NATIONAL HIGHWAY POLICY FOR CANADA

The National Highway System:

Condition and Investment Needs Update 1997

Council of Ministers Responsible for Transportation and Highway Safety

NATIONAL HIGHWAY POLICY FOR CANADA

The National Highway System:

Condition and Investment Needs Update 1997

Prepared for the
Council of Ministers Responsible for Transportation
and Highway Safety

Prepared by:

National Highway Policy Update Project Steering Committee

September 1998

COUNCIL OF MINISTERS RESPONSIBLE FOR TRANSPORTATION AND HIGHWAY SAFETY

Hon. David Collenette
Minister of Transport, Government of Canada

Hon. Tony Clement
Minister of Transportation, Province of Ontario

Hon. Jacques Brassard
Minister of Transport, Province of Québec

Hon. Clifford B. Huskilson
Minister of Transportation and Public Works, Province of Nova Scotia

Hon. Sheldon Lee
Minister of Transportation, Province of New Brunswick

Hon. Harry S. Lali
Minister of Transportation and Highways, Province of British Columbia

Hon. Glen Findlay
Minister of Highways and Transportation, Province of Manitoba

Hon. Michael Currie
Minister of Transportation and Public Works, Province of Prince Edward Island

Hon. Judy Bradley
Minister of Highways and Transportation, Province of Saskatchewan

Hon. Walter Paszkowski
Minister of Transportation and Utilities, Province of Alberta

Hon. Lloyd Matthews
Minister of Works, Services and Transportation, Province of Newfoundland

Hon. Dave Keenan
Minister of Community and Transportation Services, Government of the Yukon

Hon. Jim Antoine
Minister of Transportation, Government of the Northwest Territories

NATIONAL HIGHWAY POLICY STUDY
STEERING COMMITTEE

Chairman: **Don Norquay**
Manitoba Highways and Transportation

Secretary: **John Pearson**
Secretariat, Council of Deputy Ministers

Members: **Brian Hicks**
Transport Canada

John Dyble & Jim Hester
British Columbia Transportation and Highways

Jim Sawchuk & Brian Marcotte
Alberta Transportation and Utilities

Terry Blomme
Saskatchewan Highways and Transportation

Amar Chadha
Manitoba Highways and Transportation

Bob Breeze, Ravi Girdhar & Bill Raney
Ontario Ministry of Transportation

Pierre Leblond
Ministère des Transports du Québec

Darrell Manuel
New Brunswick Department of Transportation

Ralph Spares & Kent Speiran
Nova Scotia Department of Transportation and Public Works

Gord Tufts
Prince Edward Island Transportation and Public Works

Tom Beckett
Newfoundland Department of Works, Services and Transportation

Wally Hidinger
Yukon Department of Community and Transportation Services

Masood Hassan
Northwest Territories Department of Transportation

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

In June 1997 the Council of Ministers Responsible for Transportation and Highway Safety directed that a review be undertaken of the current condition and investment needs of the National Highway System which was identified and endorsed in 1988. This review was undertaken by a Federal-Provincial-Territorial steering committee.

The key findings of the review are as follows:

- Governments have invested over $8 billion in capital improvements and $3 billion in maintenance in the National Highway System since 1988; annual expenditures on the system are currently twice the levels reported in 1988.

- In spite of this investment, the state of the National Highway System has not improved since 1988. When measured against the minimum design and operational criteria set in 1988, the length of the system with deficiencies in the areas of pavement roughness, operating speed/capacity has increased about 30%.

- The estimated cost of correcting all current deficiencies on the National Highway System is $17.4 billion (1997 dollars). Departing from the procedure used in 1989, this updated estimate includes costs associated with required capacity improvements on existing freeways which have 4 or more lanes.

- If the same methodology employed in 1989 is used, with a "four lane cap" on eligible costs, the estimated needs of the NHS have increased about 17% to about $14.8 billion dollars. However, with inflation, this estimate is relatively unchanged from 1989.

- While estimated needs have dropped slightly in eastern Canada, cost estimates in central and western Canada are generally 30 to 50% higher than the estimates prepared in 1989.

- The impacts and benefits which would be associated with an upgraded National Highway System have increased significantly, due in large part to increasing congestion on key linkages in the system. Over a 25 year horizon, the expected present value of benefits of the NHS investment program were estimated to exceed $30 billion, comprising:

    - $ 22.0 billion in travel time savings
    - $ 5.8 billion in highway safety improvements
    - $ 2.9 billion in reduced vehicle operating costs
    - $ 1.3 billion in network benefits

    The analysis predicted that the preceding benefits would be reduced by expected additional costs associated with increased hydrocarbon emissions ($ 1.2 billion), and highway maintenance ($ 0.3 billion).

- The expected net present value of investing the required capital in upgrading the National Highway System was estimated to be in the order of $13.1 billion; using a 25 year horizon for evaluation of benefits and a 5% discount rate

- Reduced congestion and improved highway standards can be expected to reduce the number of fatal traffic accidents by up to 247 per year and injury accidents by up to 16,000 per year.

- Reducing congestion and improving the level of service provided by the NHS is expected to reduce fuel consumption by up to 236 million litres per year, although hydrocarbon emission levels are not expected to change significantly.

- A review of literature and international experience provides strong evidence that investments in highways can generate significant productivity growth and support economic development.

- Canada's annual productivity growth has been steadily declining since the 1960's, dropping from 2.4% during the period 1960-69 to -0.08% from 1990-96.

- In an era of "just-in-time" delivery and receiving systems, there is compelling evidence in the literature that increasing the reliability of the highway system can provide significant benefits and productivity gains for industry.

- Investments in new or improved highways can support productivity gains in three ways:

  Reducing Costs - New or improved highways can reduce the costs of acquiring raw materials and delivering goods to markets.

  Securing Inputs - Better highways may allow access to higher quality inputs, possibly improving the quality of outputs.

  Reaching Markets - Improved highways can facilitate access to wider markets which were not previously viable.

- The findings of the reviews of the literature and international experience go far in explaining why nations which are major competitors of Canada are allocating increased funding to highway construction and maintenance to support economic growth.

1. BACKGROUND

The concept of a National Highway Policy for Canada has been under active consideration and discussion by the Council of Ministers Responsible for Transportation and Highway Safety since 1988. Through the mechanism of a federal -provincial - territorial steering committee and cooperative studies, consensus has been achieved on the essential elements of a national highway transportation policy;

- eligibility criteria for roads to be included on the National Highway System
- a defined National Highway System based on these criteria
- minimum (and to some extent maximum) standards for design, construction, operation and maintenance of this system

An assessment of the cost implications of adopting a national policy based on these elements was carried out in 1989 by aggregating estimates prepared by each of the federal, provincial and territorial transportation departments for their respective portions of the system. It was determined that in the order of $13 billion would be required to correct the deficiencies which existed at that time in the roads which form the designated National Highway System.

In support of consensus development, additional studies were also carried out on:

- the impacts on Canada's economy of undertaking an NHS upgrading program
- the benefits to highway users of an upgraded NHS
- the approaches used by other countries to manage and fund their highway systems in general, and their National Highway systems in particular
- the reaction of industrial sectors to the need for a National Highway System

In 1991 the steering committee was directed to examine and recommend solutions to three key issues:

1. An appropriate and sustainable means of funding the National Highway System
2. An appropriate cost sharing formula between the federal and provincial/territorial governments for capital works on the National Highway System
3. An effective and equitable mechanism for implementation of a National Highway Policy

The committee's report and recommendations on these issues were presented to the Ministers in September 1992, thereby completing the mandate of the National Highway Policy Study.

Since 1992 discussions of a National Highway Policy have continued in a variety of fora, however no additional nationally based, cooperative studies have been undertaken. In June 1997 the Council of Ministers directed that work be undertaken to provide updated information on the condition, needs and economic implications of the National Highway System.

2. THE NATIONAL HIGHWAY POLICY STUDY - HIGHLIGHTS OF FINDINGS OF PREVIOUS PHASES

2.1. Overview

The National Highway Policy Study for Canada was launched by the Council of Ministers Responsible for Transportation and Highway Safety in September of 1987, with the goals of:

- identifying future needs and defining standards for a Canadian primary highway system of national significance

- establishing the benefits and costs of meeting these needs

- establishing funding alternatives for meeting these costs with a view towards recommending adoption of a national policy by their governments

To meet these goals a multi-phased study was proposed and representatives of the provincial, territorial and federal transportation ministries were appointed to a steering committee charged with carrying out the study.

The first phase of the study, completed in 1988, was used to develop broad highway policy objectives, to identify a national highway network, to establish design and operational standards for these highways, and to inventory the nature and condition of the identified network.

The second phase of the study, completed in 1989, assessed the costs of achieving the established highway design and operational standards. These costs were placed within a framework of highway user benefits and the wider economic, social and environmental impacts anticipated from an improved national highway system. As well, these costs and benefits were placed within the context of existing highway revenues and expenditures.

The third phase of the study was completed in 1990, and was used to initiate sectoral consultation on the early results of the study and to review other country's experience in the provision of highways, with particular reference to national highway systems.

The fourth phase of the study, completed in 1992, addressed a range of technical issues on which consensus among all jurisdictions would be required before a cooperative national policy and program could be initiated. These included:

- establishment of a framework for priority setting within the identified needs of the system,
- preliminary estimates of cash flow requirements and work types initiated within the first three years of an upgrading program
- elaboration of the design and maintenance standards which should apply to routes on the National Highway System
- expenditure types which should be eligible for cost sharing should cooperatively funded upgrading programs on the National Highway System be initiated

A supplement to the report on Phase 4 was prepared in 1993 which evaluated a number of potential funding options for upgrading the National Highway System, and included recommendations for allocation of pooled funding to jurisdictions for upgrading projects.

Reports on each of the four completed phases of the National Highway Policy Study are available from the Secretariat for the Council of Ministers Responsible for Transportation and Highway Safety.

2.2. Findings and Conclusions of Previous Studies

2.2.1. National Highway System Definition

In 1988 a National Highway System was identified and endorsed which comprises 25,000 kilometres of important interprovincial and international linkages within the existing network of highways. The criteria which were used to identify the system included:

> *Existing, primary routes that provide for interprovincial and international trade and travel by connecting as directly as possible a capital city or major provincial population/commercial center in Canada with:*
>
> *- another capital city or major population or commercial center*
> *- a major port of entry or exit to the USA highway network*
> *- another transportation mode served directly by the highway mode*

While the identified system constitutes less than 3% of the total network, it was estimated that over 25% of all highway travel takes place on the National Highway System.

2.2.2. Design and Operational Standards

Four design and operational standards were established as minimum criteria which should be met by all routes on the National Highway System, as follows:

> **Geometric Design -** As a minimum, the highway should have a design standard of two-lane, arterial, undivided with full shoulders (0.8 m paved shoulder and a 100 km/h design speed minimum).
>
> **Serviceability (Capacity) -** The highway should be capable of providing an 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.

2.2.3. System Condition

The condition inventory prepared in 1989 revealed that 25% of the National Highway System was built to divided, multi-lane highway standard, with the majority being paved, two lane highways.

When evaluated against minimum acceptable standards for design, service, strength and surface condition, 38% of the system was found to be deficient, and 790 of the 3,534 bridges were in need of major strengthening or rehabilitation.

2.2.4. Cost Estimates to Correct Deficiencies

In 1989, the cost of correcting the identified deficiencies was evaluated on two bases:

Scenario A - Cost Estimate: $13 billion
The costs of correcting the identified deficiencies and upgrading, where necessary, to a minimum two lane paved highway standard, and with a cap on expenditures at a four lane divided highway standard.

Scenario B - Cost Estimate: $ 18 billion
The costs of Scenario A plus the costs of completing a continuous four lane, east-west routing across Canada.

2.2.5. Economic and Highway User Impacts

In support of the policy and program development, in 1991 studies were also completed on the economic impacts of a capital works program to correct the deficiencies, the benefits to highway users of an upgraded system and a review of the expected environmental impacts

Highlights of the findings of these studies included:

- employment in the construction and related sectors would be expected to increase between 146,000 person-years (Scenario A) and 205,000 person-years (Scenario B) during a ten year program
- the economy could be expected to grow as a result of the program
- improved market accessibility and trade competitiveness for Canadian industry would be achieved in both east-west and north-south corridors
- increased tourist travel could be expected within Canada
- an improved highway system would provide benefits to highway users in all regions of the country, including:
  - a reduction in vehicle operating costs by $360 million annually
  - a reduction in travel time by 46 million person hours annually
  - a 4% reduction in current annual traffic fatalities by (160),
  - a reduction in personal injury accidents by 2300 annually
- minimal social and natural environmental impacts would be expected because the construction would be primarily on existing highway alignments

2.2.6. Stakeholder Consultation - Public and Industry Response

As a component of the third phase of the study, invitations to comment on the National Highway Policy Study and its Phase 1 and 2 reports were extended to national and industry association groups. In general, there was a strong expression of support for a National Highway Policy from highway user groups and industry sectors dependent upon highway transportation. The concept of user pay was also generally supported provided:

- all existing road use taxes are applied to road needs
- any new road use taxes are dedicated to road needs

The estimated impacts and benefits of an improved National Highway System were judged to be reasonable or understated by the groups which responded.

2.2.7. International Context

A review of international experience undertaken in 1991 revealed that Canada is one of a very few countries in the developed world without a national highway policy or program for major highway links, and is virtually alone in not having significant national government participation in support of national highway transportation infrastructure.

Canada's level of capital and maintenance investment in highway infrastructure has consistently been among the lowest of OECD member countries. In the context of North American trade, the United States has historically been spending about six times as much per kilometre on its Interstate System as the Canadian provinces and territories have on the National Highway System.

The priority placed by the United States on investment in, and renewal of, key highway linkages has been further strengthened with the recent passage of the Transportation Equity Act for the 21st Century (TEA-21). This funding authorization bill will result in $175 billion invested by the federal government in highways over a six year period, representing a 46% increase over recent annual investment levels.

3. NATIONAL HIGHWAY SYSTEM - 1997 UPDATE

3.1. Introduction and Update Study Overview

In June 1997 a cooperative project was initiated by the Council of Ministers to prepare and assemble updated information on the state of the National Highway System and to prepare updated cost estimates to meet the defined minimum standards agreed to in 1988.

In addition to preparing updated condition inventories and estimates of investment needs for the National Highway System, supplementary studies were also undertaken on:

- the impacts and benefits for highway users which would be associated with an upgraded National Highway System, and

- a review of available literature and international experience on the relationships between the state of highway infrastructure, the competitive position of transportation dependent industries and economic productivity and growth

These reports were prepared by consultants under the direction of the steering committee and are available from the Secretariat for the Council of Ministers Responsible for Transportation and Highway Safety.

3.2. National Highway System Inventory

To maintain comparability with previous work, no changes were made to the routes designated as part of the National Highway System during this review. The detailed listing of NHS routes appears in Appendix 1.

3.2.1. Design Standards

In 1988, 75% of the National Highway System was 2 lane roadway, with the remaining 25% being four or more lanes. By 1997 over 1100 km of highways had been upgraded to four or more lanes, raising the percentage of multi-lane highways within the system to over 30%.

National Highway System - 1988 vs 1997

	Two Lane	**Multilane**
1988	18,294 km	6,203 km
1997	17,145 km	7,315 km

3.3. Investment in the National Highway System

Between 1988 and 1996 over $ 8.1 billion in capital expenditures was invested in roads on the National Highway System by the provinces and territories. In addition, nearly $ 3 billion was spent over the same period for maintenance of the system.

Figure 1: Annual Investment in the National Highway System 1988-1996

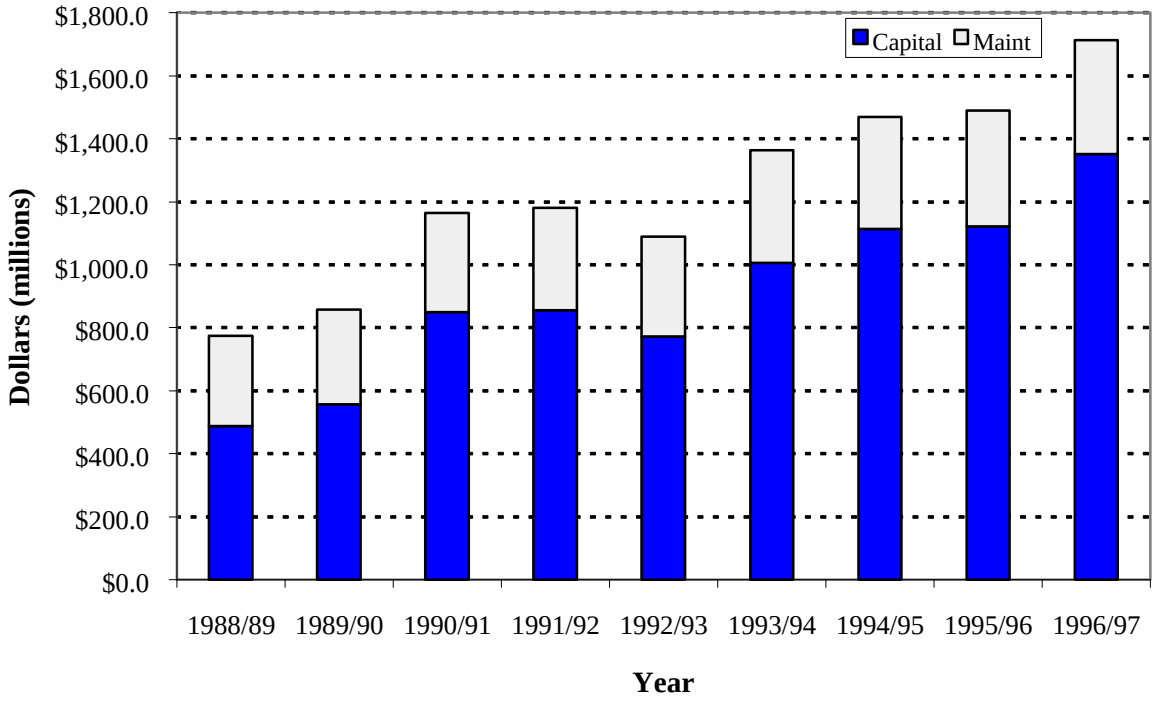
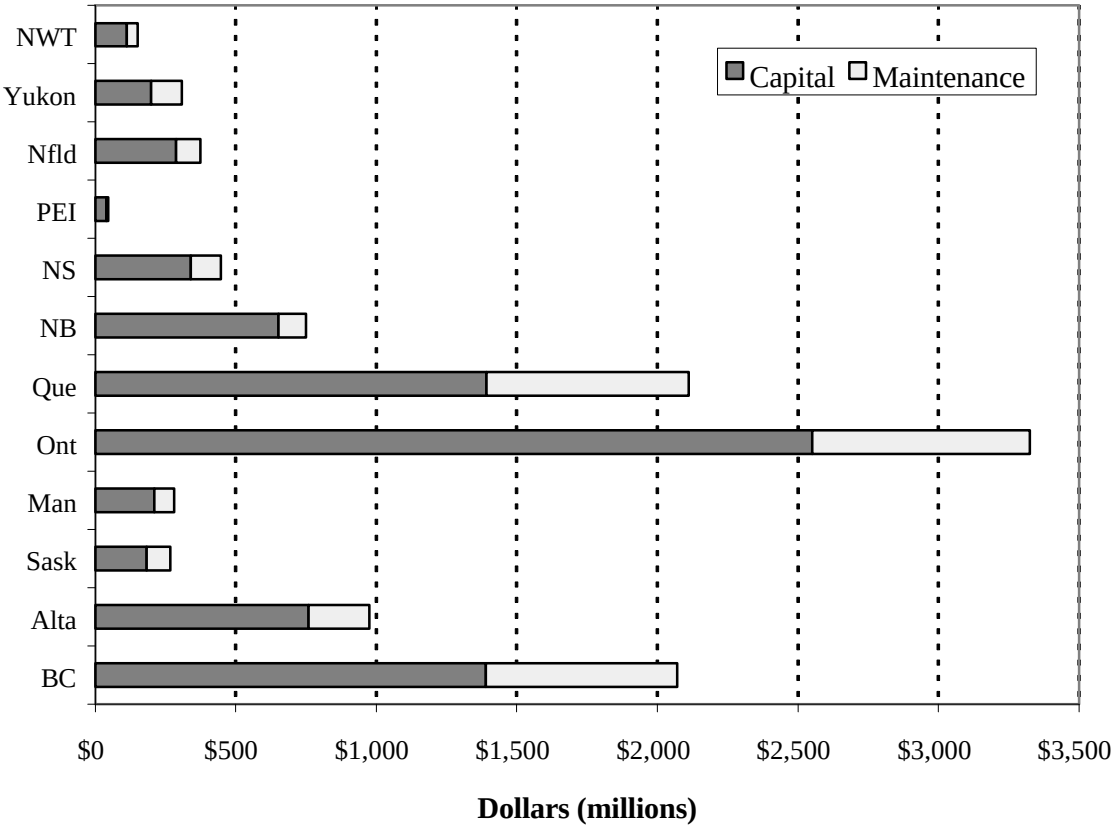


Figure 2: Investment in the National Highway System by Jurisdiction 1988-96



3.4. Condition of the National Highway System

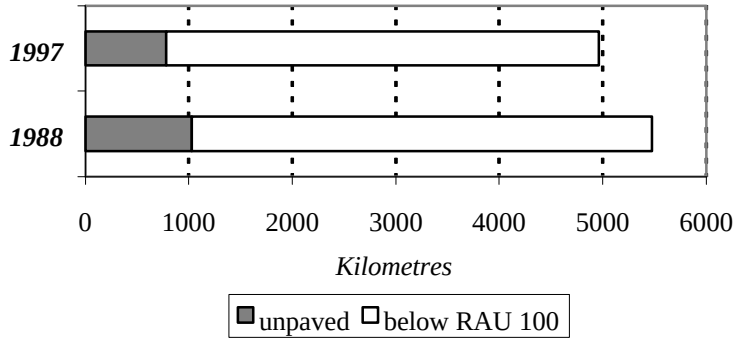
Phase 1 of the National Highway Policy Study completed in 1989 proposed four specific minimum design or operational standards which should be met by all routes on the National Highway System. These standards provide a basis for describing deficiencies in the condition of the NHS, and also serve as guiding objectives for jurisdictions in choosing appropriate remedial measures to correct the identified deficiencies.

3.4.1. Criteria 1 - Minimum Geometric Design Standard

In 1988 it was agreed that the minimum standard which should be met by all routes on the National Highway System should be a two lane paved road with partially paved shoulders, with a design speed of 100 km/h. (RAU 100)

In 1988 over 5600 km or 23% of the NHS was below this minimum standard, including over 1000 km of unpaved road. By 1997 approximately 5000 km of the NHS (20%) remained below this minimum standard, although the length of unpaved roads had fallen to less than 800 km.

Figure 3: Length of NHS below Minimum Desired Geometric Design Standard



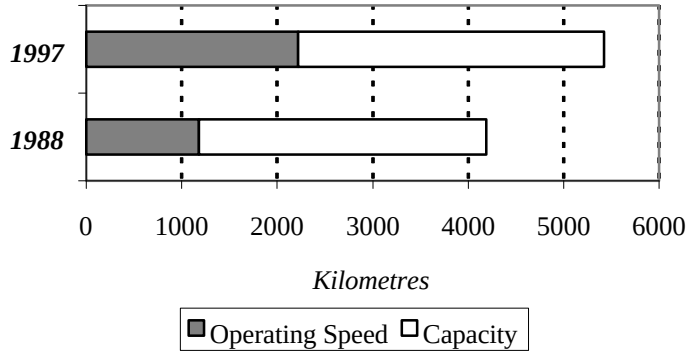
3.4.2. Criteria 2 - Operating Speed and Capacity

In 1988 it was agreed that routes on the National Highway System should provide a minimum operating speed of 90 km/h, in recognition of the role played in support of efficient interprovincial and international transportation.

The condition inventory undertaken in 1988 indicated that approximately 4200 km of the NHS was either operating below the minimum desirable speed of 90 km/h or required upgrading to increase capacity.

By 1997 capacity deficiencies had increased by 25%, with over 5300 km of the system reported as being below standard.

Figure 4: Length of NHS with Capacity or Operating Speed Deficiencies

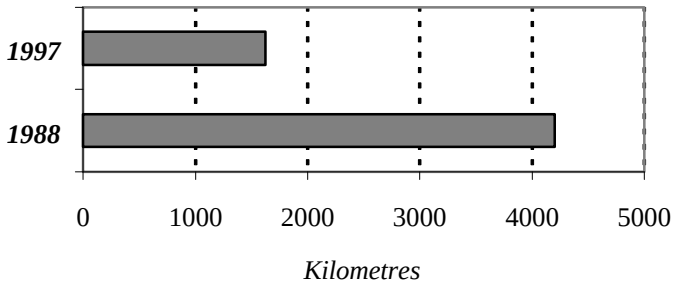


3.4.3. Criteria 3 - Structural Adequacy Strength and Condition

The third criteria stipulates that routes on the National Highway System should be capable of providing all weather service (ie. no seasonal load restrictions) and must be capable of carrying the national standards for heavy vehicle axle and gross weight limits.

In 1988 4200 km of the network required upgrading of pavement strength to meet the national truck weight limit requirements. Considerable progress appears to have been made towards correcting this type of deficiency, with a 62% reduction in the length of the system which requires upgrading (~ 1600 km).

Figure 5: Length of NHS with Structural Capacity Deficiencies



3.4.4. Criteria 4 - Rideability (Road Roughness)

The fourth criteria addresses the need to ensure that routes on the NHS provide appropriate level of service and comfort to highway users. Using "road roughness" as the means of addressing this criteria, it was agreed that routes on the NHS should be maintained to provide a Riding Comfort Index (RCI) of no less than 6.0. In addition, for both comfort and safety reasons, it was agreed that pavements should not have unacceptable levels of rutting in the wheel paths.

In 1988 approximately 5200 km of the system was found to be below the acceptable standard for pavement roughness (Riding Comfort Index). By 1997 the length of deficient network had increased by 30% to nearly 6900 km.

Figure 6: Length of NHS with Pavement Roughness Deficiencies

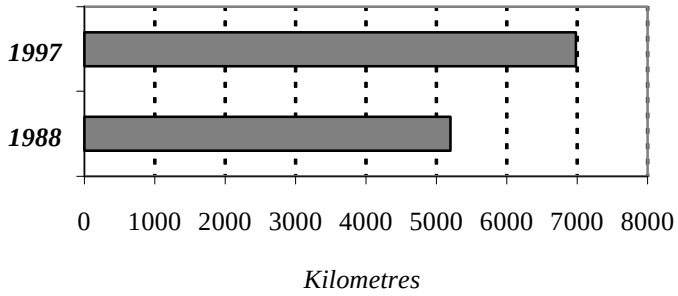
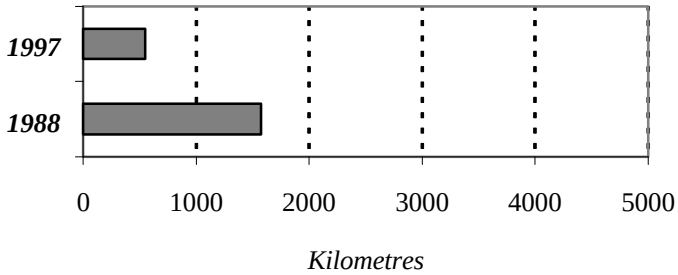


Figure 7: Length of NHS with Pavement Rutting Deficiencies



3.4.5. Bridges

In 1988 the condition survey showed that 182 bridges on the NHS had weight restrictions below the national standards for truck weights. The updated condition survey undertaken in 1997 indicates that the strength deficiencies appear to have been largely addressed, with only 10 bridges reported as remaining with weight restrictions.

3.5. Cost Estimates to Correct National Highway System Deficiencies

Cost estimates were prepared by each jurisdiction to correct the deficiencies described in the previous section, consistent with the approach taken during the original work on the National Highway Policy Study. The underlying assumptions used to develop these estimates included:

- the cost estimates are based on remedial measures or upgrading necessary to correct deficiencies which existed in 1997

- the choice of an appropriate remedial measure or upgrading strategy is based on a projection of demand for a ten year horizon

- costs of increasing capacity beyond a four lane freeway standard (RAD 130) are not included

In 1989 two upgrading scenarios were examined:

***Scenario A*:** the costs or correcting all identified deficiencies on the NHS, using the preceding assumptions

***Scenario B*:** the costs associated with Scenario A modified to include the costs of completing a continuous east-west four lane routing across Canada

For the purposes of the simplifying the depiction of the current state and needs of the National Highway System, condition and cost updating and impact analysis was restricted to Scenario A. Cost estimates were prepared using a common set of worktypes as follows:

1. ***Resurfacing*** - overlay of existing pavements

2. ***Reconstruction or Road Upgrading*** - improving existing roadway by strengthening, minor widening, new shoulders, addition of passing or truck climbing lanes etc.

3. ***New Construction*** - any new construction of intersections or two-lane bypasses, but excluding any four or more lane construction

4. ***Twinning and New Four Lane Construction*** - 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 Structures or Structure Rehabilitation*** - construction of new bridges or overpasses or major improvements including strengthening or widening of bridges or overpasses

3.5.1. Cost Breakdown by Worktype

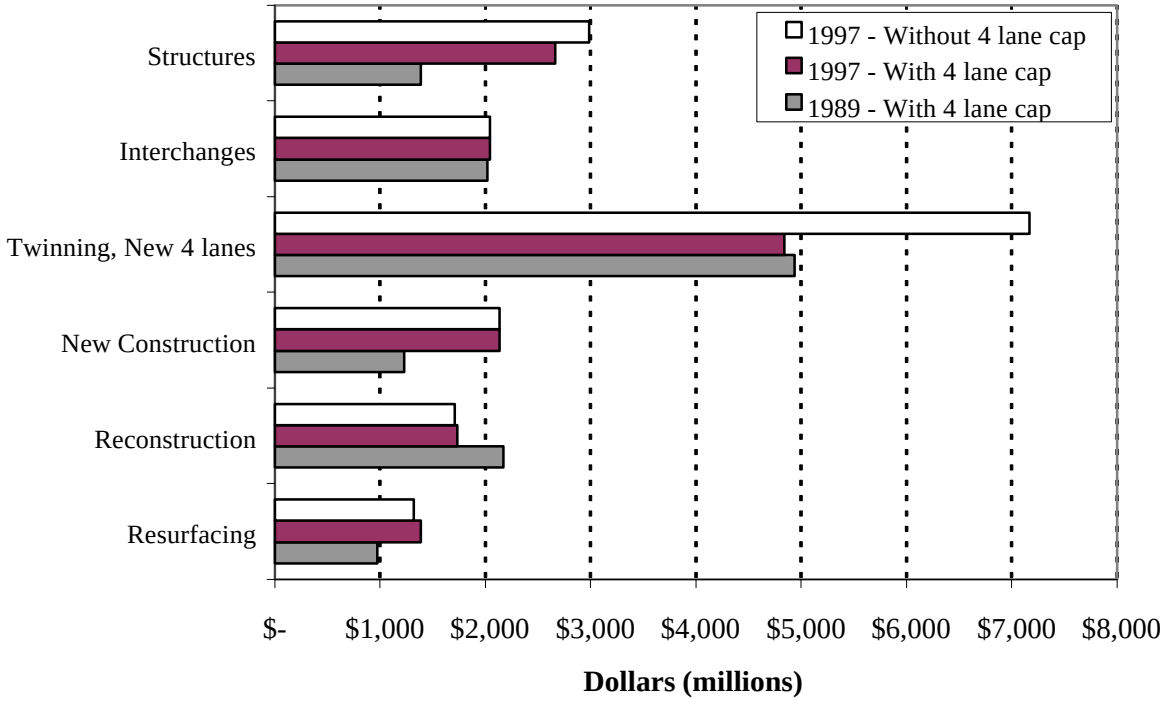
In 1989 it was estimated that nearly $13 billion was required for capital improvements to meet the minimum standards defined under the National Highway Policy Study. In 1997 this estimate has increased by 17% to about $15 billion. If the effects of inflation are considered, the investment needs are essentially unchanged

Both of these estimates were prepared using the assumption that costs which would be required to increase the capacity of routes on the NHS beyond a four-lane divided freeway standard would not be included (referred to as a "four lane cap" on cost estimates). The objective of this constraint was to limit the types of costs required to upgrade the NHS to those directly associated with serving long distance (ie. primarily interprovincial or international) traffic. Conceptually, this assumption infers that capacity requirements in excess of four lanes are based on demands from local and commuter traffic.

While this assumption does attempt to provide a cost estimate of system upgrades required to serve the needs of interprovincial and international traffic, it understates the true costs of achieving the minimum standards and level of service sought from the NHS. While congestion on NHS routes which pass through urban areas may be primarily attributable to local traffic, long distance traffic is equally and adversely affected. Consequently, in 1997 a second cost estimate scenario was developed by removing the "4 lane cap"; providing a total estimated need of $17.4 billion.

While, in aggregate and with the "4 lane cap" on eligible expenditures, the cost estimate to bring the NHS up to standard has not changed significantly since 1989, the nature of deficiencies and work required has changed markedly. As illustrated in the figure which follows, while the estimated needs for interchanges, twinning and reconstruction have declined, the cost estimates for structures and new construction have increased substantially.

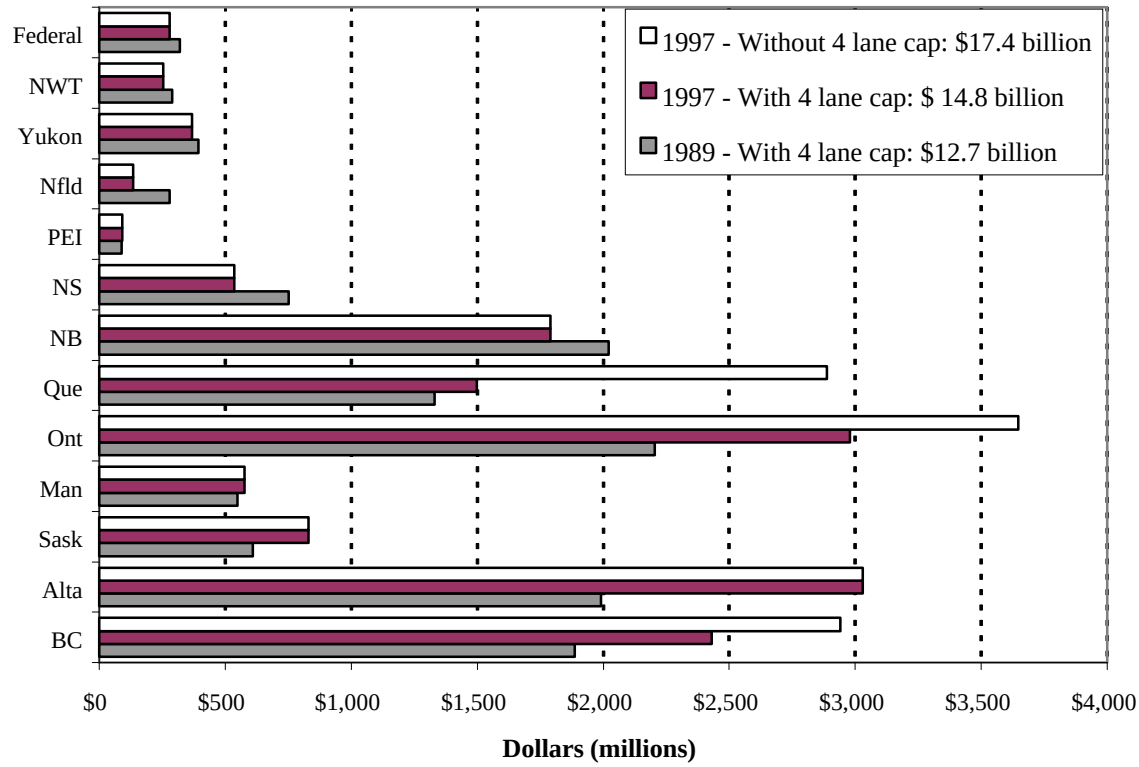
Figure 8: Cost Estimates to Upgrade the NHS by Worktype



3.5.2. Review of National Highway System Investment Needs by Jurisdiction

Overview
As illustrated in Figure 9, cost estimates have decreased in Atlantic Canada, the northern territories and for federally owned roads since 1989. The aggregated estimate for Atlantic Canada is nearly 20% lower in 1997 than in 1989, reflecting the priority which has been accorded to highway development over the past 8 years.

Figure 9: Cost Estimates to Upgrade the NHS by Jurisdiction



As would be expected, removal of the "4 lane cap" on eligible costs results in much higher estimated needs in Ontario, Québec and British Columbia. However, it should be noted that even with the "4 lane cap" applied, cost estimates in Ontario and British Columbia are 30 to 50% higher than in 1989.

Cost estimates through western Canada are also 30 to 50% higher than in 1989, with the exception of Manitoba where needs have increased risen only 5%.

British Columbia
The changes in the estimated costs of upgrading the NHS in British Columbia are a reflection of continued and increased deterioration of the infrastructure over the past ten years, coupled with modest increases in the cost of construction.

Alberta
The estimated costs of achieving the minimum standards called for by the National Highway Policy have increased significantly over the past ten years in Alberta due to:

- the number and costs of interchanges needed have increased substantially, in large part due to extensive developments along the highway

- substantial increases in traffic on the North/South Trade Corridor as a result of NAFTA requires the routing to be twinned, at considerably higher cost

- construction costs have increased by about 25% over the past ten years in Alberta

- the high priority placed on deficit reduction by the government of Alberta over the past several years resulted in reduced expenditures on highways and an increase in the backlog of roads and bridges requiring rehabilitation/reconstruction.

Saskatchewan
The increased cost estimate for upgrading of the National Highway System in Saskatchewan is due to:

- inflationary costs have increased construction costs
- costing of capacity and free-flow improvements in and around major cities
- full costing of the pavement resurfacing life-cycle costs

Manitoba
The increase in estimated cost is largely due to the need to combat the aging state of the NHS in Manitoba. While the twinning requirement has decreased from $139 million in 1989 to $105 million in 1997, the resurfacing component has increased from $43 million in 1989 to $111.6 million in 1997. Other differences are effects of inflation or changes in construction costs for the work-type needed.

Ontario
Over the period 1989 to 1997, construction costs for highway improvements on Ontario's portion of the National Highway System (NHS) have increased by over 30% with the "4 lane cap" applied, and 65% with the cap removed, due to the following reasons.

- First, inflationary costs have had an incremental effect on all components of construction.

- Second, the highway system in Ontario has deteriorated as more kilometres of roadway and number of bridges are in poorer condition than they were in 1989. In addition work on some highways requires a more expensive solution than was previously estimated. Overall, the cost for rehabilitation has increased.

- Third, initial estimates for expansion work reflected costs based on a typical per kilometre basis. Pre-engineering for specific projects has since been updated to more accurately reflect the cost of construction along selected alignments (i.e. Highways 69 and 17). In addition, little

expansion has taken place during the 10 year period. (This component accounts for the remaining 50% increase).

Québec
With the "four-lane cap" on eligible costs applied, the estimates for upgrading the National Highway System in Québec have increased from $1.33 billion in 1989 to $1.5 billion in 1997. Removal of the cap causes the estimated needs to increase to $2.9 billion. These increases can be attributed to the following reasons:

- High rates of spending on road infrastructures since 1988 have contributed to the improvement of conditions on Québec's portion of the National Highway System. This has resulted in a net reduction of the costs estimates for all the types of work, except for those required ($1.2 billion) to correct road congestion problems in the region of Montréal. The cost estimates to relieve road congestion are only included in the scenario without the "four-lane cap".

- A considerable number of bridges have inadequate vertical clearance to meet the minimum standard called for on the NHS, which would require in excess of $1 billion to correct.

It is also important to note that the total cost estimate of $1.5 billion does not include the cost of work which would be required to increase the structural capacity of routes within Québec which are subject to weight limit reductions during the spring thaw period.

New Brunswick
Since 1989, New Brunswick has undertaken a major highway construction program with emphasis on the National Highways within the Province. This effort has addressed some of the needs identified in 1989, however, a substantial amount of work remains to be accomplished to alleviate the remaining deficiencies which, for the most part, involves construction of new highway alignments. A high level of effort to address environmental, land use and other impacts will be required for future projects.

Nova Scotia
The 1997 Nova Scotia construction requirements of $538 million is 29% lower than reported in 1989. This is attributed to an aggressive program to address highway capacity needs through the construction of new highways, twinning and interchange construction. The 1997 proposed program will continue the work identified in 1989, primarily four-laning sections of the NHS which do not provide the required serviceability and upgrading the remainder of the system to a two-lane controlled access system. The 1997 estimate also includes a significant resurfacing component, as this information was unavailable in 1989.

Prince Edward Island
Changes in the estimated costs of upgrading the NHS in PEI are primarily due to the effects of inflation or changes in construction costs for the work-types needed.

Newfoundland and Labrador
The significant decline in dollar needs for upgrading of the NHS in Newfoundland is the result of annual expenditures in excess of $30 million over the past 10 years. These funds were obtained from the Newfoundland Transportation Initiative which funded highway upgrading subsequent to the closure of the Newfoundland railway.

Northwest Territories
A portion of the National Highway System in the NWT has been upgraded (through reconstruction, widening and paving) since 1989. As a result the needs have decreased by 12 %.

Yukon
The 1989 and 1997 estimates are very similar in aggregate, but this masks some major changes in the NHS in the Yukon. Reconstruction needs have dropped from $340 million to $176 million. A major factor in this drop is funding by the US government ($89 million US) for Alaska Highway improvements. Resurfacing has increased from $7.8 million to $15 million representing the aging of the system since 1989. Other differences are primarily due to the effects of inflation.

4. ECONOMIC IMPACT ASSESSMENTS

4.1. Impacts and Benefits for Highway Users

4.1.1. Study Scope and Objectives

The objective of this study was to prepare an aggregated, national level estimate of the range of impacts which could be expected as a result of upgrading the condition and/or standards of the National Highway System, from the perspectives of highway users and for the safety of the system as a whole. The work was undertaken by Hickling Lewis Brod Inc. using a computer based benefit cost assessment model, *StratBENCOST,* to estimate the benefits and impacts which would result from upgrading the entire National Highway System.

The cost estimates and upgrading program used as the basis for this analysis was the $ 17.4 billion "uncapped" scenario, which included expansion projects for freeways with four or more lanes. This approach was adopted to allow the analysis to assess the full benefits which would be realized as a result of overcoming all existing deficiencies on the National Highway System relative to the minimum desired design and level of service standards outlined previously.

It should be noted that the $ 17.4 billion estimate includes the costs of correcting *existing* deficiencies. New deficiencies can be expected to arise each year, for example as pavement condition degrades on sections which currently meet the standard, or as traffic increases on sections of the NHS. The costs of correcting new deficiencies which will likely occur over the twenty five year analysis period have not been included.

The full study report is available from the Secretariat for the Council of Ministers Responsible for Transportation and Highway Safety.

4.1.2. Key Findings

Assumptions

To provide a common and simplified basis for assessing the impacts of the wide range of projects which would be required across Canada in upgrading the National Highway System, the analysis was based on the following assumptions:

- all upgrading work would be completed on the National Highway System within the first year
- the benefits and impacts would be evaluated over a twenty-five year horizon

While it is clearly unrealistic to expect that all upgrading could be carried out in one year, as a basis for analysis, this assumption eliminated the need to develop a schedule of projects over a longer time horizon. In addition, this approach provided a fixed horizon for assessment of benefits.

The results of the analysis are depicted as a range within an 80% confidence interval. While this infers that the actual outcome will be within the bounds of this range, risk management tools and implementation strategies can be used to guide the outcome within the range.

Impacts and Benefits of the NHS Improvement Plan
The reduction in congestion and general improvement of travel conditions on the National Highway System would expected to yield the following annual impacts:

Table 1: Annual Impacts of Upgrading the National Highway System

Benefits Category	***Range (80% confidence interval)***
Annual Reduction in Travel Time	73 - 97 millions of hours
Annual Reduction in Fuel Consumption	114 - 236 millions of litres
Annual Reduction in Fatal Accidents	(52) - 247 accidents
Annual Reduction in Injury Accidents	3,413 - 16,012 accidents
Annual Reduction in Property Damage Accidents	4,280 - 17,489 accidents
Annual Increase in Hydrocarbon Emissions	2.0 - (0.6) millions of tonnes

In economic terms, the present value of these benefits is estimated to be in the range of $17 billion to $46 billion.

A significant portion of the benefits of upgrading the National Highway System are realized as travel time savings (from $18 to $26 billion). In addition, between $1.4 and $4.4 billion is expected to be saved in reduced vehicle operating costs and between $0.5 and $15.3 billion as a result of improved highway safety.

While an upgraded National Highway System would be expected to reduce required maintenance expenditures on some linkages, on the whole, a net increase in required highway maintenance outlays of between $163 and $381 million would be expected over twenty five years.

Network Benefits and Canadian Productivity
For Canadian industry, the estimated weighted average mark-up of productivity benefits over user benefits is 36 percent. Since goods movement over the NHS accounts for about 8.33 percent of vehicle kilometers of travel, and the value of time for truck travel is 1.48 times the value of time for auto travel, and total estimated user benefits are in the range from $17 to $46 billion (shown earlier), the NHS investment program would be expected to generate between $ 0.8 and $ 2 billion in the form of accelerated productivity growth.

Input Costs
The costs of the National Highway System improvement plan used in this analysis include capital outlays required to upgrade the system, and associated net increases in maintenance costs required over a 25 year forecast horizon.

Table 2: Benefits and Costs of the NHS Improvement Plan 1998 - 2022

	Present Value in Millions of 1997 $[1]
Benefits Category	***Range (80% confidence interval)***
Travel Time Savings	17,833 - 26,493
Vehicle Operating Cost Savings[2]	1,384 - 4,417
Safety Savings[3]	514 - 15,285
Emissions Savings[4]	(2,248) - (226)
Highway Maintenance Savings	(163) - (381)
Total User Benefits	**17,102 - 45,806**
Network Benefits	**759 - 2,035**
Total Benefits	**17,861 - 47, 841**
Capital Costs	17,370
Total Costs	**17,370**
Net Benefits	**491 - 30, 470**

Notes:

1. All present value calculations based on a real 5% discount rate
2. Vehicle Operating Cost Savings include fuel & oil consumption, tire wear, maintenance and repair and depreciation savings.
3. Safety savings include savings from reductions in number of fatalities, injury accidents and property damage accidents
4. Emission savings include savings from reductions in HC, CO and NOX emissions

Study Conclusions

In summary, the Net Present Value of the NHS improvement plan is expected to be (with an 80% confidence interval) between $0.5 and $30.4 billion.

The evaluation of the proposed National Highway System indicates with high probability that this is a worthwhile investment for the Canadian economy. The benefits of the national system, as measured by conventional transportation benefits, far exceed the cost of building the system. There is only a remote probability that the system would not earn a minimum rate of return of 5% in constant dollar terms.

The analysis indicates that renewed investment in the National Highway System represents a fundamental and veritably riskless part of any strategy to recapture the major losses in productivity growth suffered by Canada over the past two decades. This study finds that the public infrastructure component of such a strategy offers the promise of returns well in excess of the front-end investment costs and ongoing maintenance needs of the NHS.

4.2. The Economic Context of the National Highway System - Review of Literature and International Experience

4.2.1. Study Objectives and Scope

The primary objective of this study was to prepare an annotated bibliography of relevant international experience, available literature and studies in a form which:

- describes the context of the reports and/or studies which were undertaken
- highlights the key findings of the work
- provides an assessment of the relevance of the findings to Canada

The work was undertaken by Apogee Research/Hagler-Bailly. The full report, an Executive Summary and an annotated bibliography are available from the Secretariat for the Council of Ministers Responsible for Transportation and Highway Safety.

4.2.2. Key Findings

Productivity Growth

The Canadian, U.S., and international literature provides strong evidence that investments in highways can generate productivity growth. These studies tend to suggest that a 1% increase in highway availability (i.e., the capital stock) could generate up to a 0.6% increase in business productivity. Research from the U.S. also shows that highway investments can provide annual returns of 10% - 40%.

While the literature is consistent in linking productivity growth to economic strength, average annual manufacturing productivity growth in Canada has declined since the 1960s:

Table 3: Annual Productivity Growth in Canada

1961 - 1969	2.39%
1970 - 1979	1.22%
1980 - 1989	0.56%
1990 - 1996	-0.08%

Economic Development Benefits

Investments in highways can play a critical role in regional development, particularly for remote, frontier, and resource-based regions. Highway investments allow remote regions to capitalize on resource endowments by providing access to raw resources and goods markets, thereby generating jobs and growth.

Other Benefits

The literature also suggests that investments in highways can generate a more efficient economic structure, improve a nation’s balance of trade, and support a wide range of other user and social benefits such as safer highways and improved mobility and accessibility.

Upgrading Canada's National Highway System
Estimates of the macroeconomic impacts of improving Canada's National Highway System were made in the past using input-output and general equilibrium modeling. Other techniques are available to provide a more detailed picture of impacts on business at the micro-level, notably case studies. Similarly, techniques are available to describe the macro-level benefits of highways and highway investments, specifically production and cost function approaches, which were largely untested at the time of the original *National Highway Policy for Canada Study*.

Not included in past NHS impact assessment studies, but of growing interest in the literature, are the implications of improved highways for business productivity and competitive position. This research has demonstrated that investments in new or improved highways can support productivity growth in at least four ways:

- *Reducing Costs* — New or improved highways can reduce the costs of acquiring raw materials and delivering goods to markets.
- *Securing Inputs* — Better highways can allow access to higher quality inputs, possibly improving the quality of outputs.
- *Reaching Markets* — Improved highways can facilitate access to wider output markets which were previously not viable.
- *Business Decisions* — Better highways can fundamentally change the way business is structured and operates.

Investigative Techniques
Two families of techniques have been applied to investigate the impacts of highway spending: [i] macro-approaches including regression models, input-output analysis, and general equilibrium analysis; and [ii] micro-approaches including cost-benefit analysis and case studies. Each of these approaches brings with it individual strengths and weaknesses.

Investigative Outputs
The techniques for investigating the impacts of highway investments tend to be adopted for different purposes. Macro-approaches provide the most valuable information on aggregate sectoral and provincial impacts, and are valuable in justifying highway funding by demonstrating its return. In contrast, micro-approaches provide the richest insights into impacts on business and business decisions, how those impacts arise, and can be used to help guide investment decisions on a project-by-project basis.

Study Conclusions
In summary, the review of Canadian, U.S., and international literature provides strong evidence that investments in highways can:
- generate productivity growth
- play a critical role in regional development, particularly for remote, frontier, and resource-based regions.
- generate a more efficient economic structure, improve a nation's balance of trade, and support a wide range of other user and social benefits such as safer highways and improved mobility and accessibility.

APPENDIX 1 - ROUTES ON THE NATIONAL HIGHWAY SYSTEM

Jurisdiction	Highway Number	From	To	Length (km)
British Columbia	1	Alberta border	Victoria	1000.0
	2	Alberta border	Dawson Crk	42.0
	3	Alberta border	Hope	830.0
	5	Tete Jaune Cache	Hope	527.0
	16	Alberta border	Prince Rupert	1135.0
	17	Victoria	Hwy 99	46.0
	97	Cache Crk	Yukon border	953.0
	99	Vancouver	US border	50.0
			Total	*4583.0*
Alberta	1	Sask border	B.C. border	453.0
	16	Sask border	B.C. border	559.0
	2	Edmonton	Fort MacLeod	490.0
	3	Medicine Hat	B.C. border	330.0
	4	Lethbridge	US border	104.0
	9	Calgary	Sask border	332.0
	43	Edmonton (Hwy 16)	Valleyview	297.0
	34,2	Valleyview	B.C. border	202.0
	43,2,35	Valleyview	NWT border	629.0
			Total	*3396.0*
Saskatchewan	1	Manitoba border	Alberta border	648.0
	16	Manitoba border	Alberta border	690.0
	7	Saskatoon	Alberta border	262.0
	11	Regina	Saskatoon	251.0
	6, 39	Regina	Estevan (US border)	234.0
			Total	*2085.0*
Manitoba	1	Ontario border	Sask border	504.6
	16	Portage-la-Prairie	Sask border	267.1
	75	Winnipeg	Emerson (US border)	90.0
			Total	*861.7*
Ontario	401	Quebec border	Windsor (US border)	821.1
	417	Quebec border	Ottawa	154.8
	17	Ottawa	Manitoba	1966.9
	402	London	Sarnia (US border)	102.5
	QEW	Toronto	Fort Erie (US border)	138.1
	400	Midland	Toronto	126.2
	69	Sudbury	Midland	239.4
	427	Toronto (Hwy 401)	QEW	7.6
	11	North Bay	Nipigon	974.8
	61	Thunder Bay	US border	58.1
	11/71	Kenora	Fort Frances (US bdr)	190.0
	16	Ottawa	Prescott (US border)	75.0
	66	Quebec border	Kirland Lake	56.7
	137	Hwy 401	US border	4.3
	405	QEW	US border	8.9
			Total	*4924.4*

Jurisdiction	Highway Number	From	To	Length (km)
Quebec	A10	Montreal	Sherbrooke	154.6
	A15	Montreal	Champlain	62.6
	A15, 101, 117	Montreal	Ontario border	664.3
	A20	Ontario border	Riviere-du-Loup	492.0
	185	Riviere-du-Loup	N.B. border	101.0
	A25	Longueil (Hwy 20)	Anjou (Hwy 40)	7.6
	A35, 133	Montreal (Hwy 10)	Philipsburg	58.7
	A40	Ontario border	Quebec	331.4
	138	Quebec	Sept-Iles	655.4
	73, 175	Charny (Hwy 20)	Chicoutimi	205.6
	A55, 155, A55	Trois Rivieres	Rock Island	148.3
			Total	*2881.5*
New Brunswick	2	Nova Scotia border	Quebec border	548.5
	1	St. Stephen (US bdr)	Sussex	183.0
	7	Saint John	Fredericton	97.1
	16	Aulac (Hwy 2)	Cape Tormentine	51.5
	15	Moncton	Port Elgin	60.1
	95	Woodstock	US border	14.5
			Total	*954.7*
Nova Scotia	104	N.B. border	Port Hastings	285.2
	106	Alma (104)	Caribou	18.4
	104, 4	Port Hastings	Sydney River	130.5
	125, 105	Sydney River	North Sydney	21.9
	102, 111, 118	Truro	Halifax-Dartmouth	122.9
	101, 1	Halifax-Dartmouth	Yarmouth	314.1
	303	Digby (101)	Ferry Terminal	7.8
			Total	*900.8*
Prince Edward Island	1	Borden	Wood Islands	118.0
				118.0
Newfoundland	1	St. John's	Port-aux-Basques	862.7
	100	Trans-Canada Hwy	Argentia	42.0
			Total	*904.7*
Yukon	1	B.C. border	Alaska border	958.0
	2	Whitehorse	Alaska border	134.0
			Total	*1092.0*
Northwest Territories	1	Alberta border	Highway 3	187.0
	2	Enterprise	Hay River	35.0
	3	Highway 1	Yellowknife	340.0
			Total	*562.0*
Federal Jurisdiction	1	Newfoundland	Terra Nova Park	42.3
	1 and 16	BC and Alta	National Parks	263.0
	97	British Columbia	Alaska Hwy	832.0
			Total	*1137.3*
			Total System Length	***24401.1***

APPENDIX 2 - CAPITAL AND MAINTENANCE EXPENDITURES ON THE NATIONAL HIGHWAY SYSTEM

Capital Expenditures ($ in millions)

	1985/86	*1986/87*	*1987/88*	*1988/89*	*1989/90*	*1990/91*	*1991/92*	*1992/93*	*1993/94*	*1994/95*	*1995/96*	*1996/97*
B.C.	$339.3	$218.5	$134.0	$53.0	$101.0	$166.0	$169.0	$92.1	$131.5	$197.5	$208.3	$271.6
Alta	$113.5	$96.8	$117.8	$102.5	$89.8	$91.2	$72.5	$67.4	$76.0	$72.0	$100.0	$89.0
Sask	$13.8	$14.0	$16.6	$27.1	$28.1	$25.8	$12.3	$10.1	$26.4	$23.6	$18.1	$10.9
Man	$9.2	$14.5	$16.3	$17.5	$23.4	$30.0	$24.5	$24.8	$33.5	$26.2	$18.9	$11.1
Ont	$104.1	$105.1	$149.6	$152.8	$130.2	$228.9	$266.9	$263.7	$305.1	$371.6	$324.0	$508.7
Que	$59.6	$56.1	$65.9	$64.8	$85.1	$150.6	$139.1	$148.1	$225.4	$212.7	$184.5	$182.1
N.B.	$21.9	$13.4	$20.5	$18.1	$30.0	$57.0	$58.0	$46.7	$86.1	$72.9	$134.9	$147.1
N.S.	$12.6	$3.8	$1.3	$16.6	$25.7	$39.0	$46.6	$46.7	$42.0	$41.8	$35.6	$46.7
P.E.I.	$3.4	$1.8	$1.5	$2.2	$0.9	$2.9	$7.9	$6.7	$5.4	$3.2	$4.7	$4.6
Nfld	$16.2	$20.8	$25.2	$22.2	$25.9	$36.4	$33.4	$34.8	$35.0	$35.0	$35.0	$30.0
Yukon	$1.5	$3.2	$5.3	$7.0	$9.7	$12.6	$7.1	$13.9	$25.3	$41.8	$44.5	$36.9
NWT	$2.5	$6.2	$3.2	$3.4	$8.1	$10.1	$18.6	$16.7	$13.6	$15.4	$13.3	$13.1
Total	**$698**	**$554**	**$557**	**$487**	**$558**	**$851**	**$856**	**$772**	**$1,005**	**$1,114**	**$1,122**	**$1,352**

Maintenance Expenditures ($ in millions)

	1985/86	*1986/87*	*1987/88*	*1988/89*	*1989/90*	*1990/91*	*1991/92*	*1992/93*	*1993/94*	*1994/95*	*1995/96*	*1996/97*
B.C.	$46.7	$49.9	$58.1	$63.2	$68.0	$74.0	$79.0	$74.6	$78.2	$79.5	$81.6	$83.2
Alta	$33.8	$34.0	$33.5	*$25.0*	$22.5	$23.2	$23.3	*$24.0*	$24.0	$24.0	$25.0	$25.0
Sask	$9.7	$9.9	$11.1	*$12.0*	$13.2	$13.0	$13.0	$8.1	$6.1	$5.4	$6.3	$6.9
Man	$5.9	$6.5	$6.5	$7.2	$7.8	$8.2	$8.4	$8.6	$7.8	$7.7	$7.6	$6.8
Ont	$78.7	$77.1	$80.2	*$85.0*	$89.7	$94.4	$99.0	$98.4	$78.1	$74.0	$77.2	$77.5
Que	$44.2	$42.5	$46.4	$48.0	$50.0	$52.0	$54.0	$55.0	$117.0	$115.3	$114.8	$113.6
N.B.	$10.9	$11.3	$11.5	$11.0	$11.7	$12.0	$10.9	$10.4	$10.3	$10.6	$10.8	$11.2
N.S.	$18.2	$16.6	$16.8	$8.9	$9.8	$9.4	$9.2	$10.4	$13.4	$13.3	$19.5	$12.4
P.E.I.	$0.7	$0.7	$0.7	$0.7	$0.8	$0.8	$0.8	$0.8	$0.8	$0.9	$0.9	$1.6
Nfld	$8.3	$8.6	$9.1	$8.7	$8.6	$8.9	$9.3	$9.3	$10.3	$10.3	$10.3	$10.3
Yukon	$9.6	$10.3	$10.6	$13.8	$13.1	$15.0	$15.7	$13.3	$9.3	$9.6	$9.6	$9.1
NWT	$3.2	$3.3	$3.4	$3.9	$4.4	$4.0	$3.3	$4.2	$3.9	$4.9	$4.7	$4.6
Total	**$270**	**$271**	**$288**	**$287**	**$300**	**$315**	**$326**	**$317**	**$359**	**$356**	**$368**	**$362**

APPENDIX 3 - COST ESTIMATES TO CORRECT NATIONAL HIGHWAY SYSTEM DEFICIENCIES

Cost Estimates in Millions of Dollars (1997)

Case 1 - With Cap on Eligible Costs based on 4 Lane Freeway Standard (comparable to 1989 assessment)

Work Type	*Resurfacing*	*Reconstruction*	*New Construction*	*Twinning, New 4 lanes*	*Interchanges*	*Structures (new or rehab)*	***Total***
B.C.	$ 231.8	$ 717.7	$ 205.9	$ 596.8	$ 33.0	$ 645.2	***$ 2,430.4***
Alberta	$ 91.3	$ 114.1	$ 567.2	$ 380.7	$ 1,396.0	$ 480.7	***$ 3,030.0***
Sask	$ 105.7	$ 126.2	$ 91.5	$ 163.8	$ 241.0	$ 103.0	***$ 831.2***
Manitoba	$ 111.6	$ 35.9	$ 134.8	$ 105.1	$ 161.4	$ 27.8	***$ 576.5***
Ontario	$ 258.6	$ 25.7	$ 283.0	$ 2,207.8		$ 204.0	***$ 2,979.0***
Quebec	$ 220.7	$ 110.2	$ 20.4	$ 23.0	$ 102.9	$ 1,022.1	***$ 1,499.3***
New Brunswick	$ 25.9		$ 550.0	$ 1,213.7			***$ 1,789.6***
Nova Scotia	$ 71.4		$ 215.1	$ 105.4	$ 91.0	$ 54.6	***$ 537.5***
P.E.I.	$ 5.8	$ 7.7	$ 25.9		$ 14.6	$ 39.4	***$ 93.4***
Newfoundland	$ 9.5	$ 47.4	$ 39.7	$ 9.0	$ 7.0	$ 23.5	***$ 136.1***
Yukon	$ 156.9	$ 176.0		$ 33.0		$ 4.2	***$ 370.1***
NWT	$ 47.3	$ 146.2				$ 60.0	***$ 253.5***
Federal	$ 52.2	$ 226.6					***$ 278.8***
Total	***$ 1,388.6***	***$ 1,733.6***	***$ 2,133.5***	***$ 4,838.3***	***$ 2,046.9***	***$ 2,664.4***	***$ 14,805.4***

Case 2 - Without Cap on Eligible Costs

Work Type	*Resurfacing*	*Reconstruction*	*New Construction*	*Twinning, New 4 lanes*	*Interchanges*	*Structures (new or rehab)*	***Total***
B.C.	$ 231.8	$ 697.0	$ 205.9	$ 805.6	$ 33.0	$ 967.8	***$ 2,941.1***
Alberta	$ 91.3	$ 114.1	$ 567.2	$ 380.7	$ 1,396.0	$ 480.7	***$ 3,030.0***
Sask	$ 105.7	$ 126.2	$ 91.5	$ 163.8	$ 241.0	$ 103.0	***$ 831.2***
Manitoba	$ 111.6	$ 35.9	$ 134.8	$ 105.1	$ 161.4	$ 27.8	***$ 576.5***
Ontario	$ 258.6	$ 25.7	$ 283.0	$ 2,874.2		$ 204.0	***$ 3,645.4***
Quebec	$ 152.5	$ 108.8	$ 20.4	$ 1,480.3	$ 102.9	$ 1,022.1	***$ 2,887.0***
New Brunswick	$ 25.9		$ 550.0	$ 1,213.7			***$ 1,789.6***
Nova Scotia	$ 71.4		$ 215.1	$ 105.4	$ 91.0	$ 54.6	***$ 537.5***
P.E.I.	$ 5.8	$ 7.7	$ 25.9		$ 14.6	$ 39.4	***$ 93.4***
Newfoundland	$ 9.5	$ 47.4	$ 39.7	$ 9.0	$ 7.0	$ 23.5	***$ 136.1***
Yukon	$ 156.9	$ 176.0		$ 33.0		$ 4.2	***$ 370.1***
NWT	$ 47.3	$ 146.2				$ 60.0	***$ 253.5***
Federal	$ 52.2	$ 226.6					***$ 278.8***
Total	***$ 1,388.6***	***$ 1,711.5***	***$ 2,133.5***	***$ 4,838.3***	***$ 2,046.9***	***$ 2,987.1***	***$ 17,370.2***

APPENDIX 4 - NATIONAL HIGHWAY SYSTEM MAP