145.0	94.1	0	0	0	50.0	289.1
Federal	0	316.0	0	0	0	3.8	319.8
Total	973.4	2169.1	1229.1	4940.0	2018.9	1385.9	12,716.4

Correct all deficiencies to minimum appropriate standards (1989 $, millions), includes property and pre-engineering costs.

Costing of Improvements – Scenario B

work type	1 resurfacing	2 reconstruction	3 new construction	4 twinning and new 4 lanes	5 interchanges	6 structures: new or major rehabilitation	totals
description	overlay	strengthening, alignment, widening shoulders, passing lanes, etc.	2 lane: intersections, bypasses	new 4 lanes or twinning	grade separated interchanges	new bridges or overpasses or major structural maintenance	
deficiency addressed	rutting, strengthening, riding comfort index	structural adequacy, serviceability, geometric design	accident rate, serviceability, geometric design	accident rate, serviceability	accident rate serviceability, geometric design	structural adequacy	
policy objectives	RCI of 6 or greater, comfort, vehicle operating costs	all weather service at 90 km/hr, safety, national weight standards	operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	access control, operating speed of 90 km/hr, safety	all weather service for national weight standards, safety, operating speed of 90 km/hr	
BC	205.9	430.1	850.4	742.1	172.0	317.2	2,717.7
Alta	61.4	6.9	338.9	561.0	865.5	215.5	2,049.2
Sask	137.4	58.7	32.0	279.1	99.0	46.4	652.6
Man	43.0	34.8	9.3	154.7	262.8	60.3	564.9
Ont	214.8	0.7	453.4	2932.3	0	98.2	3699.4
Que	77.4	589.8	180.9	529.6	101.6	269.9	1749.2
NB	11.7	0	0	1412.5	384.5	258.1	2066.8
NS	1.0	19.2	1.6	699.7	184.9	215.6	1122.0
PEI	3.9	6.3	85.6	6.5	27.5	56.8	186.6
Nfld	0	0	0	1190.3	0	30.0	1220.3
Yukon	7.8	340.9	27.4	0	0	18.4	394.5
NWT	145.0	94.1	0	0	0	50.0	289.1
Federal	0	316.0	0	474.9	0	3.7	794.6
Total	909.3	1897.5	1979.5	8982.7	2097.8	1640.1	17,506.9

Correct all deficiencies to minimum appropriate standards and provide continuous 4 lane cross Canada route (1989 $, millions), includes property and pre-engineering costs.

TABLE E-4

Distribution of Benefits Scenario B

DISTRIBUTION OF BENEFITS UNDER SCENARIO 'B'

Province or Territory	Incremental Benefits Under Scenario 'B' (4 lane Cross Canada Route) (millions 1989 $) 5% Discount	10% Discount
Newfoundland	221	130
Prince Edward Island	9	5
Nova Scotia	174	102
New Brunswick	9	5
Quebec	143	85
Ontario	167	99
Manitoba	4	2
Saskatchewan	11	6
Alberta	9	6
British Columbia	217	128
Yukon[1]	N/A	N/A
Northwest Territories[1]	N/A	N/A
TOTAL	**963**	**568**

1 There is no Scenario B in these jurisdictions

TABLE E-5

Salvage Values After 25 Years – 5% Social Discount Rate

(1989 $000)

IMPROVEMENT TYPE	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
Resurfacing	Not Applicable; Resurfacing included in user benefits												
Road Reconstruction	20,178	267	2,275	1,349	98	22,907	1,805	698	245	6,771	12,210	5,392	74,197
New Road Construction	13,796	21,622	1,240	1,517	17,574	16,922	32,574	6,318	829	2,977	1,062	0	116,429
Twinning	22,406	11,097	9,228	2,514	52,730	2,236	11,801	10,752	0	0	0	0	122,764
Interchange/ Intersection	26,429	124,292	14,617	45,007	0	12,978	50,570	20,878	1,954	0	0	0	296,725
Bridge Rehabilitation	9,927	664	6,423	8,431	13,550	1,772	207	2,052	0	3,987	2,702	295	50,010
New Structure	36,109	30,401	0	474	3,416	9,966	37,155	19,859	5,020	0	0	7,383	149,783
Drainage	148	0	0	0	0	0	0	0	0	0	0	0	148
Property	2,333	7,974	0	744	0	0	12,820	715	547	0	0	0	25,134
TOTAL	131,326	196,317	33,784	60,035	87,367	66,782	146,933	61,270	8,595	13,735	15,974	13,070	835,189

TABLE E-6

Salvage Values After 25 Years – 10% Social Discount Rate

(1989 $000)

IMPROVEMENT TYPE	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
Resurfacing	Not Applicable; Resurfacing included in user benefits												
Road Reconstruction	782	10	88	52	4	888	70	27	77	262	473	209	2,943
New Road Construction	535	838	48	59	681	656	1,263	245	259	115	41	0	4,740
Twinning	868	430	358	97	2,044	87	457	417	0	0	0	0	4,758
Interchange/ Intersection	3,902	18,352	2,158	6,645	0	1,916	7,467	3,083	611	0	0	0	44,133
Bridge Rehabilitation	1,466	98	948	1,245	2,001	262	31	303	0	589	399	44	7,384
New Structure	5,331	4,489	0	70	504	1,472	5,486	2,932	1,569	0	0	1,090	22,943
Drainage	22	0	0	0	0	0	0	0	0	0	0	0	22
Property	689	2,355	0	220	0	0	3,786	211	171	0	0	0	7,431
TOTAL	13,595	26,572	3,601	8,388	5,234	5,280	18,559	7,217	2,687	966	913	1,343	94,354

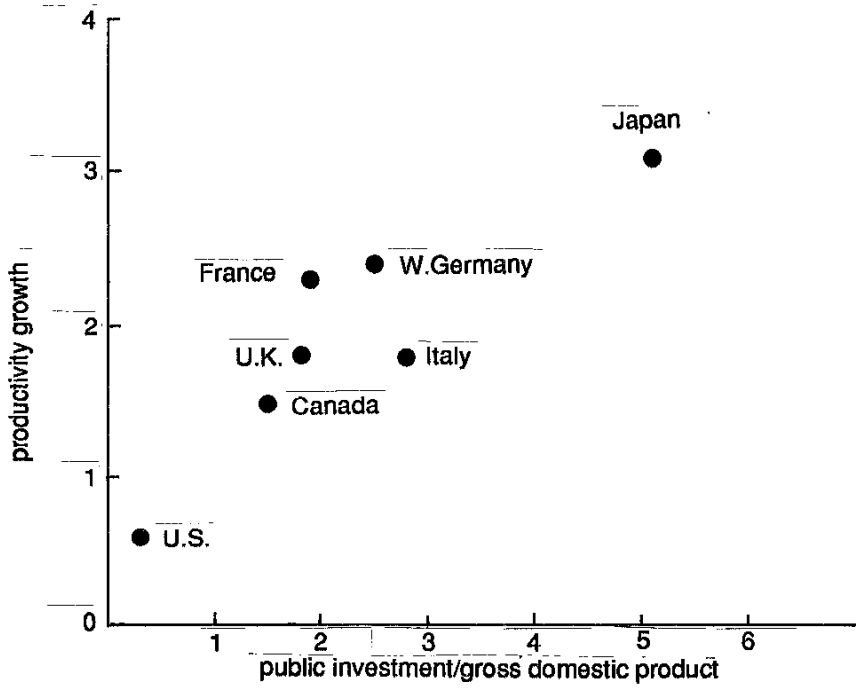
THE PRODUCTIVITY OF PUBLIC EXPENDITURE

GOVERNMENT CAPITAL FORMATION

The role of public investment is sometimes assumed to be unrelated to the productivity of business investment. In work for U.S., David Aschauer (1) found that "significant weight should be attributed to public investment decisions – specifically, additions to the stock of nonmilitary structures such as highways, streets, water systems and sewers – when assessing the role the government plays in the course of economic growth and productivity improvement." Aschauer's study shows that a one per cent increase in the ratio of public to private capital stocks brings a higher (0.39 per cent) response in the productivity of capital compared to a similar increase in the labour-private capital ratio (0.35 per cent). Aschauer interprets his results to support a view that the slow relative growth in public infrastructure contributed to the productivity slowdown in the U.S.

Aschauer also presented an interesting cross-country comparison of public investment and productivity trends. The following figure, reproduced from the Aschauer study, shows an apparent relationship between the change in labour productivity and the ratio of public investment to gross domestic product for the period 1973-85. Aschauer makes the point that, in focusing on the relationship between the public sector budget deficit and interest rates, expectations, investment and dynamic performance, it is important to also emphasize the direct effects of public investment on the productivity of the private sector.

Public investment and productivity



(1) Aschauer, David, "Is Public Expenditure Productive?", Federal Reserve Bank of Chicago Staff Memorandum SM-88-7.

Matrix of Program Elements vs Potential Social and Economic Effects, and Potential Natural Environmental Effects

	Elements of National Highway Program							
	Scenario "A"							"B"
	Resurfacing (9522 km)	Road Upgrading/ Reconstruction (7679 km)	New Two Lane Construction (582 km)	Twinning (3010 km) and New Four Laning (794 km)	Interchanges (229)	New Structure (127) and Rehabilitation (441)	Total Scenario "A" Program	Scenario "A" plus Four Laning to Complete System
Potential Social & Economic Effects								
Accessibility		•	•	●	•		●	●
Land Use			•		•		•	•
Agriculture		•	●	●	•		●	●
Noise			•	•	•			
Heritage			•	•	•		•	•
Aesthetics			•	•	•		•	•
Maintenance Cost	•	•	•	•	•	•	•	•
Operating Cost		•	●	●	•		●	●
Safety Components	•	●	●	●	●	•	●	●
Property Value Changes			•	•	•		•	•
Inter Provincial Travel		•	●	●	•		●	●
Potential Natural Environmental Effects								
Ground Water			•	•	•		•	•
Surface Water		•	●	●	•	●	●	●
Wetlands		•	●	●	•		●	●
Vegetation		•	•	•	•		•	•
Terrestrial Wildlife		•	●	●	•		●	●
Aquatic Wildlife			•	•		•	•	•
Air Pollution			•	•	•		•	•
Topography			•	•			•	•

Legend: blank = of no significance on majority of projects

• = may be of significance on some individual projects

● = probably significant on majority of projects

TABLE E-2

Distribution of User Benefits Scenario A – 5% Social Discount Rate

(Millions 1989 $)

Improvement Type	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
RAU100	206	26	42	N/A	N/A	140	N/A	N/A	2	77	43	2	536
RCI < 6	409	188	175	49	554	1,023	16	N/A	12	64	26	9	2,524
2 to 4 Lane	290	333	90	13	388	77	310	356	N/A	31	N/A	N/A	1,888
2 Lane Bypass of Low Posted Speed Section	8	20	67	75	N/A	72	7	6	10	73	N/A	N/A	338
4 Lane Bypass For Congestion	N/A	66	N/A	43	355	118	867	222	N/A	0	N/A	N/A	1,670
Bypass of Spot Speed Restriction	325	656	40	N/A	N/A	N/A	N/A	14	35	4	N/A	N/A	1,073
Interchanges	567	634	324	75	N/A	458	401	48	N/A	N/A	N/A	N/A	2,507
Pavement Strengthening	N/A	N/A	68	25	N/A	1,326	15	N/A	N/A	30	1	0	1,464
Bridge Rehabilitation	35	N/A	62	253	3,467	1,225	8	N/A	N/A	24	N/A	4	5,078
TOTAL	1,839	1,922	867	533	4,765	4,439	1,623	647	58	303	70	15	17,080

Note: Alberta and British Columbia figures do not include Alaska Highway or National Parks.
Totals may not agree due to rounding

TABLE E-3

Distribution of User Benefits Scenario A – 10% Social Discount Rate

(Millions 1989 $)

Improvement Type	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
RAU100	122	12	25	N/A	N/A	83	N/A	N/A	1	46	25	1	314
RCI < 6	274	132	114	33	385	620	10	N/A	7	41	19	6	1,641
2 to 4 Lane	161	178	37	5	211	42	174	201	N/A	17	N/A	N/A	1,026
2 Lane Bypass of Low Posted Speed Section	5	13	44	49	N/A	47	5	4	7	48	N/A	N/A	221
4 Lane Bypass For Congestion	N/A	43	N/A	28	232	77	567	145	N/A	0	N/A	N/A	1,092
Bypass of Spot Speed Restriction	201	405	25	N/A	N/A	N/A	N/A	8	22	3	N/A	N/A	662
Interchanges	316	339	175	37	N/A	251	194	24	N/A	N/A	N/A	N/A	1,335
Pavement Strengthening	N/A	N/A	42	15	N/A	812	9	N/A	N/A	15	1	0	894
Bridge Rehabilitation	21	N/A	38	155	2,126	751	5	N/A	N/A	15	N/A	3	3,113
TOTAL	1,099	1,121	498	322	2,954	2,682	964	383	37	183	46	9	10,297

Note: Alberta and British Columbia figures do not include Alaska Highway or National Parks.
Totals may not add due to rounding

TABLE E-4

Distribution of Benefits Scenario B

DISTRIBUTION OF BENEFITS UNDER SCENARIO 'B'

Province or Territory	Incremental Benefits Under Scenario 'B' (4 lane Cross Canada Route) (millions 1989 $) 5% Discount	10% Discount
Newfoundland	221	130
Prince Edward Island	9	5
Nova Scotia	174	102
New Brunswick	9	5
Quebec	143	85
Ontario	167	99
Manitoba	4	2
Saskatchewan	11	6
Alberta	9	6
British Columbia	217	128
Yukon[1]	N/A	N/A
Northwest Territories[1]	N/A	N/A
TOTAL	**963**	**568**

1 There is no Scenario B in these jurisdictions

TABLE E-5

Salvage Values After 25 Years – 5% Social Discount Rate

(1989 $000)

IMPROVEMENT TYPE	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
Resurfacing	Not Applicable; Resurfacing included in user benefits												
Road Reconstruction	20,178	267	2,275	1,349	98	22,907	1,805	698	245	6,771	12,210	5,392	74,197
New Road Construction	13,796	21,622	1,240	1,517	17,574	16,922	32,574	6,318	829	2,977	1,062	0	116,429
Twinning	22,406	11,097	9,228	2,514	52,730	2,236	11,801	10,752	0	0	0	0	122,764
Interchange/ Intersection	26,429	124,292	14,617	45,007	0	12,978	50,570	20,878	1,954	0	0	0	296,725
Bridge Rehabilitation	9,927	664	6,423	8,431	13,550	1,772	207	2,052	0	3,987	2,702	295	50,010
New Structure	36,109	30,401	0	474	3,416	9,966	37,155	19,859	5,020	0	0	7,383	149,783
Drainage	148	0	0	0	0	0	0	0	0	0	0	0	148
Property	2,333	7,974	0	744	0	0	12,820	715	547	0	0	0	25,134
TOTAL	131,326	196,317	33,784	60,035	87,367	66,782	146,933	61,270	8,595	13,735	15,974	13,070	835,189

TABLE E-6

Salvage Values After 25 Years – 10% Social Discount Rate

(1989 $000)

IMPROVEMENT TYPE	BC	ALTA	SASK	MAN	ONT	QUE	NB	NS	PEI	NFLD	YK	NWT	Total
Resurfacing	Not Applicable; Resurfacing included in user benefits												
Road Reconstruction	782	10	88	52	4	888	70	27	77	262	473	209	2,943
New Road Construction	535	838	48	59	681	656	1,263	245	259	115	41	0	4,740
Twinning	868	430	358	97	2,044	87	457	417	0	0	0	0	4,758
Interchange/ Intersection	3,902	18,352	2,158	6,645	0	1,916	7,467	3,083	611	0	0	0	44,133
Bridge Rehabilitation	1,466	98	948	1,245	2,001	262	31	303	0	589	399	44	7,384
New Structure	5,331	4,489	0	70	504	1,472	5,486	2,932	1,569	0	0	1,090	22,943
Drainage	22	0	0	0	0	0	0	0	0	0	0	0	22
Property	689	2,355	0	220	0	0	3,786	211	171	0	0	0	7,431
TOTAL	13,595	26,572	3,601	8,388	5,234	5,280	18,559	7,217	2,687	966	913	1,343	94,354

APPENDIX F

Economic Impacts Summary Tables

TABLE F-1

Scenario A – Major Economic Indicators

Scenario A (General Revenue Financing)		1991	1995	2000
			% Impact	
Total Real Output		0.15	0.15	0.09
Consumption Expenditure		-0.03	0.05	0.01
Government Expenditure		0.97	1.08	1.14
- Current		0.01	0.19	0.37
- Capital		6.16	5.82	5.21
Business Investment		0.06	-0.09	-0.22
of which:				
- Nonresidential		0.06	-0.09	-0.25
Net exports	(1)	-25	-89	-119
Employment	(1)	12	6	-10
Unemployment Rate (%)	(1)	-0.08	-0.06	0.05
Wage & Salary/Employee ($C)		0.10	0.16	0.19
Output per Employee ($71)		0.05	0.12	0.20
Consumer Price Index		0.08	0.11	0.14
Disposable Income/Capita ($K)		-0.09	-0.07	-0.12
Government Balances (Mn $C)				
All Governments	(1)	-106	-236	-520
- Federal	(1)	284	288	398
- Provincial	(1)	-409	-542	-921
Current Account Balance	(1)	-57	-296	-378
Industrial Bond Rate	(1)	0.00	0.03	0.05

(1) Level Impact

TABLE F-2

Scenario B – Major Economic Indicators

Scenario B (General Revenue Financing)		1991	1995	2000
			% Impact	
Total Real Output		0.22	0.22	0.15
Consumption Expenditure		-0.04	0.07	0.03
Government Expenditure		1.36	1.51	1.61
- Current		0.02	0.28	0.53
- Capital		8.59	8.12	7.28
Business Investment		0.09	-0.12	-0.30
of which:				
- Nonresidential		0.09	-0.12	-0.33
Net exports	(1)	-35	-123	-155
Employment	(1)	14	6	-17
Unemployment Rate (%)	(1)	-0.10	-0.05	0.10
Wage & Salary/Employee ($C)		0.15	0.25	0.28
Output per Employee ($71)		0.05	0.19	0.32
Consumer Price Index		0.11	0.15	0.18
Disposable Income/Capita ($K)		-0.12	-0.09	-0.16
Government Balances (Mn $C)				
All Governments	(1)	-176	-379	-808
- Federal	(1)	316	277	341
- Provincial	(1)	-540	-724	-1222
Current Account Balance	(1)	-84	-414	-496
Industrial Bond Rate	(1)	0.01	0.04	0.07

(1)Level Impact

THE PRODUCTIVITY OF PUBLIC EXPENDITURE

GOVERNMENT CAPITAL FORMATION

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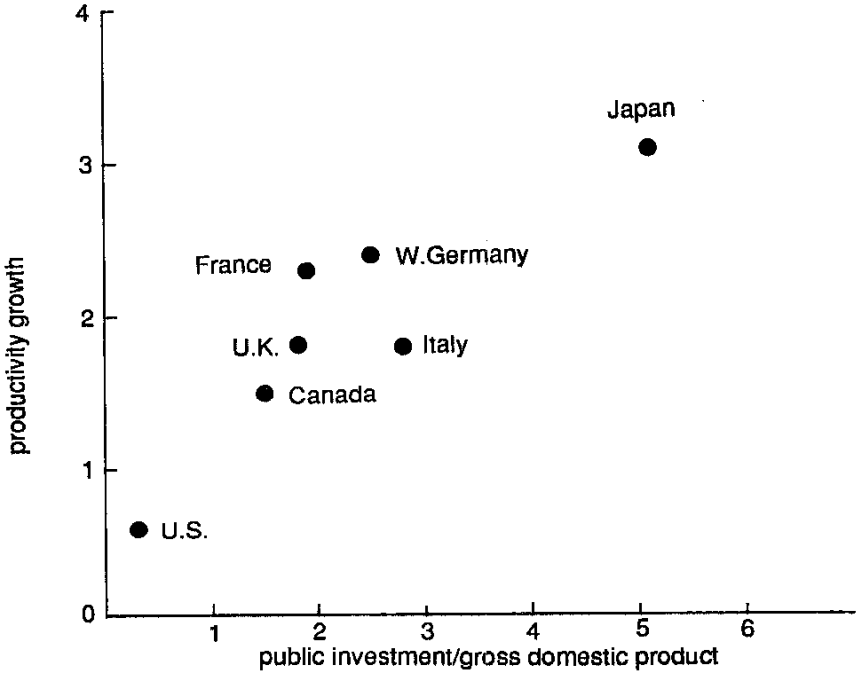
Public investment and productivity



(1) Aschauer, David, "Is Public Expenditure Productive?", Federal Reserve Bank of Chicago Staff Memorandum SM-88-7.

In some exploratory work which attempted to replicate the Aschauer results for the Canadian economy, the identical specifications yielded inappropriately high coefficients for labour and government capital. Modification to his specification provided some indications of support for his thesis in the Canadian data.

The general result of the analysis is that public capital does contribute to the productivity of private capital. Table 1 provides a summary of the principal results based on the Aschauer specification. Although the initial equation (1.1) shows the significance of government investment. The collinearity of the Canadian data results in an unacceptable negative estimate for the coefficient on private capital. The second equation (1.2) shows that, with the replacement of the general government capital variable by the engineering stock estimate, the problem is even more exacerbated. The issue may be that government capital contributes as much through its quality as its quantity. To consider this, the average age of government structures capital was introduced. This variable shows that the average age declined by about 3 years from the beginning of the sample period (1962) through to 1972 before rising by a similar amount to the end of the estimation range (1985).

THE PRODUCTIVITY OF PUBLIC EXPENDITURE

Table 1 **Dependent Variable - Output-Capital Ratio (y-k) 1962-85**

Equ.	Const.	Time	n-k	g-k	ge-k	cu	76	78	81	ADTAGE
1.1	-.9	0.0117	.44	.81		.357	.015	-.038	.011	
	(-2.9)	(7.4)	(6.4)	(16.5)		(10.7)	(2.6)	(-.66)	(1.8)	
	F-610.	SE- 0.005		RBAR - 0.99			DW 1.8			
1.2	-1.42	0.012	.16		1.16	.414	.007	-0.012	.016	
	(-4.7)	(7.6)	(2.2)		(16.4)	(12.9)	(1.3)	(2.10)	(2.6)	
	F-604.4	SE- 0.005		RBAR - 0.99			DW 1.8			
1.3	-1.04	0.007	.29		.53	.424	.010	-.010	.009	-.019
	(-3.8)	(3.5)	(4.1)		(2.5)	(16.4)	(2.2)	(2.13)	(1.7)	(-3.2)
	F-827.1	SE- 0.004		RBAR - 0.99			DW 2.2			

Variables:

y - logarithm of business real GDP
n - logarithm of business real employment
k - logarithm of business real capital
g - logarithm of government capital (G)
ge - logarithm of government engineering capital (GE)
cu - logarithm of manufacturing capacity utilization

ADTAGE - level of the average age of the government structures stock
76,78,81 - dummies for apparent anomalies in 1976,1978 and 1981
t scores are in brackets

By "qualifying" government capital by its age, the final equation (1.3) provides the most acceptable results. For a one per cent increment in the ratio of government engineering to private capital stock, this equation implies that the productivity of private capital will rise by 0.53 per cent. It should be noted that the implicit elasticity of response of output to changes in private capital is 0.18. The significance (-3.2) of the age variable adds the important qualification, to the Aschauer conclusions, that it is not just the scale of public capital that matters but rather its vintage.

APPENDIX G

Environmental Impact Overview Summary

Matrix of Program Elements vs Potential Social and Economic Effects, and Potential Natural Environmental Effects

	Elements of National Highway Program							
	Scenario "A"							"B"
	Resurfacing (9522 km)	Road Upgrading/ Reconstruction (7679 km)	New Two Lane Construction (582 km)	Twinning (3010 km) and New Four Laning (794 km)	Interchanges (229)	New Structure (127) and Rehabilitation (441)	Total Scenario "A" Program	Scenario "A" plus Four Laning to Complete System
Potential Social & Economic Effects								
Accessibility		•	•	●	•		●	●
Land Use			•		•		•	•
Agriculture		•	●	●	•		●	●
Noise			•	•	•			
Heritage			•	•	•		•	•
Aesthetics			•	•	•		•	•
Maintenance Cost	•	•	•	•	•	•	•	•
Operating Cost		•	●	●	•		●	●
Safety Components	•	●	●	●	●	•	●	●
Property Value Changes			•	•	•		•	•
Inter Provincial Travel		•	●	●	•		●	●
Potential Natural Environmental Effects								
Ground Water			•	•	•		•	•
Surface Water		•	●	●	•	●	●	●
Wetlands		•	●	●	•		●	●
Vegetation		•	•	•	•		•	•
Terrestrial Wildlife		•	●	●	•		●	●
Aquatic Wildlife			•	•		•	•	•
Air Pollution			•	•	•		•	•
Topography			•	•			•	•

Legend: blank = of no significance on majority of projects

• = may be of significance on some individual projects

● = *probably significant on majority of projects*