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Ministry of Transportation and Highways

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auditor general's comments

This report is my third report to the Legislative Assembly for the 1996/97 year. It provides the results of my Office's performance audit of the Vancouver Island Highway Project, a $1.3 billion upgrade to the Island Highway corridor between Swartz Bay (north of Victoria) and Campbell River. Our audit looked at the facility planning and design phases of the project, as decisions made during these phases—particularly during facility planning—determine the bulk of the capital costs of the highway, and significantly affect its lifecycle costs.

Since 1987, there have been a number of reports dealing with large highway projects in British Columbia. One of them, released in that same year, the *Report of the Commissioner Inquiry into the Coquihalla and Related Highway Projects* by Douglas L. MacKay, was highly critical of the way the Ministry of Transportation and Highways planned, managed, and reported on major highway construction projects. Commissioner MacKay found that there was no comprehensive long-range highway capital plan, the selection of projects was not based on objective criteria, and highway planning was not integrated with overall transportation planning.

Following that report, the ministry undertook to improve the way it managed capital projects by employing the "proven project management practices" recommended by MacKay. It also initiated a province-wide inventory and evaluation of all modes of transportation, and announced the "Freedom to Move" transportation planning process.

In 1990, my Office conducted an audit of the ministry's process for managing major capital projects, focusing on the steps that the ministry had taken to implement the project management principles and practices to which it had committed itself. We found that the ministry had significantly improved the way it managed capital projects, but that it needed to make additional improvements before it would be able to ensure that it was getting good value for money on capital projects.

In 1991, we conducted an audit of highway planning. Our report noted that the ministry had introduced new planning and budgeting processes, but that the new processes did not yet meet a reasonable standard for ensuring that good value is achieved from highway capital

expenditures. The processes were, however, significantly better than previous ones and efforts were being made to make further improvements.

In this audit, which we conducted in early 1996, we assessed what the ministry has done to ensure that its planning and design processes for the Vancouver Island Highway provide good value for the money spent. The decisions taken at this stage of the capital project drive the lifecycle cost of the highway that is ultimately built.

I wish to thank the Ministry of Transportation and Highways staff, and other government personnel, for the cooperation and assistance provided to my audit staff during the course of their work on this audit.

George L. Morfitt, FCA
Auditor General

Victoria, British Columbia
November 1996

highlights

Vancouver Island Highway Project: planning and design

An audit of the planning and design of the Vancouver Island Highway Project

For any highway capital project, planning and design decisions determine what will be built, where it will be built, when it will be built—decisions that effectively determine most of the cost of, and cash flow required for, building the highway.

The Vancouver Island Highway Project is a $1.3 billion upgrade to the Vancouver Island Highway corridor, including both upgrading existing highway and new construction, between Swartz Bay (north of Victoria) and Campbell River. To ensure that the highway eventually constructed will provide good value for money, it is important that the planning and design processes in place for this project are appropriate and are followed.

Audit Purpose and Scope

The purpose of this audit was to assess whether the Ministry of Transportation and Highways has taken appropriate steps to ensure that the designs for the Vancouver Island Highway provide good value for money. "Appropriate steps" include:

- planning and design management processes which provide reasonable assurance that needs are identified and designs developed to address those needs in a cost-effective manner; and
- a suitable framework of technical standards within which the planning and design processes occur.

We looked mainly at the period since November 1988, when the Minister of Transportation and Highways announced that the government would upgrade the highway, and that the project would be completed by 1996. This announcement signaled the beginning of the project as it exists today.

Our audit focused on the planning and design of specific sections of the project. We did not review the broader issues of transportation planning, or the decision of the government to make upgrading the Vancouver Island Highway its number one highway capital priority in 1988.

Our examination was performed in accordance with value-for-money auditing standards recommended by the

Canadian Institute of Chartered Accountants, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

Overall Conclusions

We concluded that the designs for the Vancouver Island Highway will provide good value for money within the context of current ministry standards and guidelines.

Although there was insufficient planning during early phases of the project, the Vancouver Island Highway Project team has addressed most of the deficiencies during the subsequent planning and design phases. The team has also developed appropriate design management processes, including an adequate Quality Management program.

The ministry's planning and design standards, including guidelines for establishing functional classification of highways, are generally adequate. However, we believe the ministry would benefit from reviewing these standards and their application to ensure that they promote cost-effective planning and design decisions.

Key Findings

The ministry established an appropriate organizational structure and project management processes to deliver the Vancouver Island Highway Project

The ministry set up a separate project team, within the Major Projects Branch, to deliver the Vancouver Island Highway Project. It also established a joint venture with UMA Engineering Ltd., a private sector firm, for the management of the project. Ministry employees work with UMA employees in an integrated fashion. This arrangement has provided the ministry with access to private sector project management tools, while at the same time developing the project management skills of ministry employees.

The ministry also created a Project Management Committee and a Technical Review Committee to facilitate communications between the Vancouver Island Highway Project and the rest of the ministry. The Project Management Committee was established to deal with policy and project scope, schedule, and budget issues. The Technical Review Committee was established to deal with proposed variances from design standards and other technical issues.

In 1991, the ministry commissioned a firm of project management consultants to conduct a management audit of the Vancouver Island Highway Project. The consultants concluded that, in general terms, the project was being well managed, although they made a number of suggestions for

improvements. In 1994, the same consultants were asked to assess progress and to review some additional areas not covered in the original audit. Again they confirmed that the Vancouver Island Highway Project was functioning well. They made a number of recommendations, including implementation of a Value Engineering program. The ministry acted on many of these recommendations, including the implementation of a Value Engineering program.

The designs for the Vancouver Island Highway Project will provide adequate value for money

The audit included a review of the results of the planning and design processes for a number of project segments. The project segments selected included both bridges (stream crossings and grade separations) and highway segments that were at different stages of completion, and in different parts of the project. To help us in assessing the appropriateness of the designs and to evaluate whether they would provide value for money, we contracted the services of technical experts in highway design.

We found that the designs we reviewed provide adequate value for money within the context of current ministry standards and guidelines. The designs were developed in accordance with the established design criteria, and satisfied the project objectives. Technically and functionally, they are consistent with the established criteria that govern highway or bridge design and, when necessary, any significant departures from those criteria were adequately investigated, explained, and documented.

For all the project segments we reviewed, alternatives were developed and evaluated during the planning and design process. On one of the project segments, two of the design criteria—functional classification and design speed—were amended following preliminary design studies, when it was recognized that the project segment, as originally planned, would result in significant overcapacity.

However, an adequate capital management program requires that design alternatives be compared using estimated lifecycle costs as well as expected performance of each alternative. We found that only limited attention was given to lifecycle costs during development of designs.

Earlier Value Engineering reviews conducted on the project designs might have resulted in better value for money

Value Engineering is a formal, organized procedure for reviewing a project in order to identify alternatives that can provide a more cost-effective product without reducing performance or reliability.

Value Engineering studies were carried out as part of a pilot project in 1995. The studies indicated that the designs of the sample of the project segments included in the pilot project provide adequate value for money. The project team implemented a number of recommendations made as a result of the studies, and has incorporated other suggestions into the project's planning and design processes.

Although the studies also identified other potential savings opportunities, these were not explored because the studies were, for the most part, conducted at a late stage of design and the costs of redesign were prohibitive, public commitments had been made, or fiscal year spending targets made delay unattractive. Conducting Value Engineering studies earlier in the planning and design process would have permitted consideration of a broader range of recommendations. The pilot project committee recognized this fact and indicated that Value Engineering studies should be conducted during preliminary design, before public information sessions are conducted, and then again later in the process but before commitments are made to major design features.

System planning was incomplete when the project was announced

System planning is planning for the highway network of the province as a whole or of a region (such as Vancouver Island). Its purpose is to ensure that the province's system of highways is developed in a logical and coherent manner, balancing transportation needs throughout the province with resources available for development. The need for good planning was emphasized in the 1987 *Report of the Commissioner Inquiry into the Coquihalla and Related Highway Projects.*

In the 10 years before the announcement of the Vancouver Island Highway Project in 1988, a number of studies called for improvements to the Vancouver Island Highway, based on safety and traffic volume concerns. These studies were not sufficiently detailed—from an engineering point of view—to permit accurate estimates of the costs of alternative improvement options. The 1988 project announcement, however, created a public expectation that the project would have certain features (such as a freeway to north of Campbell River), even though sufficient planning had not yet been done to determine what those features might cost or whether they were necessary or appropriate.

The scope and budget for the Vancouver Island Highway Project has changed considerably over the life of the project. As the project has progressed, better information about needs, costs, and financial limitations has transformed the preliminary cost estimate for the project from "in excess of

$600 million" to approximately $1.3 billion and has also significantly affected what will actually be constructed. A combination of public input, financial pressures, and emerging needs has resulted in a reshaping of the scope of the project; adding to the project in some areas, reducing the scope of work in other areas.

The Vancouver Island Highway Project is a program of work along a corridor. The schedule for the project was determined more by when sections of the project were able to be built rather than by which sections were the most needed. Initially, insufficient consideration was given to staging the project so that highway capacity would become available as demand grew. However, capping of the overall project budget and recent reviews required to meet debt management targets have resulted in scope reductions and the staging of some parts of the project.

Facility planning for the project is satisfactory

Facility planning is planning that determines exactly what will be built—for example, two lanes or four lanes, an intersection or an interchange, and so on. Despite deficiencies in the early planning for the Vancouver Island Highway Project, facility planning for the project has been adequate. The planning procedures are clearly described in the terms of reference in contracts with planning consultants, and project management documentation describing policy and procedures for facility planning is currently available.

Relatively little facility planning remains to be done, with most of the major planning studies having been completed by 1991. Project segments planned since then include the Millstream Connector, the South Courtenay Connector, and the South Campbell River Connector.

Public communication has been a significant element in the planning of the project. Community liaison groups have been established, open houses held, and information published in newspaper advertisements and flyers. The project team has sought to identify and balance the interests of various groups.

Design management for the project is appropriate and adequate

Design is the detailed definition of what will be built and how the construction process will be organized. The Vancouver Island Highway Project's design management procedures are adequate. Procedures have been well documented and are set out in the draft Implementation Plan. The project's design management process is similar to that used in other jurisdictions and for other ministry projects. Project-specific procedures are set out in the terms of reference of each design contract.

The project also has an adequate quality management program. Consultants are required to ensure adequate quality control procedures are built into their design processes, and Vancouver Island Highway Project design coordinators monitor consultants to ensure that quality control procedures are effective. Design deliverables are reviewed by a multi-disciplinary team of Vancouver Island Highway Project staff, and certain technical issues may be referred for review by other ministry staff. Designs produced by consultants are expected to meet the ministry's current design standards.

The ministry's design standards are generally adequate

Ministry design standards are comprehensive, well documented, and within the range of those used in other North American jurisdictions. However, there are opportunities for improvement. Lifecycle cost analysis is not always considered in the development of standards. As well, the current standards have been developed primarily for rural, rather than urban, highways and do not recognize regional variations.

In 1995, the ministry hired a consultant to review its design standards. The consultant reported that ministry standards were consistent with those in other jurisdictions and that a general reduction in standards was not warranted. However, the consultant identified some specific areas for review. Subsequently, the ministry began a process to review its standards with a focus on the potential for cost savings. The results of that review have been positive, with a number of opportunities for cost savings found.

The Vancouver Island Highway Project team has questioned the application of ministry design standards in specific cases, and presented proposals for variance to the Technical Review Committee. The project team believes that the standards are being applied too rigidly. Other ministry staff respond that, if a viable alternative is suggested, a variance from standards will be approved. Only limited use is made of formal risk and cost-benefit analyses to determine whether a request for variance should be approved.

Decisions about functional classification, design speed, and level of service of a highway determine a large part of the costs of a project. The functional classification of highways, a planning decision, is guided by a manual which indicates the type of highway that should be built to serve specific traffic volumes at an acceptable level of service. This guideline reflects the ministry's policy with respect to the level of service that will be provided to highway users, subject to resource limitations.

background

The Vancouver Island Highway Project

The Vancouver Island Highway Project (Exhibit 1) involves upgrading the existing highway between Swartz Bay (north of Victoria) and Parksville, and building a new highway from Parksville to Campbell River. In addition to the new 125 km highway from Campbell River to Parksville, the project includes a new 21 km parkway along the western edge of Nanaimo, the upgrading of 87 km of the Trans Canada Highway between Nanaimo and Goldstream Park to a four-lane divided arterial highway, and the upgrading of most of the highway between Goldstream Park and Victoria to a four-lane freeway. A number of improvements have also been made to the highway between Victoria and Swartz Bay.

History of the Project: 1981–1987

In 1981, the Ministry of Transportation and Highways began a review of the long-term transportation requirements of Vancouver Island. As part of the review, a ministry consultant prepared a report entitled *Study of the Projected Growth of the Economy of Vancouver Island, 1981–2001.* The consultant's report presented an overview of the Vancouver Island economy, examined the role of Vancouver Island in the context of the economy of the province, reflected upon industrial development and regional growth, and prepared population forecasts for Vancouver Island.

At about the same time, the ministry initiated a "Traffic Analysis and Forecasts" project. The objective of this project was to assemble an inventory of Vancouver Island's existing transportation services and traffic volumes, and provide baseline traffic projections to the year 2001. The report, published in September 1983, projected traffic levels for the year 2000 to increase 30–80% over 1980 levels.

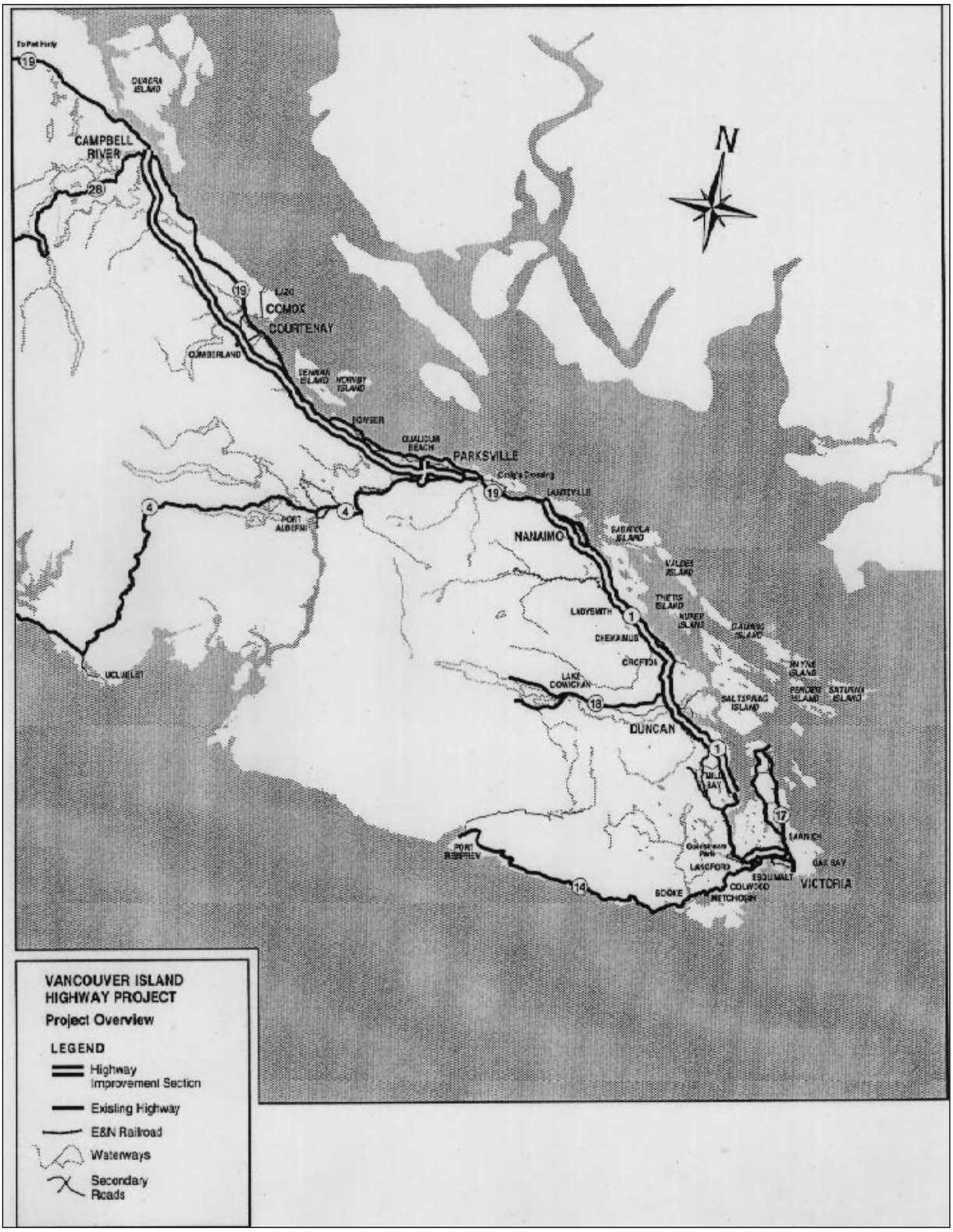
In the fall of 1986, the government announced its commitment to a major highway improvement program on Vancouver Island. The following spring, the ministry produced a report entitled *A Development Strategy for the Vancouver Island Highway*, in which it proposed a 10–year, $511 million program of new highway construction and improvements to the existing highway. The program was to include construction of a four–lane inland highway from Parksville to Campbell River, a four–lane freeway bypass around Nanaimo, and four lanes on the existing Island Highway between Nanaimo and Victoria, including the stretch of highway through Goldstream Park. The report indicated that cost estimates were preliminary only.

The Project Since 1988

The current project can be traced back to announcements made by the government in November 1988. At that time, the

Exhibit 1

Vancouver Island Highway: Project Overview



Source: Ministry of Transportation and Highways

Glossary of Terms

Project scope: The scope of a highway project describes the physical characteristics of the highway or structure that will be built, including the physical boundaries and a list of the significant elements included in the project.

Functional classification: Functional classification describes the type of highway (freeway, expressway, arterial or secondary) theoretically required to provide an adequate level of service for a particular daily volume of traffic.

Level of service: A measure of the smoothness of traffic flow ranging from level "A"(free flow generally associated with low density traffic) to level "F" (very high density, stop-and-go conditions, long delays).

Design year: The year established as a planning horizon.

Freeway: A divided highway with two or more lanes in each direction. Access to a freeway is via interchanges only.

Expressway: A divided highway with two or more lanes in each direction. Access to an expressway is via intersections at public roads.

Arterial highway: A major highway of two or more lanes, not always divided, along which access roads to adjacent private properties may be restricted.

Parkway: An urban expressway**.**

Intersection: A meeting or crossing of two roads at the same elevation. Through traffic, or movement from one road to another, requires traffic on one of the roads to yield to traffic on the other, and is often controlled by traffic lights.

Interchange: A meeting or crossing of two roads, whose grades are separated (that is, there are different elevations at the crossing point). Movement from one road to the other is accomplished by ramps and merging streams of traffic, without traffic on either road being required to stop.

Global planning: Multi-modal transportation planning for the whole province or an area within the province (Vancouver Island, for example)

System planning: Planning for the highway network within the province or a smaller area.

Facility planning: Planning for a specific road, section of road, interchange, intersection, bridge, tunnel, etc.

Planning study: A study to identify and prioritize requirements for new or upgraded highways. Planning studies consider safety concerns, user needs, economic development issues, population or demographic changes, urban planning, and other transportation modes.

Planning criteria: Planning criteria summarize existing conditions and future conditions considered to be desirable, affordable, and achievable. In their early stages, planning criteria are a guide for planners; when completed, they are a summary of the planning done, and a guide for designers. Planning criteria define the "problem" that a project is expected to address.

Corridor study: An evaluation to select a preferred corridor from a number of alternatives. A corridor identifies, in general terms, where a highway might be built. Corridor studies compare alternatives on the basis of identified needs, natural obstacles, environmental and social issues, and cost-benefit analyses.

Route study: A route study is the next level of refinement after a corridor study. A route study evaluates alternative road alignments through a corridor, refining the issues considered in the corridor study.

Preliminary design: Preliminary design identifies possible alignments, develops evaluation criteria, selects one alignment, and develops a design for that alignment.

Functional design: After site surveys and geotechnical investigation, functional design refines the preliminary alignment design.

Design criteria: One of the products of the preliminary design process, the design criteria establish parameters within which designers must work. Design criteria identify the number and configuration of lanes, design speed limits, access requirements and limitations, and social and environmental constraints.

Detailed design: The development of sufficiently detailed information to define construction requirements.

Design standards: Design standards are a collection technical requirements that describe (sometimes in general terms, sometimes in specific terms) the parameters within which a design must be developed.

Staging: Completing construction of a facility over a period of time rather than all at once, for the purpose of matching supply and demand and deferring costs.

Courtesy: Ministry of Transportation and Highways

Rush hour (pre-construction) Victoria approaches

project had an eight-year schedule, with completion to be by 1996 and a preliminary cost estimate "in excess of $600 million" (1988 dollars). In January 1989, that preliminary estimate was used in a presentation to Treasury Board. The project was approved in principle, with a requirement that detailed plans and funding needs be provided.

Since 1988, the scope of the project has been revised many times. Some items—such as the Millstream Connector—have been added; others— such as some work on the Patricia Bay Highway between Victoria and Swartz Bay and on the Millstream Road to Goldstream Park section of the Island Highway—have been deferred. Goldstream Park was explicitly excluded from the project in the 1988 announcement because of environmental sensitivities in the area. Changes to scope have been made for many different reasons, including: local traffic needs, projected traffic volumes, increased property acquisition costs, and debt management limitations.

Details about the evolution of the scope, schedule, and budget for the project are contained in Exhibit 5 (which can be found at page 44 of this report).

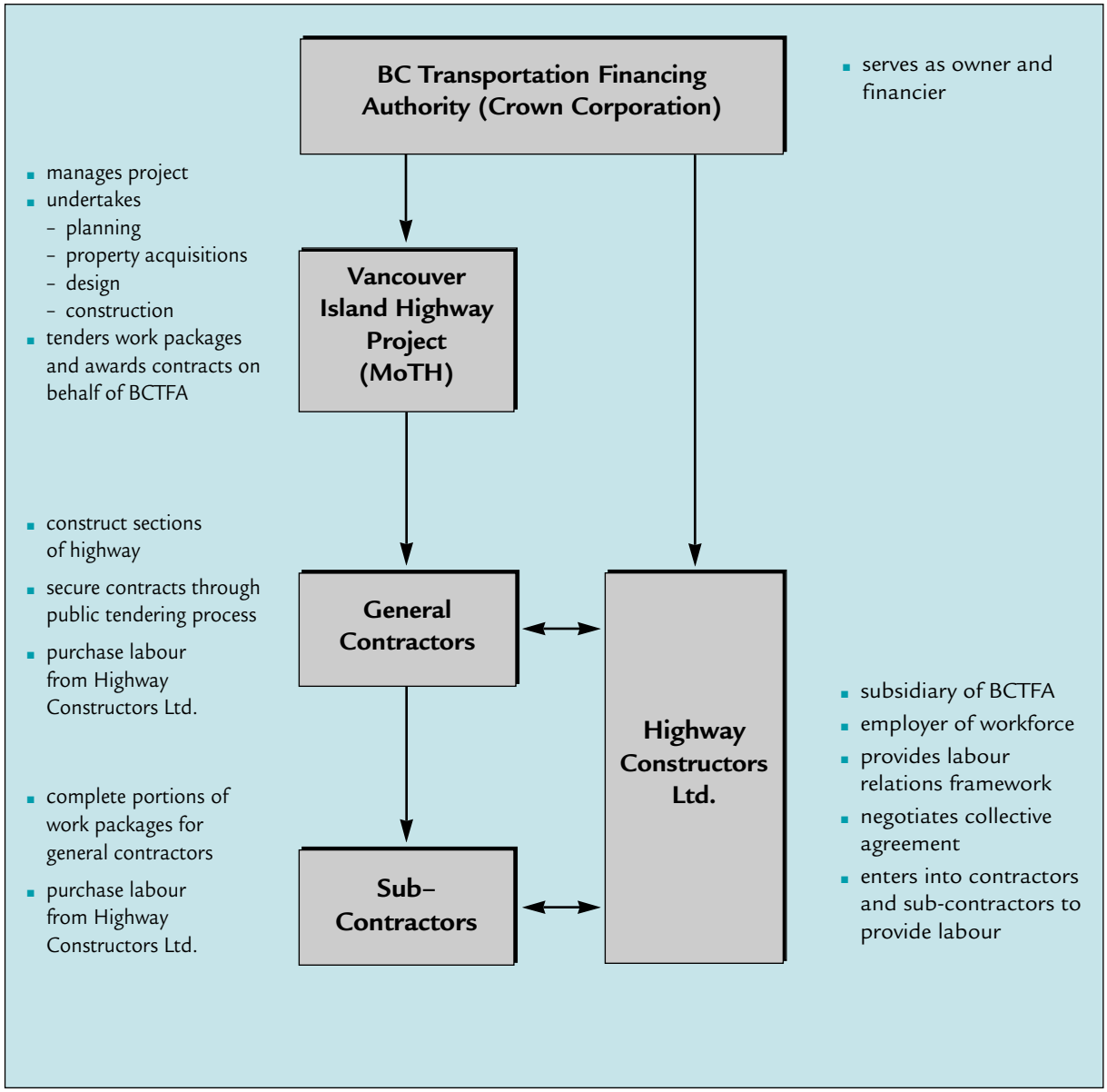
Project Funding and Expenditure to Date

The project is being funded through the BC Transportation Financing Authority, a Crown corporation established April 1, 1993, by the Build BC Act. Before 1993, the Ministry of Transportation and Highways was responsible for funding the construction and maintenance of all provincial highways. Since 1993, it is the Transportation Financing Authority that funds highway capital projects and approves project scope, schedule, and budget changes. The Transportation Financing Authority has a formal agreement with the ministry to have the ministry manage the planning, design, and construction of the Vancouver Island Highway Project (Exhibit 2).

At the time of our audit, the Transportation Financing Authority was responsible for project scope, schedule, and budget changes involving up to $10 million.

Exhibit 2

Vancouver Island Highway Project Relationships



Source: Ministry of Transportation and Highways

Changes in excess of $10 million must go to Treasury Board for approval.

At the end of June 1996, the budget for the Vancouver Island Highway Project was $1,296.3 million (1996 dollars), an increase of $32.7 million over the previous quarter, reflecting the addition of the Duke Point interchange to the project and adjustments to show the budget in 1996 dollars. To the end of June 1996,

Exhibit 3

Financial Information at June 30, 1996 ($ Millions)

	Budget	Forecast	Actual Expenditure
Engineering/Administration	$ 151.1	$ 172.9	$ 126.3
Land Acquisition	281.4	318.8	216.3
Construction	782.9	758.7	328.8
Contingency	80.9	—	–
	$1,296.3	$1,250.4	$ 671.4

Source: Ministry of Transportation and Highways, Vancouver Island Highway Project, First Quarter Report, Fiscal 96/97

$671.4 million had been spent on the project (Exhibit 3).

At the start of the 1996/97 fiscal year, spending limits were established at $175.6 million and $159.5 million for fiscal years 1996/97 and 1997/98, with the expectation that the project would be completed in fiscal year 2000/01. In June 1996, the government announced a freeze on capital spending pending a review of its capital programs (including the Vancouver Island Highway). The review is expected to be completed by the end of December 1996.

Project Management

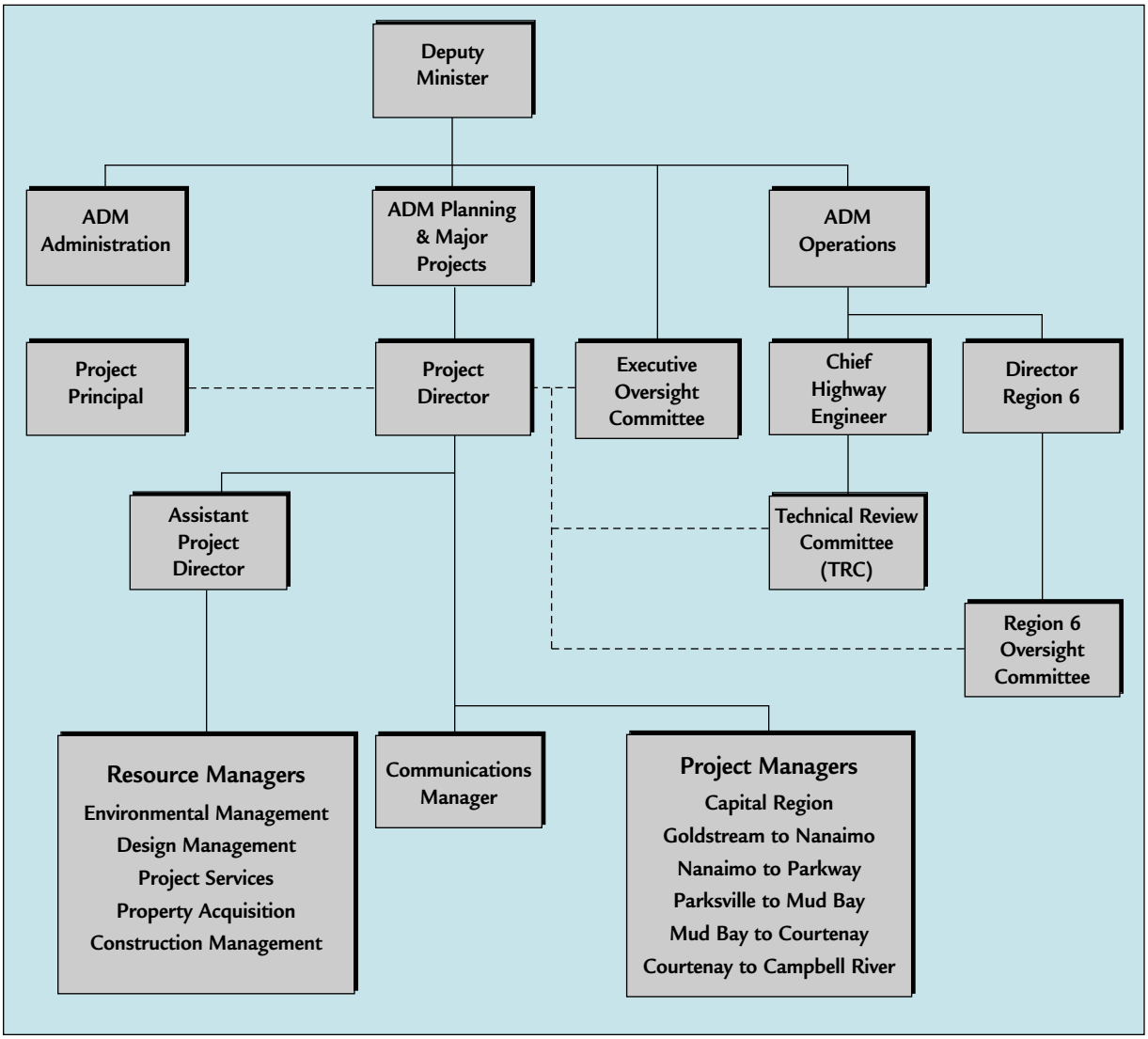
In December 1987, in the *Report of the Commissioner Inquiry into the Coquihalla and Related Highway Projects*, Commissioner Douglas L. MacKay reported the results of his inquiry into the issues relating to the estimated and actual costs of highways constructed in recent years in British Columbia. He was critical of the way the Ministry of Transportation and Highways planned, managed, and reported on highway construction projects. Many of his criticisms were directed, in particular, at the way the ministry managed large construction projects. He recommended that the ministry adopt "proven project management practices for major projects."

In the wake of Commissioner MacKay's report, the ministry undertook to change the way it managed highway construction projects. It effected an extensive ministry reorganization, made a commitment to the principles of project management as practiced in the private sector, and created the Planning and Major Projects Department, with responsibility for transportation planning and the management of selected major projects, particularly those expected to cost more than $50 million. These projects are referred to as "major" projects.

In 1988, the Vancouver Island Highway Project was consolidated under the Major Projects group of the Ministry of Transportation and Highways. Although the Vancouver Island Highway Project office is part of the ministry, it is a separate operating unit providing almost all the services required for the delivery of a major project (Exhibit 4).

Exhibit 4

Vancouver Island Highway Project/Ministry Administration Structure



Source: Ministry of Transportation and Highways

Partnership with Private Sector

In the late 1980s, when the Vancouver Island Highway Project was in its early stages, the Ministry of Transportation and Highways did not possess state-of-the-art project control systems for managing the scope, quality, cost, and schedule of a project the size of the Vancouver Island Highway Project. As well, in addition to the other changes in the ministry, the government had recently introduced an Early Retirement Incentive Program that resulted in the loss of a large number of the ministry's most senior and experienced people.

To ensure that the project had adequate resources—both human and systems—the ministry requested proposals from the private sector to provide project management services. UMA Engineering Ltd. was selected, and the ministry entered into an agreement with the firm in June of 1990.

The project is currently being managed by a project team within the Ministry of Transportation and Highways that is a hybrid of ministry employees and employees of UMA Engineering. The project team is headed by the Project Director, who is an employee of the Ministry of Transportation and Highways, and each of the sub-projects has been assigned to a Project Manager, who is an employee of either the ministry or UMA Engineering. The sub-projects are:

- Capital Region
- Goldstream to Nanaimo
- Nanaimo Parkway
- Parksville to Mud Bay
- Mud Bay to Courtenay
- Courtenay to Campbell River

Project managers are responsible for delivering their projects within a set scope, schedule, and budget, and in accordance with ministry standards.

Transfer of Knowledge and Technology to the Ministry

The creation of a hybrid project management team to manage the Vancouver Island Highway Project was partially predicated on a recognition of the need for the ministry to acquire the management systems and expertise required to adopt the "proven project management practices" referred to by Commissioner MacKay. UMA Engineering brings its project management expertise and systems to the project, and knowledge is being transferred to ministry employees as they work with UMA employees.

One of the deliverables of the Vancouver Island Highway Project is an organized body of knowledge about how to manage a major project. This is to be contained in the Vancouver Island Highway Project Implementation Plan. The plan manual will describe the policies and procedures for managing the planning, design, and construction components of a project within the standards established by the ministry and within the scope, schedule, and budget parameters established by the government. It will also set out how a project should be organized, implemented, monitored, and controlled, with guidance on project scope, budget, and scheduling management, and on the development and reporting of project information for monitoring and project management decision-making purposes.

The Implementation Plan was in draft form at the time of our audit, and due to be published before the end of 1996. It is expected to evolve and be updated over the life of the project.

Project Management Audits

In 1991, the ministry retained a consulting firm to perform a management audit of the Vancouver Island Highway Project. The audit was intended to:

> "Review and assess the appropriateness and effectiveness of the functions, policies, practices and controls (financial, administrative and technical) currently in place for the management of the Vancouver Island Highway Project."

The consultants concluded, in their March 1992 report, that the Vancouver Island Highway Project had a sound project management organization in place, with project management systems functioning properly to provide appropriate information for management decision-making. They approved of the use of a hybrid team of professionals to provide project management and to enable the ministry to maintain direct control of the project while tapping the resources of state-of-the-art project management personnel and technology. The consultants also concluded that the scope, schedule, and budget goals established for the Vancouver Island Highway Project were being managed within reasonable tolerances and with adequate accountability. However, they found there was no framework within the ministry for quality management.

The consultants made a number of recommendations they believed would enhance the overall effectiveness of the project management team and the project management process. Recommendations included: implementation of a Quality Management strategy to provide the proper balance between those responsible for executing projects within scope, schedule, and budget and those responsible for the quality of results; clarification of the division of responsibilities between the Vancouver Island Highway Project project team and the professional services branches of the ministry; and a quality assurance focus within the project team to ensure that the work of retained design consultants met required standards.

The quality management recommendations of the consultant were consistent with comments made by the Auditor General in 1990. We noted that one result of the decision to do more business by contract was that the ministry's quality assurance processes would have to become more formal and be supported by staff with enough experience to carry them out. Part of the reason for contracting with UMA Engineering to provide project management services to the Vancouver Island Highway Project was to ensure the adequacy of the ministry's quality assurance processes.

In 1994, the ministry asked the consulting firm to perform a follow-up review of the Vancouver Island Highway Project. The consultants' report (issued in December 1994) concluded that, since the earlier audit, the project had made significant progress in organizational evolution. Overall improvements had been achieved in all functional areas, and project performance had been good.

Also noted was that the traditional ministry approach to project delivery—separating the design phase from the construction phase, with limited engineering involvement in the construction phase—had changed significantly on the project so that construction

managers had become responsible for approving design documents before they were issued for tender. The consultants recommended that this progress be supported through the implementation of a program to have design consultants involved throughout construction and, specifically, to have designers review all design changes made during construction to ensure that the integrity of the design is maintained and that design criteria are met.

The review identified a number of potential risk areas, including again the lack of a ministry-wide quality management program, and suggested the implementation of a Value Engineering program for the project. Value Engineering was implemented in regard to the project in mid-1995. Although it was undertaken too late to provide maximum benefits for those project segments reviewed as part of a pilot project, the results of the process were worthwhile. The project team has subsequently conducted Value Engineering reviews at an earlier stage on other project segments.

During the course of our review, we found that project management structures and processes have continued to evolve over the life of the project to address the issues raised in the MacKay Commission report and in the various consultants' reports.

Organization of This Report

We have organized our findings into four sections:

- Assessment of Designs
- Highway Planning
- Design Management
- Standards

assessment of designs

Adequate planning and design management processes can provide reasonable assurance that adequate results (designs) will be produced. However, a review of the actual results of the planning and design process provides a better assessment.

As part of our audit examination, we reviewed the results of the planning and design process for a number of project segments on the Vancouver Island Highway Project.

The project segments selected included both bridges (stream crossings and grade separations) and highway segments that were at different stages of completion, and in different parts of the project. To help us in assessing the appropriateness of the designs and to evaluate whether they would provide value for money, we contracted the services of technical experts in highway design.

We expected to find designs that should meet functional requirements at projected levels of service and forecasted traffic volumes; designs that are within scope and budget parameters; and designs that incorporate lifecycle cost minimization objectives. We looked for cost-benefit analyses (including lifecycle cost analyses) of alternatives.

Conclusion

We concluded that the designs reviewed offer adequate value for money within the context of current ministry standards and guidelines. Technically and functionally, they are consistent with the established criteria that govern highway or bridge design and, when necessary, any significant departures from such criteria have been adequately investigated, explained, and documented.

However, if the Value Engineering reviews had been done earlier in the planning and design process, it might have been possible to achieve better value for money from the projects.

Findings

Meeting Requirements

We found that the designs for the project segments included in our sample, whether preliminary or detailed, were developed in accordance with the established design criteria and satisfied the project objectives.

For several of the project segments reviewed, design criteria variances were considered and assessed before confirming the appropriateness of the proposed design criteria. On one of the project segments, two of the design criteria—functional classification and design speed—were amended following preliminary design studies, when it was recognized that the project segment, as originally planned, would result in significant overcapacity.

Documentation of changes to design criteria or functional requirements is one area that needs improvement. In several of the project segments, changes were made to design criteria (functional classification and design speed)

during the design process, but the reason, or sometimes the approval, for the change was not documented.

Considering Alternatives

We found that for all the project segments we reviewed, alternatives were developed and evaluated during the planning and design process. For example:

- configuration and staging variations were considered for the Craig's Crossing Interchange;
- alignment alternatives were considered for the Transfer Beach to Jones Road section of the highway through Ladysmith;
- different structural solutions were considered to deal with severe geotechnical conditions found at the Colwood Overpass;
- several alignment alternatives for the Campbell River crossing were developed and assessed; and
- level crossings and other alternatives were reviewed in an effort to avoid construction of bridges for logging roads crossing the Inland Island Highway corridor.

Cost-Effective Designs

Cost-effective designs provide good value for money. The term "cost-effective" describes an appropriate balance between functionality of an item and the lifecycle cost of the item. Functionality of a highway or a bridge is measured according to how well it performs its intended function of providing for safe and swift movement of vehicles over the lifetime of the asset. Lifecycle cost of a highway or bridge includes the total of capital and maintenance (including periodic rehabilitation) costs over its lifetime.

The cost-effectiveness of design alternatives can be assessed by comparing the functionality and estimated lifecycle cost of each alternative. This has not been done for all of the Vancouver Island Highway Project designs, nor is it part of the ministry's current design process requirements. We believe that such analyses should be included as a required element in the ministry's design process.

We found no evidence of imbalance between the functionality of designs and their capital cost. However, we noted that only limited attention had been given to lifecycle costs during development of the designs.

Least Lifecycle Costing

In 1991, we suggested that the ministry must do better costing if good value-for-money decisions were to be made. We noted that, for highways, the quality of the initial construction and the rate of wear are directly related. The stronger the initial construction, the longer the road will last, and the less maintenance and rehabilitation it will require. However, high quality costs more money initially. The best value for money is achieved when quality that minimizes the lifetime cost of the road is chosen.

Our report acknowledged that the determination of least lifetime cost was a difficult task, but we noted that the ministry was starting to give more consideration to the concept in its decision-making.

In this audit we found that explicit consideration of lifecycle costing was still not part of the design process for any of the project segments reviewed.

Recommendation

The ministry should include, in addition to estimated capital cost, the estimated lifecycle cost of each alternative being evaluated during the design process.

Value Engineering on the Vancouver Island Highway Project

In response to the project management consultant's recommendation that the Vancouver Island Highway Project perform Value Engineering, a pilot project of nine Value Engineering reviews—which were considered to cover a representative sample of project segments—was conducted by several Value Engineering consultants in the summer of 1995.

Value Engineering

Value Engineering is a formal, organized procedure for reviewing a project in order to identify alternatives that can provide a more cost-effective product. The purpose of such a review is to ensure identification of the most cost-effective designs without reducing performance or reliability. In use for approximately 50 years in the United States, it evolved out of the need to find substitutes for materials that had become scarce during the Second World War.

Value Engineering evaluates a proposed design against the functional requirements the project is intended to meet. Cost-effective alternatives are identified and evaluated. However, emphasis is not simply on reducing the cost of a project—rather, it is to identify savings without reducing performance or reliability. The goal is to identify design solutions that provide the greatest value over the long term, not designs that simply result in reduced capital cost but may increase overall lifecycle costs.

This type of analysis is inherent in all good design practice. The added value of a separate Value Engineering review comes from having a team of experts take an independent look at a design. Because of the cost in assembling a team of experts for even a short review, however, the project must be of sufficient magnitude and complexity to warrant the cost of a review.

The literature advocating Value Engineering promises savings ranging any where from 5 to 50% of construction and operating costs. The greatest returns have been reported from reviews that took place early in the project—during planning or preliminary design. If a review takes place early in a project, impact on project schedule is minimized, costs of changing plan documentation is less than if changes are made later, and there is less chance that "pride of ownership" of ideas will interfere with consideration of alternatives.

The success of any Value Engineering review is dependent on the extent of the implementation of the review team's recommendations. Implementation can be limited by a number of factors. If, for example, maintaining an announced schedule for project completion is more important than achieving best value for money, recommendations that conflict with such priorities will not be implemented. Other limiting factors are an inherent resistance to change and concern about risks associated with innovation.

Even a Value Engineering review that does not identify opportunities for achieving more cost-effective designs can be useful, providing an owner, or other stakeholder, with the benefit of independent confirmation that the original design is likely to provide good value for money.

Six highway segments and three bridge project segments were selected from the project, providing a sample that represented the range of geographic distribution and project type. The total estimated construction cost of these project segments was $125 million (approximately 15% of the total project construction cost at that time).

As a result of the nine reviews, a number of recommendations were implemented, resulting in estimated benefits of more than $2 million. Other recommendations valued at over $1 million were deferred for further review and possible implementation. The cost of the Value Engineering reviews was $630,000.

Review of Value Engineering Studies

We reviewed the results from seven of the Value Engineering studies that were part of the 1995 pilot project. We looked in particular at the extent to which some recommendations had been implemented and the reasons for not implementing others.

We found that, in general, Value Engineering recommendations had been implemented where possible. For those that were not adopted, the reason included one or more of the following:

- the recommendation included changes to design criteria;
- the recommendation did not comply with ministry policies or standards;
- further detailed review by the project team revealed that the estimated savings identified by the Value Engineering studies were not available either because of implementation costs or because the potential savings had been overstated;
- other ministry branches were the final decision-makers, and implementation of the recommendation would have to be reviewed from a province-wide perspective; or
- previous commitments had been made to the public and to local municipalities.

We concluded that the Value Engineering studies, in several cases, had been undertaken too late in the design process. Nevertheless, the results of the studies have been worthwhile to the Vancouver Island Highway Project from both an economic and a process improvement point of view.

Since the pilot project in 1995, the project team and other areas of the ministry have conducted several Value Engineering studies with positive results. Value Engineering guidelines are now in place as part of the planning and design process for future portions of the Vancouver Island Highway Project. We believe that similar guidelines should be applied to other ministry projects.

highway planning

The decision to build or upgrade a highway is based on an analysis of the transportation needs and goals of the provincial and local governments. The initial decision about whether or not to proceed with a particular project should take into consideration: identified need for the highway, preliminary public input, and known constraints (economic, environmental, etc.). Once the decision to proceed has been made, a few basic planning decisions—decisions about the classification and design speed of the highway, the level of service that will be provided, and the extent to which construction of the project will be staged—effectively determine much of the cost of a project.

We expected to find: an assessment of needs and how those needs will be addressed by the Vancouver Island Highway Project; planning based on reliable information and reasonable forecasts; and a reasonable process for receiving and incorporating public input. We also expected an appropriate evaluation of costs and benefits—monetary and non-monetary—of alternatives.

Conclusion

When the project was announced, neither a global transportation plan nor a highway system plan existed for the province, or even for Vancouver Island. Many of the early planning decisions for the Vancouver Island Highway Project that would have been part of system planning were thus made without adequate information. Furthermore, documentation of early planning decisions is incomplete—many decisions appear to have been based on professional judgment without formal analysis. Despite these deficiencies in needs identification and evaluation of cost and benefits of alternatives, once the project was approved by the government the detailed system and facility planning for the Vancouver Island Highway Project has been adequate.

Findings

The Decision to Undertake the Vancouver Island Highway Project

Our audit did not include a review of the decision to undertake the Vancouver Island Highway Project. The decision to proceed with the project—to allocate much of the ministry's capital funding to the project—was an issue of resource allocation and a decision made by government.

Early Planning

In early November 1988, the Minister of Transportation and Highways announced that the government would be spending more than $200 million on the first phase of the Vancouver Island Highway Project. The announcement said that the Vancouver Island Highway Project would include a major upgrade from Swartz Bay to Nanaimo and a new Inland Island Freeway from Nanaimo to Campbell River. The project was to be completed by 1996 at a total cost in excess of $600 million. Details of the construction schedule were also provided.

The information on which the announcement was based was limited, originating from conceptual, rather than detailed, planning studies. One of the drawbacks of making announcements with limited information is that the announcement creates expectations that further review may determine are not practical or possible. This was the reason that Commissioner MacKay recommended, in late 1987, that "in the event a major capital highway project must be announced at a conceptual level of development, the government [should] ensure that expenditure authorizations be limited to interim amounts sufficient to develop project planning to a level such that proper estimation of cost and definition of scope can be made."

At the time of the announcement, Treasury Board had not approved either the scope or the budget for the project. Not until October 1989 did the ministry prepare a Treasury Board submission seeking approval for a scope of work similar to that announced. With the more detailed information then available, the proposed project budget was $1.4 billion.

In late November 1988, the Premier announced the formation of regional transportation planning task forces to prepare regional transportation plans. The report of the Vancouver Island Transportation Task Force, released in June 1989, concluded that, for safety and regional economic development reasons, the Vancouver Island Highway Project was the main priority for the region.

Justification for the Project

The decision to upgrade the Vancouver Island Highway was based on apparent deficiencies—specifically, safety and mobility—of the existing facility. Functional classification and design speed for the proposed highway were initially set at a high level to improve safety and mobility factors. Anticipated population growth for Vancouver Island was also a factor. However, traffic volumes were not the determining factor for initial decisions about what would be built. The Minister's 1988 announcement anticipated the functional classification for the highway without consideration of projected traffic volumes.

No detailed analysis of costs and benefits was conducted until 1991, when a ministry-commissioned consultants' report indicated that, based on the project scope and budget at the time, the project had a positive net benefit. The consultants found that the project was largely justified on the basis of lives saved and injuries and property damage avoided as a result of improvements to the highway. This, the consultant concluded, combined with the benefits of reduced travel time, increased user comfort and convenience, fuel savings and reduced vehicular emissions, made the Vancouver Island Highway project "a cost-effective expenditure of funds."

In 1993, another consultant's review also concluded that there would be positive net benefits from the project, although the consultant found that time savings made up 60-70% of user benefits. This consultant made the findings using the ministry's recently-developed procedures for measuring the direct economic benefits and costs to society of selected portions of the Vancouver Island Highway Project.

Courtesy: Ministry of Transportation and Highways

McKenzie Interchange (Victoria)

Facility Planning

The purpose of facility planning is to assess alternatives and, ultimately, to identify the optimum configuration and route for a highway.

We found that each of the subprojects has undergone in-depth study and the information used for planning has been comprehensive. However, forecasting methods have varied between subprojects, and planning assumptions have not been well documented in some cases. Although the different methods have yielded reasonable results, we believe that a more uniform approach, using standardized evaluation criteria, should be used to ensure consistency between project segments and to facilitate comparisons between the Vancouver Island Highway Project and other projects.

Early planning studies thoroughly reviewed the options, taking into account not only engineering, topographical, and geotechnical considerations, but also environmental, socio-economic, and cultural (e.g., ancient burial grounds) factors. However, some options seem to have been eliminated based on professional judgment and experience, without formal analysis. For example, upgrading Highway 19 from Parksville to Courtenay was considered to be impractical because of the high cost of land along the highway. That option was therefore excluded from early planning studies. Little use was made of formal economic review techniques such as cost-benefit analysis, and in some cases the criteria used to choose between alternatives were not clear.

Although traffic forecasting was done, little emphasis was placed on the forecasts for shaping the proposed project . Building the Inland Island Highway from Parksville to Courtenay in stages, as traffic volumes increased, was discussed, but rejected without formal analysis by the project team. The Courtenay to Campbell River section of the Inland Island Highway was reduced from a freeway to a two-lane expressway with protection for future expansion to a four-lane freeway; but, for the most part, the early plans changed little from the scope as announced. Staging considerations concerned the order of construction rather than the need to bring capacity on stream as demand required.

Another problem we encountered was in following the decision-making trail in some projects. In one case, we noted a major change in direction between sequential planning studies, but no documentation of how or why the decision was made.

Summary of Planning Up to 1991

In June 1991, a consulting firm was commissioned to "provide a written record within one document of the planning work done to date on the [Vancouver Island Highway Project], a description and economic analysis of the project as proposed at this time, [and] a conceptual plan for the long range development of the corridor."

The review, which predated the involvement on the project of most of the Vancouver Island Highway Project project team, was commissioned because of the apparent lack of detailed planning—or at least an apparent lack of documentation of such planning—before many of the basic decisions were made. The consultants reviewed and documented: available traffic assumptions and conditions for a 20 to 25 year horizon; levels of service with planned and committed highway improvements; planning criteria used for various project segments; alternatives considered and criteria used to evaluate them; transit alternatives; and environmental issues.

The report, entitled *Comprehensive Planning Assessment: Vancouver Island Highway Project*, was issued in June 1991. It noted that no plan had been developed for improvements through Goldstream Park, despite the apparent need to deal with the bottleneck created by a two-lane road through the park joining proposed four-lane facilities on either side of the park. Also described were the limitations imposed by the decision to upgrade the existing corridor between Goldstream and Nanaimo, and the need to identify a corridor for a new highway on a new alignment at some point in the future (with specific concerns raised about the level of service available to traffic passing through Duncan).

Nevertheless, it concluded that "despite the obvious lack of an overall planning process which would clearly have been desirable, the major decisions and directions chosen in pursuit of the project are well founded."

Planning Since 1991

There has been only limited planning undertaken for the Vancouver Island Highway Project since 1991.

The Victoria Approaches section of the project was halted in May 1991 to permit the Capital Regional District to conduct its own transportation planning exercise. It did this by developing a multi-modal plan, a highway systems plan, and then specific facility plans. One of the outcomes of the process was that the Millstream Connector was added to the project in 1993.

The Planning Framework

Since 1991, the ministry has made significant improvements to the planning process in several areas. It has developed a number of guidelines for planning, including a functional classification study and a guidebook on the appraisal of highways investments. It has also developed a model for conducting cost-benefit analysis—the User Benefit Cost Spreadsheets model—and is enhancing its techniques for multiple accounts evaluation, a method of evaluating economic and social costs. These tools will bring a greater degree of uniformity to the methodologies used in planning studies.

Until recently, consultants maintained a proprietary interest in any model they developed for traffic forecasting. The ministry, therefore, could not re-use an existing model unless it belonged to the consultants currently doing the work. To address this, the ministry has been developing a formal framework for planning, and now has guidelines for planning and formats for modeling. Models now become the property of the ministry so that successive consultants do not have to recreate the models for each planning study. However, many of the ministry's policy and procedure documents for planning have yet to be finalized.

The ministry is also in the process of developing a provincial highway plan based on measurable performance factors and criteria, with data about how well those criteria are being met or are likely to be met in the future. The ministry hopes to use the plan to identify current and projected deficiencies in the highway system, and actions required to address the deficiencies. A draft of the strategy component of the plan was produced in the summer of 1995, but had not yet been finalized at the time of our audit.

The Vancouver Island Highway Project team has documented its planning procedures for inclusion in a project management manual and these procedures have been used on recent planning projects on the Vancouver Island Highway Project. The procedures are consistent with industry standards.

Since 1993, budget pressures have had an impact on the project. Certain planning decisions have been revisited, staging of construction has become a primary consideration, and other opportunities to reduce or defer costs have been identified. For example, initial construction of the Admirals-McKenzie interchange on the Trans Canada Highway north of Victoria will retain some characteristics of an signalized intersection, rather than becoming a full interchange. This will save about $15 million in capital costs.

In summary, it is clear that significant progress has been made in planning since the project was announced, particularly in the area of global and systems planning. Facility planning has been adequate —if not always consistent—although there are gaps in the documentation of the planning process.

Public Consultation

Communication with the public has been a major feature of this project. On past projects, the ministry has been criticized for holding public information sessions in which the ministry seemed to be simply informing the public of what was going to be done, without providing any opportunity for feedback or discussion. During early public meetings to introduce the Vancouver Island Highway Project, ministry staff met with unanticipated public resistance to the project as proposed. People envisaged a "Los Angeles-type freeway system" and the immediate reaction was negative. The ministry response was to hold such meetings earlier in the planning process and to change the meeting format so that the public could comment on the project alternatives. Initially, the Public Affairs Branch of the ministry conducted public information sessions, but when the Vancouver Island Highway Project office was established, a Communications Manager position was created with responsibility for planning and implementing an effective public information campaign for the project.

The project team has moved to an "open house" format—perceived to be a more positive forum than public meetings—which gives the public an opportunity to talk with staff and express their concerns in a relatively quiet, more personalized atmosphere. The project team developed printed materials and circulated questionnaires to gauge public reaction to proposals. As project staff became more aware of the public's desire to provide input, questions became more open-ended and opportunities for input came at an earlier stage in the planning process.

To ensure that a wide range of community interests were represented, liaison committees were also set up in each community, consisting of representatives of the municipal council, the head of Engineering for the municipality, up to four representatives of community-based groups within the municipality, and the highway project's Project Manager for that section of the project.

The process for receiving public input appears to be reasonable, and the Vancouver Island Highway Project team has responded to many suggestions from the public, local politicians, and MLAs.

The ministry also set up Vancouver Island Highway Project information offices in Colwood, Nanaimo, Courtenay, and Campbell River. These are open to the public year round. As well, newspaper advertisements and information supplements are distributed periodically, advising the public of progress and upcoming events.

design management

Highway planning evolves into highway design. After corridor and route selection decisions have been made, a project moves into an iterative design process. Preliminary design defines the basic characteristics of the route selected. Functional design follows preliminary design, providing more detail in terms of alignments, intersections, and right-of-way requirements. The final design details the construction specifications necessary to permit contractors to bid on the construction of the various projects that make up a highway.

We expected to find a good design management process, structured and managed in a manner to ensure that designs are consistent with approved project scope and will result in highways and bridges that are both functionally effective and cost-effective. A good design management process is one in which there is: a clear process, clearly defined responsibilities, and an adequate quality assurance program, including an adequate design review mechanism.

Conclusion

The project team has an adequate process to manage design. However, we believe that improvements could be made over the long term if the ministry had a formal program to assess the functional effectiveness and cost-effectiveness of designs as built, and to capture the experience in its corporate memory.

Findings

The Design Management Process

Design policy and procedures for the project have been documented and published in one form or another since 1992. The process, as set out in the draft Implementation Plan, includes all possible steps that could be required in the design of a section of highway or a structure (such as a bridge or interchange). The process—intended to be used as a guideline—is adapted to suit the specifics of each contract, and the process to be followed is clearly laid out in the terms of reference for each design assignment.

In 1994, the consultant engaged to review the Vancouver Island Highway Project's project management practices concluded that the design management procedures, as drafted, were "comprehensive and provide an adequate basis for the management of the Vancouver Island Highway Project design process and, when followed, ensure a consistent design approach by Vancouver Island Highway Project design consultants." Our review has confirmed this assessment, and found that the required procedures are being followed.

Consultants are required to produce a series of deliverables which are subject to review by Vancouver Island Highway Project staff at several points during the design process. The project staff involved in the review vary

according to the facility being designed.

The process used on the Vancouver Island Highway Project is much like that used on the ministry's other projects, and in other jurisdictions, although some extra reviews are performed. Design consultants confirmed that they are comfortable with the project's design management process and have a clear understanding from their contract documents about what is required of them.

Responsibilities for Design

A number of distinct groups have specific responsibilities related to the project: the Vancouver Island Highway Project staff, the ministry Professional Services staff, the ministry regional staff, and the consultants.

The Vancouver Island Highway Project staff are responsible for ensuring that the design is consistent with the approved scope and budget, and that the design complies with ministry technical standards.

The ministry Professional Services staff provide technical advice and policy direction to the project, and review any proposed variances from ministry standards. At one time, Professional Services staff were more involved with design review, but as the project team has developed their involvement has declined. The recent restructuring of the ministry has made it clear that, in future, Professional Services staff will have a monitoring role and provide technical advice only when requested.

Ministry regional staff provide input to the project based on their local knowledge and experience. In some cases, they also provide specific technical and professional design services to the project.

Consultants do most of the actual design work, in accordance with the terms of reference contained in their contracts. They are responsible for producing a design that meets ministry design standards, and for providing sufficient justification to support any proposed variances from those standards.

Two committees have been established to provide liaison between the Vancouver Island Highway Project management team and the rest of the ministry.

The Project Management Committee was set up in 1990 to enable ministry oversight of the project, provide guidance and direction to senior project management on scope, schedule, budget, and standards, and monitor the status of the project. Over time, this project oversight role has changed because of the formation of the Transportation Financing Authority. In fact, based on a review of the minutes of the meetings and interviews with committee members, a project management consultant noted that the Project Management Committee was not fulfilling its mandated terms of reference. The future of the committee was under review at the time of our audit.

The Technical Review Committee was established to provide guidance on technical matters, make recommendations to the Chief Highway Engineer about proposed variances from standards, and facilitate communication

between the Vancouver Island Highway Project management team and the rest of the ministry. Membership consists of representatives of each of the Highway Engineering disciplines (including Bridge Engineering, Highway Safety, Highway Environment), the Regional Director for Region 6, and the Vancouver Island Highway Project Manager or Design Manager.

In July 1995, the consultant engaged to review the Vancouver Island Highway Project's project management practices concluded that the Technical Review Committee was "effective in providing the communications between Professional Services and the Vancouver Island Highway Project, ensuring the involvement of Professional Services in approval of Design Criteria early in the design process, and facilitating Vancouver Island Highway Project design quality assurance." We observed, however, that the committee has recently been less effective, perhaps partly because of the differing perspectives of the project team and the rest of the ministry. At the time of our audit, discussions were taking place to address the committee's problems.

Communication within the Ministry

Communications within the ministry need to be improved. During our audit, we noted some tension between different groups involved in the project.

Each group tends to perceive issues in terms of its own concerns, priorities, and accountability, rather than seeing the issue from a ministry perspective. The priorities of the Vancouver Island Highway Project staff emphasize building to scope, meeting the schedule, and minimizing capital and lifecycle costs, with emphasis on minimizing capital costs. Professional Services staff are concerned with the integrity of ministry design standards. Ministry regional staff are concerned about how improvements and additions to the highway system will affect long term maintenance and rehabilitation costs.

These tensions are particularly noticeable in the area of the application of design standards. In their efforts to minimize construction costs, the Vancouver Island Highway Project team has proposed alternatives to design standards which it believes will meet functional requirements at a lower cost. Ministry Professional Services staff are reluctant to approve variations unless they are convinced the alternatives have equal performance characteristics in both the short and long terms. Ministry regional staff are concerned that variations may have negative implications for maintenance and rehabilitation costs—implications that will not be evident until after the project has been turned over to them. These concerns are exacerbated by the fact that the ministry does not have an established analytical framework (one that includes risk analysis and cost-benefit analysis) by which such concerns can be resolved.

Design Consultants

Consultants registered with the ministry are invited to submit proposals for design assignments. The objective of the registration and rotation system is to ensure

that consulting work is reasonably distributed throughout the consulting community. The consultants' credentials are reviewed before they are placed on the list of registered consultants, and each consulting firm is assessed to determine the maximum size of contract on which it can bid.

The relationship between the Vancouver Island Highway Project and consultants is clearly described in the terms-of-reference portion of design contracts (which set out the responsibilities of the parties). The primary responsibility of the consultants is to meet all the milestones and produce all the deliverables as required in the terms of reference.

The consultants are also required to provide quality control over the design process to ensure that designs meet functional requirements and ministry standards. In the past, the ministry performed the quality control function, reviewing consultants' work and being closely involved in design development. However, in the case of the Vancouver Island Highway Project, the project team has concentrated instead on a quality management (or quality assurance) role, ensuring that consultants have quality control procedures in place and working properly. All consultants must submit a quality control plan with their proposals and they are responsible for submitting the quality control reports they have identified in their plan. The Design Coordinator for the sub-project visits the consultant's office and monitors compliance with the consultant's quality control plan.

Quality Assurance of Consultants' Work

Design reviews play an important role in providing quality assurance. The reviews may be formal or informal, and they may involve internal peer review or review by outside consultants. It is standard practice for new consultants to review the work of their predecessors when they take over a design project as it moves from one level of detail to the next, and for design teams within the consulting firm and within the ministry to critically review designs as they progress.

Review of the deliverables by Design Coordinators and other members of the project team provides an opportunity to ensure that the consultants are conducting appropriate analyses and reviewing all relevant options (subject to scope and budget constraints) in terms of cost and other project objectives. Design Coordinators may also ask ministry Professional Services staff to review designs at any stage, particularly if there are special concerns.

There are no specific penalties for poor performance by consultants. If a contract is not going well, the Project Manager may ask for different staff to be assigned to the job by the consultant. In extreme cases, the Project Manager can terminate the contract with the consulting firm. In most cases, however, there is negotiation until ministry staff are satisfied that the design meets requirements.

At the end of each design assignment, Design Coordinators are required to make reports to the consultant registration system

Courtesy: Ministry of Transportation and Highways

Big Qualicum River Bridge (near Parksville)

administrator about the performance of the consultants. If there has been poor performance by a consultant, the Design Coordinator is expected to make a negative report. This could result in the firm being removed from the list of qualified consultants or having its assessed capability downgraded. However, at this time, evaluations of past performance are not always considered when selecting consultants.

Post-construction Evaluation of Designs

Post-construction evaluations of designs are a useful quality improvement tool if the performance results of designs are fed back to consultants and ministry staff.

Although post-construction reviews are conducted on the Vancouver Island Highway Project, they are mainly to identify problems related to construction. They do not include any analysis of the cost-effectiveness of the designs, although it is understood that designs that are difficult to construct generally result in higher costs.

The Environment Management section of the ministry does conduct post-construction evaluations that look at the functional effectiveness and cost-effectiveness of environmental protection and mitigation work for the purpose of improving future efforts.

As well, the ministry monitors the performance of its facilities on an ongoing basis and this experience may be reflected in standards, although there is no

formal process for this. For the most part, the feedback loops are not well developed and ministry staff are not well informed about the performance of designs. Consultants also receive little feedback from the ministry about the performance of their designs.

Recommendation

We recommend that the ministry formally monitor the performance of the highway system over time in order to identify and replicate, where practical, design features that provide the most cost-effective solutions to identified highway transportation needs.

standards

In order to ensure a reasonable degree of consistency in the highway system throughout the province, the ministry has, over the years, developed a number of standards that predetermine how recurring planning, design, and construction issues will be handled. These standards are intended to ensure the planning, design, and construction of highways that are safe and reliable. We think they should also ensure the planning, design, and construction of highways that are cost-effective capital investments.

Our audit reviewed the application of the ministry's standards to the Vancouver Island Highway Project to determine if they are likely to produce cost-effective designs that meet the needs of the project. We expected to find planning and design standards that are adequately documented, consistent with similar standards in other provinces, and regularly reviewed and updated to incorporate policy changes and new technology. We also expected that value for money would be a factor in the development and application of standards.

Conclusion

The planning and design standards currently being used by the ministry are generally adequate from a technical point of view. However, historically, the ministry has placed more emphasis on safety and reliability in the development and application of its standards than on their cost-effectiveness. Consequently, although the design process provides opportunity to develop cost-effective design alternatives to ministry standards, there has been insufficient use of formal cost-benefit and risk analysis techniques to evaluate alternatives.

Findings

Planning Standards

Planning standards—specifically, the guidelines for the determination of functional classification, design speed, and planned level of service within the design life of a highway—are major determinants of the cost of a new or upgraded highway. Potentially greater savings are available from reviews of these standards than from changes to design standards.

Since June 1992, a major decision in the highway planning and design process has been the determination of the functional classification for a highway project that is to be built. This decision is now fundamental in determining how a particular highway will be configured and what it will cost.

The Highway Functional Classification Study, described as a guideline for planning highway system development, establishes a functional classification matrix which groups highways into classes according to the character of the service they are to provide—for example freeway, expressway, or arterial highway. The character of service reflects the relative emphasis given to mobility (ease of passage) on one hand and access (opportunity to enter or exit the highway) on the other hand.

Two of the critical elements in the determination of the appropriate functional classification for a highway are the forecast traffic volume for the design life of the highway (usually 20 years into the future) and the targeted minimum level of service during that period. Level of service describes the smoothness of the flow of traffic on a highway and is categorized from levels A to F (A being free-flowing, low-volume traffic and D, E, and F ranging from occasional traffic congestion to stop-and-go conditions with frequent long delays). Level of service goals drive the calculations that lead to the determination of appropriate functional classification, based on expected future daily traffic volumes.

The type of terrain that the highway will traverse is another factor. The ministry categorizes terrain types as level, rolling, or mountainous. The levels of forecast traffic volume that justify a certain type and configuration of highway vary according to terrain. For example, more than 7,000 daily units of traffic on mountainous terrain suggest the need for a four-lane freeway, whereas more than 14,000 units are required on level terrain.

Functional classification, and therefore capital costs, could be reduced by accepting a lower level of service. A lower level of service would result in increased likelihood of traffic congestion during more of the day. The ministry may determine that the social and economic impact of such congestion balance (or outweigh) reduced capital costs. However, the importance and value of free-flowing traffic may be less, in light of the current need for fiscal restraint, than it was in the past. We believe the ministry should consider the impact that providing a lower level of service would have on the costs and benefits related to highway construction.

Recommendation

The ministry should review the planning guidelines contained in the Highway Functional Classification Study. In particular, it should confirm that functional requirements associated with the current level of service goals—and the costs associated with meeting those requirements—are consistent with government fiscal policies.

Design Standards

Once the functional classification of a highway is established, the highway's physical characteristics are determined by application of the ministry design standards. These standards are contained in the Highway Engineering Design Manual, published by the Engineering Branch.

The design manual is based on design policies of the Transportation Association of Canada (TAC) and the American Association of State Highway and Transportation Officials (AASHTO). The general purpose of TAC and AASHTO policies and standards is to promote uniformity of design features, in the interests of maintaining the overall well-being of the travelling public through the provision of safe roads. The ministry manual represents the ministry's interpretation of, and instructions on how to apply, these policies to British Columbia highway projects. Similar design manuals exist in other Canadian provinces and the United States, as well as in other countries.

Courtesy: Ministry of Transportation and Highways

Overpass on Inland Island Highway

We found the documentation of the standards to be adequate. However, we also found that the rationale underlying the standards is not always clearly described in the highway design manual. The addition of more commentary explaining the highway design standards would be of assistance to consultants when they are contemplating a design variance. The bridge design manual, on the other hand, offers better commentary and rationale for many bridge design elements.

Reviews of Design Standards

Independent Review

In November 1994, the ministry initiated a review of the ministry's highway design standards. A consultant was hired to determine if the standards could be changed in order to reduce costs while maintaining an acceptable level of safety.

At the end of the review, in March 1995, the consultant concluded that "British Columbia highway design standards are adequate based on the comparison to the standards of other jurisdictions and the literature reviewed" and that "current Ministry of Transportation and Highways geometric standards are considered to be minimum standards and reductions are unwarranted." The suggestion was made that a way to reduce the capital cost of highway construction would be by staging construction to match capacity to demand.

The report also concluded that risk had not been systematically addressed in all design standards, and that assessment of risk was important in the application of design standards.

The report identified four areas for further review: road grades, lane width, clear zones alongside roads, and shoulder and median widths.

Internal Review of Standards

After receiving the consultant's report, the ministry began a further internal review of its standards. The project team made a number of recommendations related both to the standards themselves and the process for developing, reviewing, and maintaining them. In particular, it was suggested that the ministry "create standards that are flexible and permit deviation under certain conditions."

In January 1996, in response to budget pressures, the review of the ministry's road design standards was assigned a higher priority. The terms of reference drafted for the review called for the implementation of all cost savings measures that could be identified, and the inclusion of both lifecycle and initial capital costs in economic analysis. Improved cost-effectiveness in the application of standards was also sought, including deviating from standards if doing so would result in a better design at equal or less cost.

The review committee produced a draft final report in June 1996, in which it identified a number of areas in which savings could be realized by adopting different standards. The committee also identified additional standards for review, including: instituting narrower lane and shoulder widths; reducing design speed in urban areas and in rural areas with extreme topographical constraints; and basing clear zone requirements on design speed and traffic volume rather than highway classification.

We believe that the ministry should continue to review its technical standards with a view to identifying further opportunities to achieve greater cost-effectiveness without unduly compromising safety.

Ongoing Review of Standards

The process for reviewing and updating standards is, itself, presently being reviewed as a result of the ministry downsizing that was taking place at the time of our audit. As part of a ministry restructuring, the Standards Section of the Highway Engineering Branch was reduced from seven staff to two.

During recent years, technical standards have been reviewed annually, with suggestions for changes being submitted to the Standards Section. The process has been reactive, and driven mainly by technical, rather than economic, considerations. Cost-effectiveness has not, over the years, been systematically taken into consideration in the development or review of standards. This has been changing, however, and cost-effectiveness of design standards has been considered in some cases. For example, cost-effectiveness was considered in the initial decision to adopt current standards for clear zones alongside highways. Lifecycle cost considerations have also been considered in some of the ministry's design standards. For example, weathering steel is now being used in bridge construction to avoid the requirement for periodic repainting. However, these standards were developed based on the experience and expertise of ministry staff, rather than as the result of any specific lifecycle cost analyses.

Opportunity for Innovation within Standards

As noted earlier in this report, the establishment of the functional classification of a highway, based on forecast traffic volume, determines much of the design characteristics of the highway. During the preliminary design process, design criteria are established on the basis of the functional classification of the highway. Once the design criteria are established, the designer has only limited opportunity to produce innovative designs; the ultimate design solution involves meeting the design criteria and design standards.

Designers do not usually attempt to produce innovative designs that incorporate variances to design standards. Using the design standards, the designer attempts to optimize the plan and profile for the roadway (or roadways, in the case of a divided highway or interchange configuration) so that, for example, minimum quantities of fill need to be acquired, moved, or removed from the project site. The designer's goal is to produce an optimal design based on the design criteria established for the project.

Currently it is the Technical Review Committee that reviews requests for variance from design standards. Any variance must then be approved by the Chief Highway Engineer. This process is intended to ensure that standards are applied —and variances approved—in a consistent manner.

The ministry's Professional Services staff state that they neither expect nor desire rigid adherence to standards, but rather want to ensure that any deviation from standard is appropriate and approved. Conversely, Project Managers on the Vancouver Island Highway Project believe that the rest of the ministry regards standards as being prescriptive. The Project Managers also believe that many of the standards require practices that are not cost-effective.

The approach of design consultants is to be conservative in developing designs because there is little incentive to invest the time, effort, and expense in developing and justifying innovative approaches to design.

We believe the ministry should encourage designers to develop site-specific design alternatives, including variations to design standards, where a more cost-effective design can be achieved within the appropriate performance and safety requirements. Pavement design, for example, is not tailored to traffic and geotechnical conditions; rather, the ministry's "typical" design is applied universally regardless of conditions because there is no incentive for designers to perform the risk and cost-benefit analyses required to support a variance proposal.

Recommendation

The ministry should encourage designers to consider cost-effective alternatives that include variances from ministry design standards. Requests for variance from ministry standards should be supported by detailed risk and cost-benefit analyses.

Exhibit 5

Scope, Schedule, and Budget for the Vancouver Island Highway Project

1988

In 1988, Cabinet approved the Vancouver Island Highway Project in principle based on a general "order of magnitude" estimate of cost.

1989

In January 1989, the ministry requested Treasury Board approval to proceed with a program of major highway system improvements for Vancouver Island. Scope of the project was described as:

- staged upgrading of the Pat Bay Highway, between the Swartz Bay ferry terminal and McKenzie Avenue, to freeway status;
- staged upgrading of the Trans Canada Highway, between Tillicum Road and Goldstream Park, to freeway status;
- completion of the Trans Canada Highway, between Goldstream Park and Nanaimo, to a multi-lane arterial highway standard; and
- construction of a new freeway-standard Inland Island Highway around the urban area of Nanaimo and between Parksville and Campbell River.

The cost of the project, based on very preliminary engineering, was estimated to be something in excess of $600 million (1988 dollars). It was proposed that work be completed by 1996.

In February 1989, Treasury Board advised the ministry that the request had been deferred pending more detailed plans and cash flow projections.

1990

In January 1990, the ministry presented a package of alternatives for upgrading different sections of the Vancouver Island Highway to Cabinet. This presentation was based on a submission to Treasury Board that had been made in October 1989. The recommended scope for the project was:

- upgrading Pat Bay Highway, from Swartz Bay to Saanich Municipal Hall, to four-lane freeway;
- upgrading the Trans Canada Highway to Goldstream Park to four-lane freeway;
- upgrading the Trans Canada Highway from Goldstream Park to Nanaimo to four-lane expressway;
- building a new four-lane expressway through Nanaimo, plus the designing and acquiring right-of-way for a freeway bypass; and
- building a new four-lane freeway from Parksville to Menzies Bay.

The budget estimate for the recommended scope was $1,425 million (1989 dollars). The ministry cautioned that the estimate was actually within a range of $1,150 million to $1,500 million. The work was to be completed by 1996.

At the time of the presentation to Cabinet, Treasury Board had instructed the ministry to identify significant reductions in program cost. Treasury Board set target levels of $1,100 million, $900 million, and $700 million for the development of alternative project scope packages.

In May 1990, Cabinet approved a project scope that included: an expressway on the Pat Bay Highway, freeway status on the Trans Canada Highway from Tillicum Road to Millstream Road, an expressway from Millstream to Goldstream Park, an expressway from Goldstream Park to Nanaimo, an Inner Route expressway through Nanaimo instead of the Nanaimo Bypass freeway, and an expressway from Parksville to Menzies Bay north of Campbell River. Estimated cost of the project was $1,100 million (1989 dollars).

In May 1990, Treasury Board approved the project scope but requested further submissions concerning total project budget, annual cash flow, and project completion date before final approval would be given. Within the approved scope:

- The Pat Bay Highway was to be upgraded to four-lane expressway standard, with interchanges at McKenzie Avenue, Beacon Avenue, Island View Road, and Land's End Road. The ability to expand the highway south of Island View Road to six-lane freeway was to be protected.
- The Trans Canada Highway was to be upgraded to four-lane freeway from Victoria to Millstream Avenue, and four-lane expressway from Millstream Road to Goldstream Park, with interchanges at McKenzie Avenue, Helmcken Road, and Highway 1A. There were to be intersections with signals at Millstream Road and Amy Road. The ability to expand the highway east of Millstream Road to six lane freeway and place an interchange at Millstream Road was to be protected.
- Goldstream to Nanaimo was to be upgraded to four-lane expressway standard except between the Shawnigan Lake Road and Bamberton, with frontage roads placed alongside existing four-lane sections and median barriers to be installed on existing four-lane sections.
- Highway 19 through Nanaimo and between Nanaimo and Parksville was to be maintained at its current standard. A second route through Nanaimo was to be constructed to four-lane expressway standard, with access limited to major intersections with signals. Necessary steps to protect a corridor for a freeway bypass of Nanaimo were to be taken.
- The inland route from Parksville to Menzies Bay was to be built to four-lane expressway standard from Parksville to Courtenay, and to two-lane expressway standard from Courtenay to Menzies Bay. The ability to expand the latter section to four lane expressway was to be protected.

1990–1993

As already stated, in May 1990 the budget was estimated to be $1,100 million (1989 dollars), based on planning level information. The ministry expected that by September of that year it would be able to upgrade the budget estimate for the project to a preliminary design estimate level. From May 1990 to May 1993, the ministry continued to refine the scope, schedule, and budget for the project. During this time, the ministry made several major scope revisions including:

- deleting the Beacon Avenue interchange at the request of the Town of Sidney;
- adding four-laning from the Malahat Summit to Bamberton;
- downgrading the standards from Goldstream to Nanaimo to arterial standard;
- extending the Nanaimo parkway northward from Mary Ellen Road to Superior Road;
- connecting the parkway at Northfield Road rather than East Wellington Road at the request of the City of Nanaimo; and
- revising the connection at the north end of the Inland Island Highway.

The net effect of these scope changes was a reduction of $27 million. The ministry also recommended the following additional scope changes:

- adding an interchange at Millstream and the Trans Canada Highway;
- upgrading Millstream Road to four lanes between the Trans Canada Highway and Goldstream Avenue;
- extending Millstream Road south to Highway 14; and
- simplifying the interchange at Thetis Lake overpass.

In May 1991, planning for the Victoria portion of the Trans Canada Highway and the Pat Bay Highway ceased, pending the outcome of a Capital Regional District planning study. The results of the study were presented in May 1994.

1993

In May 1993, the ministry estimated the budget for the project to be $1,226.4 million (1993 dollars).

In August 1993, Treasury Board approved a scope, schedule, and budget for the Vancouver Island Highway Project. The approved scope was based on earlier submissions but included a number of scope changes:

- The Beacon Avenue interchange at Sidney was deleted, and the existing intersection was to be improved.
- The intersection of Millstream Road and the Trans Canada Highway was upgraded to an interchange.
- The Millstream Connector, a four-lane arterial road from the Millstream Interchange to Highway 14, was added to the project.
- A new connector road was to be built north of the Victoria General Hospital.
- The section of the Trans Canada Highway from Goldstream Park to Nanaimo was downgraded from an expressway to a four-lane divided arterial highway.

The approved budget was $1,227 million (1993 dollars). The schedule called for completion of the project in 1999.

1994

In November 1994, facing a budget overrun of $180 million (attributed to scope changes proposed by the ministry and land acquisition costs, and annual spending limits imposed on the project) the Transportation Financing Authority asked the ministry to identify opportunities to reduce the scope of the project and the annual expenditures for the project. The ministry responded with alternatives that delayed project completion or reduced the scope of the project, thereby reducing annual expenditure in future years. Proposed scope changes included:

- eliminating of any further work on the Pat Bay Highway, including the interchange planned for Island View Road and improvements to the highway between Quadra Street and Martindale Road;
- deferring the widening, lane separation, and reduction of the number of access points for the Trans Canada Highway on either side of Goldstream Park; and
- deferring some work on the northern portion of the Inland Island Highway, reducing some planned four-lane sections to two lanes, and deleting some logging road grade separations.

1995

In January 1995, Treasury Board approved the Transportation Financing Authority's recommended reduction in scope and extended the completion date for the project to the year 2000.

In October 1995, the Transportation Financing Authority approved another scope reduction to keep the project within the budget of $1,263.6 million (1995 dollars). The scope reduction substituted a signalized intersection and flyover ramp from the Trans Canada Highway to McKenzie Avenue for the planned full diamond interchange. This change will save $16 million.

1996

In 1996, the Transportation Financing Authority approved an addition of $12.3 million to the project for the Duke Point Interchange—required to accommodate traffic that will be generated by the new ferry terminal. With adjustments of $20.4 million to reflect inflation, the budget for the project is currently $1,296.3 million (1996 dollars).

ministry response

The Ministry is pleased to receive the critique of the Auditor General related to planning and design for the Vancouver Island Highway Project. In general, we agree with the "Overall Conclusions" and concur with the "Key Findings." The Ministry is continually looking to improve the way it conducts its business and considers comments from outside the Ministry as extremely helpful as they provide a fresh perspective.

Ministry Response to "Overall Conclusions":

The Ministry is pleased with the conclusions that the Vancouver Island Highway Project will provide good value for money and that the Ministry's planning and design standards are generally adequate. It is also of value to receive your opinion that the project team has developed appropriate design management processes, including an adequate Quality Management program.

We share the conclusion that there was insufficient planning during early phases of the project and that subsequent work phases have addressed most of these deficiencies.

Your conclusion that the Ministry would benefit from a review of standards and their application to ensure cost-effectiveness is supported and actions are underway to respond to this finding.

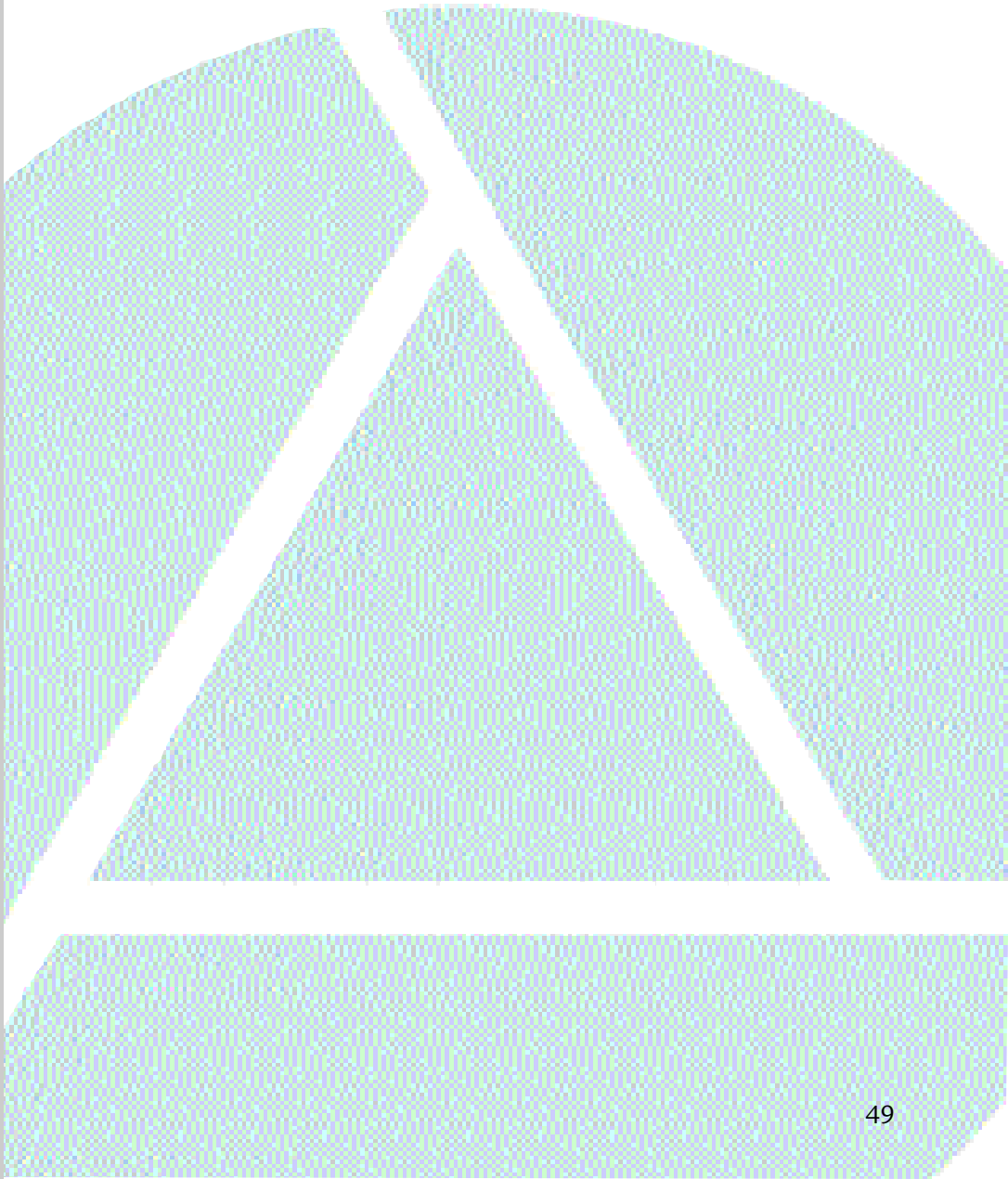
Ministry actions to address comments and recommendations from the audit report:

- *The Ministry recognizes that there was insufficient planning and documentation of planning during the early stages of the Vancouver Island Highway Project, though most of the deficiencies were addressed during the subsequent planning and design phases. In future, it is the firm requirement of both the Ministry and of the BC Transportation Financing Authority that all potential projects will have adequate early planning in the form of system and corridor planning, project needs identification, analysis of alternative improvement options and project scope/cost estimate development. The Ministry is currently developing policy and procedure documents to facilitate consistent planning practices. Deliverables will be refinement of the Provincial Highway Plan, regional systems plans and highway corridor plans and strategies to provide a comprehensive context for project justification and definition.*
- *The Ministry agrees that the more attention to estimating lifecycle cost is appropriate for planning, design, and standards development and review. Lifecycle costing, and other formal economic review techniques, are now included in the Ministry's planning processes. In future, the Ministry intends to incorporate into its design processes, in addition to estimated capital cost, the estimated lifecycle cost of each alternative being evaluated.*

- *The Ministry agrees that formal risk and cost-benefit analyses should be developed for requests for variance from standards by the project: to document such requests, to improve communication within the Ministry, and to facilitate development of cost-effective alternatives by designers that include variances from design standards.*
- *The Ministry agrees that guidelines for determining functional classification of highways require ongoing review to ensure cost-effectiveness and consistency with government policies. The Ministry recognizes that, historically, it has placed emphasis on safety and reliability in the development of its design standards, and that there has been insufficient use of formal cost-benefit and risk analysis techniques in standards development and review. As noted in the report, the Ministry has recently concluded external and internal reviews of its design standards, including consideration of both lifecycle and capital costs to improve the cost-effectiveness of standards. In future, the Ministry intends to take a more systematic and proactive approach to standards reviews.*
- *The Ministry agrees that the different Ministry groups involved in the project should view issues from an overall Ministry perspective rather than seeing them in terms of their own concerns, priorities and accountability. The groups within the Ministry are working together to modify their approach to the project, beginning with understanding and considering issues from each others' point of view.*
- *The Ministry agrees that a formal program to assess the functional and cost-effectiveness of "as constructed" designs and capture this experience in its corporate memory would be beneficial. The project is currently developing processes for project close out, including providing feedback to the Ministry and consultants on project management and technical lessons learned. In future, the Ministry intends to investigate means to measure effectiveness of "as constructed" designs from a longer term perspective so that the experiences may be communicated throughout the Ministry.*

It is apparent that the audit team gained a solid understanding of the planning and design processes as applied to the Vancouver Island Highway Project both in the late 1980's as well as current practice. This substantial appreciation of the progressive enhancement of planning and design processes has contributed in a very tangible manner to the value of the audit findings. We sincerely wish to thank you and your staff for the professional approach undertaken throughout the audit.

appendices



appendix a

1996/97 Audit Reports Issued to Date

Report 1

Performance Audit

Management of
Child Care Grants

Report 2

Crown Corporation
Governance Study

Report 3

Performance Audit

Vancouver Island
Highway Project:
Planning and Design

appendix b

Office of the Auditor General: Audit Objectives and Methodology

Audit work performed by the Office of the Auditor General falls into three broad categories:

- Financial auditing;
- Performance auditing; and
- Compliance auditing.

Each of these categories has certain objectives that are expected to be achieved, and each employs a particular methodology to reach those objectives. The following is a brief outline of the objectives and methodology applied by the Office for performance auditing.

Performance Auditing

Purpose of Performance Audits

Performance audits look at how organizations have given attention to economy, efficiency and effectiveness.

The concept of performance auditing, also known as value-for-money auditing, is based on two principles. The first is that public business should be conducted in a way that makes the best possible use of public funds. The second is that people who conduct public business should be held accountable for the prudent and effective management of the resources entrusted to them.

The Nature of Performance Audits

An audit has been defined as:

> *. . . the independent, objective assessment of the fairness of management's representations on performance, or the assessment of management systems and practices, against criteria, reported to a governing body or others with similar responsibilities.*

This definition recognizes that there are two primary forms of reporting used in performance auditing. The first—referred to as attestation reporting—is the provision of audit opinions on reports that contain representations by management on matters of economy, efficiency and effectiveness.

The second—referred to as direct reporting—is the provision of more than just auditor's opinions. In the absence of representations by management on matters of economy, efficiency and effectiveness, auditors, to fulfill their mandates, gather essential information with respect to management's regard for value for money and include it in their own reports along with their opinions. In effect, the audit report becomes a partial substitute for information that might otherwise be provided by management on how they have discharged their essential value-for-money responsibilities.

The attestation reporting approach to performance auditing has not been used yet in British Columbia because the organizations we audit have not been providing comprehensive management representations on their performance. Indeed, until recently, the management representations approach to value for money was not practicable. The need to

account for the prudent use of taxpayers' money had not been recognized as a significant issue and, consequently, there was neither legislation nor established tradition that required public sector managers to report on a systematic basis as to whether they had spent taxpayers' money wisely. In addition, there was no generally accepted way of reporting on the value-for-money aspects of performance.

Recently, however, considerable effort has been devoted to developing acceptable frameworks to underlie management reports on value-for- money performance, and public sector organizations have begun to explore ways of reporting on value-for-money performance through management representations. We believe that management representations and attestation reporting are the preferred way of meeting accountability responsibilities and are actively encouraging the use of this model in the British Columbia public sector.

Presently, though, all of our performance audits are conducted using the direct reporting model, therefore, the description that follows explains that model.

Our performance audits are not designed to question government policies. Nor do they assess program effectiveness. The *Auditor General Act* directs the Auditor General to assess whether the programs implemented to achieve government policies are being administered economically and efficiently. Our performance audits also evaluate whether members of the Legislative Assembly and the public are provided with appropriate accountability information about government programs.

When undertaking performance audits, auditors can look either at results, to determine whether value for money is actually achieved, or at managements' processes, to determine whether those processes should ensure that value is received for money spent.

Neither approach alone can answer all the legitimate questions of legislators and the public, particularly if problems are found during the audit. If the auditor assesses results and finds value for money has not been achieved, the natural questions are "Why did this happen?" and "How can we prevent it from happening in future?" These are questions that can only be answered by looking at the process. On the other hand, if the auditor looks at the process and finds weaknesses, the question that arises is "Do these weaknesses result in less than best value being achieved?" This can only be answered by looking at results.

We try, therefore, to combine both approaches wherever we can. However, as acceptable results information and criteria are often not available, our performance audit work frequently concentrates on managements' processes for achieving value for money.

We seek to provide fair, independent assessments of the quality of government administration. We conduct our audits in a way that enables us to provide positive assessments where they are warranted. Where we cannot provide such assessments, we report the reasons for our reservations. Throughout out audits, we look for opportunities

to improve government administration.

Audit Selection

We select for audit either programs or functions administered by a specific ministry or public body, or cross-government programs or functions that apply to many government entities. There are a large number of such programs and functions throughout government. We examine the larger and more significant ones on a cyclical basis.

We believe that performance audits conducted using the direct reporting approach should be undertaken on a five- to six-year cycle so that members of the Legislative Assembly and the public receive assessments of all significant government operations over a reasonable time period. Because of limited resources, we have not been able to achieve this schedule.

Our Audit Process

We carry out these audits in accordance with the value-for-money auditing standards established by the Canadian Institute of Chartered Accountants.

One of these standards requires that the "person or persons carrying out the examination possess the knowledge and competence necessary to fulfill the requirements of the particular audit." In order to meet this standard, we employ professionals with training and experience in a variety of fields. These professionals are engaged full-time in the conduct of performance audits. In addition, we often supplement the knowledge and competence of our own staff by engaging one or more consultants, who have expertise in the subject of that particular audit, to be part of the audit team.

As performance audits, like all audits, involve a comparison of actual performance against a standard of performance, the CICA prescribes standards as to the setting of appropriate performance standards or audit criteria. In establishing the criteria, we do not demand theoretical perfection from public sector managers. Rather, we seek to reflect what we believe to be the reasonable expectations of legislators and the public. The CICA standards also cover the nature and extent of evidence that should be obtained to support the content of the auditor's report, and, as well, address the reporting of the results of the audit.

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