BRITISH COLUMBIA

Ministry of Transportation

Trans Canada Highway 1

Broderick Creek to Ford Road

Business Case Development for Property Acquisition and Construction of Improvement Options

1961.0151.01 / October 2003

URBANSYSTEMS
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS
Suite 500 – 1708 Dolphin Ave.
KELOWNA, BC V1Y 9S4
Phone: (250) 762-2517
Fax: (250) 763-5266

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Trans-Canada Highway 1 is the primary east-west through the Province of BC and is of critical strategic importance both Provincially and Nationally. Previous analysis (*Trans Canada Highway Corridor Management Plan* and the *Trans Canada Highway - Cache Creek to the Rockies - Sorrento West to Ford Road Functional Planning Report*) has confirmed that the segment between Broderick Creek and Ford Road is a strong candidate for upgrading to a four lane expressway standard. Property acquisition and construction is currently underway. In conjunction with these works, four specified additional improvement options are presently being considered and assessed for inclusion in the overall project, which is the subject of this document.

The four specific improvement options are relatively minor and operational in nature as compared to the overall project, and are non-competitive (ie. the options are being assessed independently and are treated as unrelated). They are described as follows:

Closure of the Kirkpatrick Road Intersection – This option considers closure of the Kirkpatrick Road intersection at Highway 1. Access to the highway would be provided at the upgraded Ford Road intersection via an improved Kirkpatrick Road connection. Defined problems include a historic accident severity problem (rate is 15.6 which is greater than the Provincial average of 9.1) in addition to perceived low safety levels and challenging geometrics (skewed angle of intersection).

The Addition of a North Side Frontage Road - Three (3) existing accesses along the north side of Highway 1 from approximately 1 km west of Ford Road to Ford Road would be closed with this improvement option. Access to the highway is provided at Ford Road via a new frontage road. Problems with maintaining the existing access points relate to differential speeds between highway traffic and farm vehicles on a 6% grade, and inconsistency with expectation and current design standards.

The Addition of a South Side Frontage Road - Six (6) existing accesses along the south side of Highway 1 from approximately 1 km west of Ford Road to Ford Road would be closed with this improvement option. Access to the highway is provided at Ford Road via a new frontage road. Problems with maintaining the existing access points relate to differential speeds between highway traffic and farm vehicles on a 6% grade, and inconsistency with expectation and current design standards.

Installation of CMB in the Area of the Offset Diamond at the White Lake Road Intersection - Proposed improvements at the White Lake Road intersection include a highway overpass and two offset right in/out intersections connected by a frontage road. This improvement option includes the addition of a concrete median barrier in the vicinity of the two intersections, eliminating left-turn movements at each. The observed accident rate (0.69 accidents/MVK) at this location is greater than the critical rate (0.66 accidents/MVK) indicating a defined problem area. The existing highway alignment is confusing to the driver, particularly during the evening, as White Lake Road is the continuation of the Highway 1 tangent for westbound drivers. In addition, the geometrics add to the driver confusion.

A mini-MAE (Multiple Account Evaluation) has been undertaken on each option to gain a preliminary sense of the option performance indicators and sensitivity to pertinent variables. The evaluation included a quantitative assessment of the standard financial and economic indicators as well as a qualitative assessment of the environmental and community/social implications. Quantitative results were generated through the use of the MicroBENCOST model and methodology using updated (May 2003) BC Ministry of Transportation default values. The results are summarized in Table ES-1.

Table ES-1 – Option MAE Summary

Account	Close Kirkpatrick Intersection	South Side Frontage	North Side Frontage	CMB @ Offset Diamond Over 600 m
Financial				
Project Cost	$800,000	$700,000	$700,000	$148,000
Discounted Costs (6% for 25 Years)				
Project Cost	$755,000	$660,000	$660,000	$140,000
Salvage Value	$158,000	$130,000	$130,000	$29,000
Life Cycle Cost	$597,000	$530,000	$530,000	$111,000
Customer Service (6% for 25 Years)				
Travel Time Cost	$28,000	$0	$0	$0
Reduced Vehicle Operating Cost	$11,000	$0	$0	$0
Reduced Accident Costs	$17,501,600	$144,680	$8,700	$347,110
Total User Benefits	$17,540,600	$144,680	$8,700	$347,110
Community Social	Moderate	Moderate	Moderate	Low
Economic (6% for 25 Years)				
Net Present Value	$16,943,600	- $385,000	- $521,000	$237,000
Benefit Cost Ratio	29.4	0.3	0.02	3.1
NPV Project Cost Ratio	28.4	-0.7	-1.0	2.1
Environmental	None	None	None	None

In general, exclusive of the MAE results noted in table ES-1, it is important to note that all of the improvement options possess merit and are worthy of due consideration. This analysis, and typical project justification processes are dependent upon established historic trends (generally either in mobility or safety terms) which are quantified to determine the range of potential benefit. In this case, it is equally important to note and consider is the potential for new trends and problems to develop as a result of the proposed overall upgrade to an expressway standard, as historic trends may possess little significance once the alignment and configuration of the roadway are substantially changed. This latter point requires the injection of professional judgement, as forecasting tools for safety performance have not yet evolved to the rural expressway category. In this regard, all of the improvements being considered relate to design consistency with driver expectation along what will ultimately be a higher order and faster section of the corridor and should be considered valuable additions and in-line with the project and CMP goals for the project.

Project justification for the closure of the **Kirkpatrick Road intersection** is sound. The intersection possesses an established problem historically, which will be exacerbated with the new roadway configuration. Economic indicators are strong (NPV of $ 16.9 M and B/C of 29), community and social implications are moderate as they relate to more circuitous travel patterns for the few local residents and environmental implications are negligible. Implementation during construction of the overall roadway upgrade provides the best opportunity to both mitigate costs to the extent possible as well as public and stakeholder issues.

Project justification for the addition of **north and south side frontage roads** is challenged when examining the project indicators alone, as is often the case when considering this type of facility. This is primarily due to a limited historic trend in accidents that can be specifically traced to the driveway access points and high (in relative terms) construction and property acquisition costs. In the context of the overall upgrade project, care must be exercised when considering the performance indicator results in isolation, as the notion of maintaining low volume rural farm driveways on a 6% grade expressway standard roadway remains inadvisable without some special provision for farm equipment and vehicles. Access configurations of this nature are inconsistent with driver expectation, particularly considering the treatments provided on other nearby similar sections of the same roadway. These installations remain highly desirable in the context of public safety, sound engineering design principles and opportunity for implementation with the overall project.

Project justification for the installation of **CMB at the offset diamond at White Lake Road intersection** Kirkpatrick Road intersection is sound. The intersection possesses an established problem historically, which will be exacerbated with the new roadway configuration. Economic indicators are strong (NPV of $ 0.24 M and B/C of 3.1), community and social implications are moderate as they relate to more circuitous travel patterns for the few local residents and environmental implications are negligible. Implementation during construction of the overall roadway upgrade provides the best opportunity to both mitigate costs to the extent possible as well as public and stakeholder issues.

This assessment has indicated that two of the four improvement options, closing the Kirkpatrick Road intersection and installing CMB in the area of the offset diamond at White Lake Road, provide a strong return on investment and would represent valuable additions to the overall project. The installation of the frontage roads along both the north and south sides of Highway 1 in the vicinity of the Ford Road intersection, while less attractive from the perspective of standard economic indicators, are sound additions within the context of the urban expressway standard being created and maximizing public safety. Risks associated with the range of options are generally very low as the degree of work completed to date on the project is significant, effectively reducing the uncertainties. Sensitivity analysis confirms similar conclusions with varying discount rates, cost estimates and traffic growth projections and the project options support existing corridor management plans.

Opportunities for cost sharing are limited, although some potential for partnership with ICBC could be explored.

Opportunity cost savings related to implementation of the options in concert with the overall major 4 laning project have been estimated to be in the range of $260,000.

1.0 BACKGROUND

Highway 1, the Trans Canada Highway, is the primary east-west route through British Columbia and is the primary connection to the rest of Canada. This highway is strategically important for the movement of goods, connection of communities, commuting and tourism. Recent planning assessments, including the Trans Canada Highway Corridor Management Plan (Kamloops to the Alberta Border) and the Trans Canada Highway - Cache Creek to the Rockies (Sorrento West to Ford Road Functional Planning Report) have identified the need for upgrading the section of Highway 1 between Broderick Creek and Ford Road to a four lane rural expressway standard. This project was identified as a priority in the Trans-Canada Highway Corridor Management Plan and was chosen as an 'early winner' in the functional planning process.

The project was previously 'tender ready' but delayed due to funding constraints. In conjunction with the current scope of work, opportunities to introduce minor upgrades have presented themselves, which is the topic of this document.

The CCRP Functional Planning Report provides 1998 baseline traffic volumes and an annual growth rate of 1.8%, which are used in this assessment. The AADTs used in the analysis are:

- 10,227 vehicles/day (1998) - Highway 1 east of Ford Road; and,
- 9,669 vehicles/day (1998) - Highway 1 west of Ford Road.

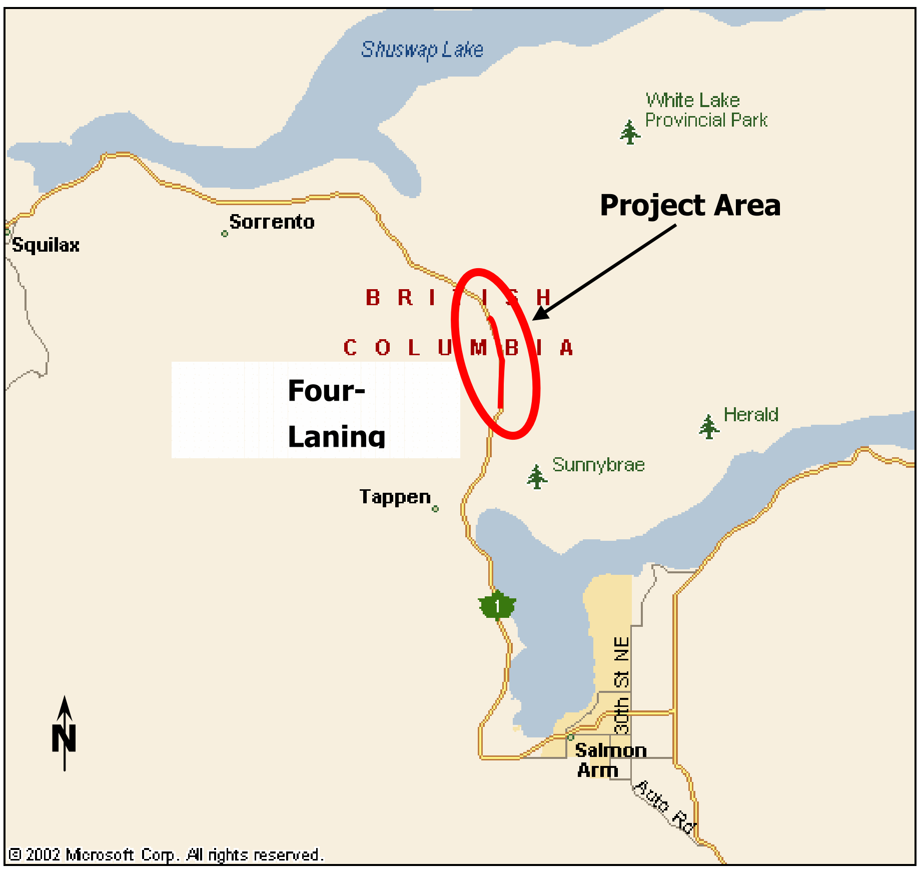
1.1 Study Objectives

The objective of this analysis is to generate the business case to support four (4) proposed minor upgrades being considered consistent with the implementation of the overall corridor expansion. The business case will be generated based upon a simplified multiple account evaluation process, to a level of detail consistent with the project scope and magnitude, including an assessment of the relative benefits associated with each of the projects as compared to the costs, and upon professional judgement relating to the circumstances dictating their need. The methodology to be employed is based upon the application of the MicroBENCOST model in use by the Ministry of Transportation and consideration of the appropriate accounts in a MAE process.

1.2 Study Area

The overall project study area is illustrated in Figure 1. The project is located on the Trans Canada Highway between Sorrento and Salmon Arm. It commences approximately 0.5 km west of Broderick Creek and extends to approximately 0.7 km east of Ford Road. The location of the four (4) improvement options being considered are discussed in the proceeding section.

Figure 1 – Study Area



1.3 Improvement Options

As noted, four (4) improvement options have been brought forward for consideration in conjunction with this overall major project. They are described as follows:

1.3.1 Closure of the Kirkpatrick Road Intersection

This option considers closure of the Kirkpatrick Road intersection at Highway 1. Figure 2 illustrates the existing intersection. Access to the highway would be provided at the upgraded Ford Road intersection via an improved Kirkpatrick Road. Figure 3 illustrates the proposed improvements.

Figure 2 - Kirkpatrick Road Intersection

Figure 3 - Closure of Kirkpatrick Road Intersection

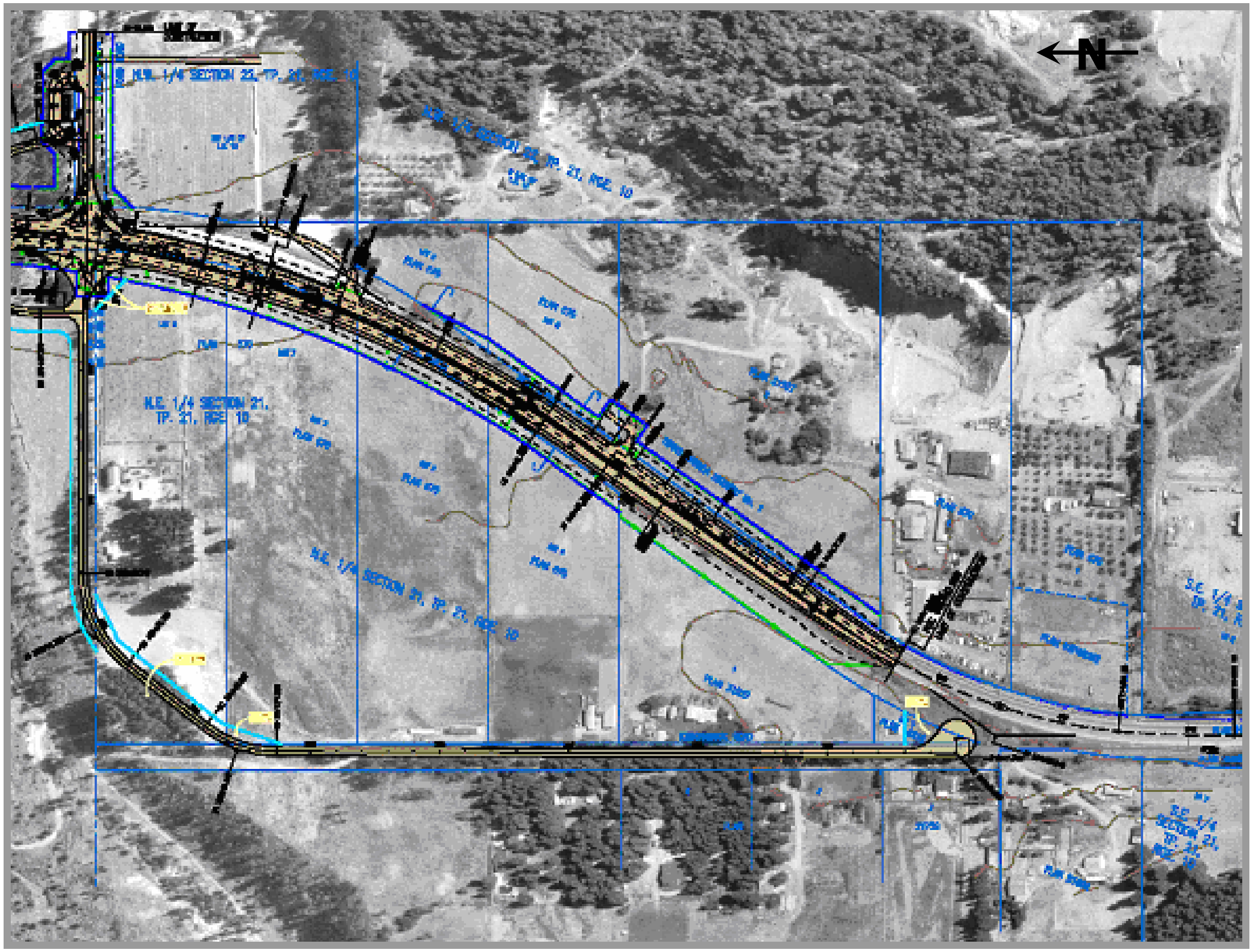
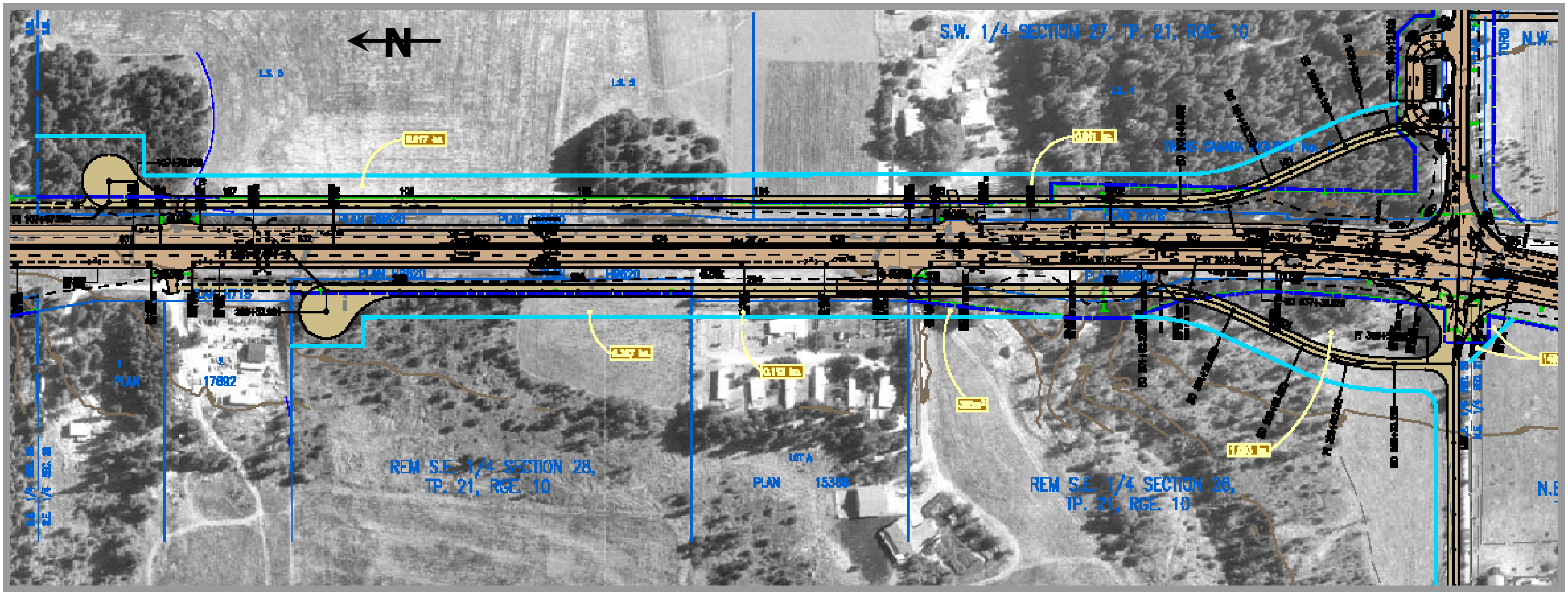


Figure 4 - South Side and North Side Frontage Road Improvement Options



1.3.2 North & South Side Frontage Roads

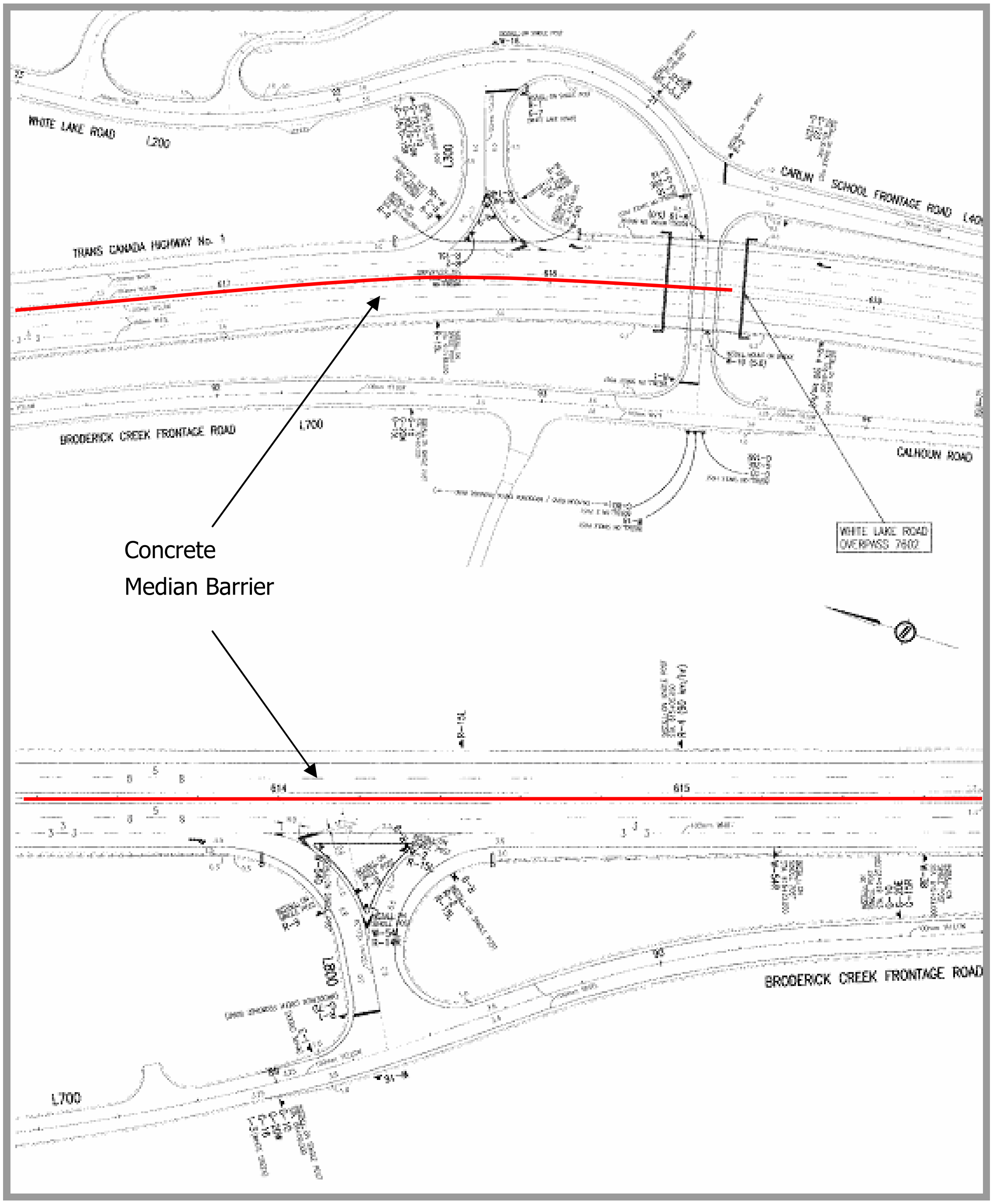
Six (6) existing accesses along the south side and three (3) along the north side of Highway 1 from approximately 1 km west of Ford Road to Ford Road would be closed under these two separate improvement options. Access to the highway is provided at Ford Road via new frontage roads. Figure 4 illustrates the south side frontage road improvement option.

1.3.3 Concrete Median Barrier at Offset Diamond at White Lake Road

Proposed improvements at the White Lake Road intersection include a highway overpass and two offset right in/out intersections connected by a frontage road. This improvement option includes the addition of a concrete median barrier in the vicinity of the two intersections, eliminating left-turn movements at each. The existing White Lake Road intersection is shown in Figure 5 and the improvement option in Figure 6.

Figure 5 - White Lake Road Intersection (Existing)

Figure 6 – White Lake Road Intersection Improvement Option (CMB at Offset Diamond)



URBANSYSTEMS
PLANNERS • ENGINEERS • LANDSCAPE ARCHITECTS

2.0 PROBLEM DEFINITION

This section outlines the historic safety and mobility performance indicators associated with the Highway 1 corridor in the area and specifically in the vicinity of the subject improvement options. Generally, the benefits to be accrued from the range of improvement options being considered are safety related benefits, as few, if any mobility benefits can be realistically quantified under the circumstances. While it can be argued that some mobility benefits are demonstrated when frontage roads, for example, are installed, such benefits are miniscule in the context of the low volume farm driveways on a four lane expressway, and, it could be argued, are offset by the increased travel distances resulting from the more circuitous travel patterns required with frontage roads. As a result, the problem definition and subsequent benefit assessment focuses on the safety performance of the subject areas. The primary measure for safety is a comparison of historical observed collision rates with provincial averages for similar facilities and critical rates (localized tests for statistical significance).

Closure of the Kirkpatrick Road Intersection (LKI 0935 km 64.83)

The Kirkpatrick Road intersection is perceived as a safety problem. The historical accident rate (1990 – 1995) at the intersection approximates the Provincial average for intersections (0.4 accidents/MVK) but is less than the critical accident rate (0.66 accidents/MVK). The severity index (15.6), however, exceeds the threshold of 9.11 and one fatality has occurred at the intersection (in 1990). Closure of the intersection is proposed in order to alleviate these safety concerns in recognition of this historic trend as well as the fact that once improved, intersection complexity will increase substantially as differential speeds, traffic volumes and roadway width increase and exacerbate the current trends.

North and South Side Frontage Road (LKI 0935 km 62.8 to 63.8)

Under current highway conditions (a two lane rural highway), friction exists between through vehicles on the Trans-Canada Highway and vehicles turning into and out of various farm access points along the corridor. This friction has the potential to impact mobility of vehicles travelling through the corridor. In addition, FHWA research indicates that the accident rate along a section of highway is has a direct correlation to the number of accesses. While the historical accident rate along the section of highway where the accesses are proposed to be treated is less than the Provincial average and the critical accident rate, closure of six south side accesses and three north side accesses has the potential to reduce/maintain the existing accident rate in addition to minimizing the friction between through and turning vehicles.

In addition, when considering the nature of the proposed upgrade (to an expressway standard) direct rural farm vehicle driveway access is inconsistent with driver expectation, particularly as differential speeds increase (between through traffic and farm vehicles on a 6% grade). Design consistency (frontage roads are consistent with the treatments provided on previous sections) and context sensitivity are key considerations supporting the introduction of the frontage roads.

Concrete Median Barrier (CMB) at Offset Diamond at White Lake Road (LKI 0935 km 61.3 to 61.9)

The CCRP Functional Planning Study provides indication that the White Lake Road intersection experiences a poor accident record. The observed accident rate (0.69 accidents/MVK) is greater than the critical rate (0.66 accidents/MVK). The existing alignment is confusing to the driver, particularly during the evening, as White Lake Road is the continuation of the Highway 1 tangent for westbound drivers. In addition, the geometrics add to the driver confusion.

The proposed addition of CMB (and associated attenuators at each end) at the two offset t-intersections has the potential to reduce the number of intersection conflicts from 9 for two full access t-intersection to 4 for a right in/out intersection by eliminating illegal left turn movements in addition to providing positive guidance to drivers.

2.1 Problem Definition Summary

Analyses conducted for this Business Case Development exercise has confirmed the following safety problems:

- High accident severity index in the vicinity of the Kirkpatrick Road intersection;
- Higher accident rate due to number of highway accesses; and
- High accident rate in the vicinity of the White Lake Road intersection.

These problems are exacerbated with the proposed roadway improvement as highway travel speeds increase, differential speeds increase along with exposure, traffic volumes, truck composition, roadway width and general overall complexity.

If left unaltered, the features being discussed are increasingly inconsistent with driver expectation when considering the roadway upgrade project. Allowing direct property access points on a four lane expressway standard roadway establishes an undesirable precedent and opportunities to rectify such situations should be explored as they present themselves. While the problem definition is typically based upon historic trends, professional judgement would suggest that these existing trends will worsen following the improvement for the reasons stated earlier (primarily increasing travel speeds).

3.0 OPTION EVALUATION

This section presents a summary of the evaluation process for each of the four options identified. Cost estimates have been provided by Ministry of Transportation, and the mobility and safety benefits associated with each option have been quantified using the MicroBENCOST model and the recently updated Ministry of Transportation 2003 default values (metric version).

3.1 Multiple Account Evaluation

Multiple account evaluation (MAE) is the most common method of comparing options used by the Ministry of Transportation. MAE is a form of multi-criteria decision support and uses a combination of quantitative and qualitative assessments organized by 'accounts'.

There are five accounts that are usually considered by the Ministry of Transportation, as follows:

- Financial;
- Customer Service;
- Social / Community;
- Economic Development;
- Environmental.

These criteria used in applying these accounts are described in the following sections.

3.1.1 Financial Account

The financial account represents the discounted life-cycle cost of the project. Includes all project costs (construction, property, engineering, project management), rehabilitation cost over the life of the analysis period, annual maintenance and salvage value, discounted over 25 years at 6% (the Ministry of Transportation's standard rate). The financial account does not include consideration of cost-sharing or other differentiation between funding responsibility. Cost sharing opportunities should be considered exclusive of the MAE process. Costs (for maintenance and salvage values) are based on MicroBENCOST default values (May 2003 defaults for BC MoT, annual maintenance costs are $3,967 per lane kilometre based on the 2002-2003 provincial maintenance contract costs).

3.1.2 Customer Service Account

The customer service account is the cost to highway users expressed as dollar values for travel time, vehicle operating costs and accidents. The MicroBencost default travel time values of $11.17/hour for automobiles, $20.90/hour for single unit trucks and $23.41/hour for combination trucks have been used. The vehicle operating costs are based on a combination of costs for fuel, oil, tires, depreciation and maintenance. Again, the default MicroBencost values are used for accident costs. Fatal accidents have a value of approximately $5.7 M, injury are $100,000 each and property damage accidents carry a value of approximately $7,300. All user costs are discounted over the 25-year analysis period at 6%. The sensitivity to the discount rate and other factors is provided in later sections.

Accident benefits are primarily due to the reduction in collisions for the improved section, based on FHWA accident modification factors, Minnesota DoT research, and historical accident experience.

3.1.3 Social / Community Account

The social / community account assesses the potential effect of the highway project on communities and social values. Factors generally considered include:

- Noise, Visual and Pollution Impacts – exposure and magnitude of the impacts related to the highway project:
- Community Displacement – property takings, partial and full;
- Community Severance – the “barrier effect” of the highway on local vehicle and pedestrian traffic;
- Consistency With Community Plans – degree of support the project provides to local community plans; and
- Equity – changes that benefit one group at the expense of another.

These factors will be summarized in a simple qualitative assessment of the impacts given the non-competitive nature of the options under review and their very localized context and impacts.

3.1.4 Economic Account

This account provides an indication of **Provincial** economic benefits. Regional and local benefits are generally captured within the community / social account. Also, income and jobs generated during highway construction represent an economic benefit to the local area, but are a loss to other regions and thus there is no net provincial gain. The Provincial economic benefits are derived from reductions in out-of-pocket costs for transportation and health care due to reduced travel times, lower vehicle operating costs and reduced highway accident costs.

3.1.5 Environmental

While this account should identify significant environmental issues, it is not a replacement for an environmental assessment. Where reliable information is available, the account should identify consumption of lands with specific environmental or other value, such as parks/protected areas, wetlands, agricultural lands and high habitat values. The account may also include fuel consumption and carbon monoxide emissions as calculated within MicroBENCOST. Within the context of this assessment, where the options being assessed are very localized and specific environmental assessments have not been undertaken or are even necessary, and a simple qualitative assessment will be provided.

The Ministry of Transportation has confirmed that no significant environmental issues exist with any of the proposed improvement options.

3.2 Closure of the Kirkpatrick Road Intersection

A summary of the MAE for the closure of the Kirkpatrick Road Intersection is offered in Table 1. For the purposes of this analysis, the safety benefit was generated based upon the assumption that all intersection related accidents would be removed, and that construction was assumed to occur in 2004 (note the discounted project cost). In addition, the assessment of future benefit assumed the improved four lane cross-section. All performance benefits were assumed to be safety related, for reasons as described earlier.

Table 1 – MAE Summary for the Closure of the Kirkpatrick Road Intersection

Account	Result
Financial	
Project Cost	$800,000
Discounted Costs (6% for 25 Years)	
Project Cost	$755,000
Salvage Value	$158,000
Life Cycle Cost	$597,000
Customer Service (6% for 25 Years)	
Travel Time Cost	$28,000
Vehicle Operating Cost	$11,000
Reduced Accident Costs	$17,501,600
Total User Benefits	$17,540,600
Community Social	Moderate
Economic (6% for 25 Years)	
Net Present Value	$16,943,600
Benefit Cost Ratio	29.4
NPV Project Cost Ratio	28.4
Environmental	None

As noted in Table 1, the project performance indicators associated with the closure of this intersection are very strong, although highly influenced by the one fatality that occurred in 1990. Both the project net present value and benefit cost ratio exhibit results suggesting a highly desirable investment. Sensitivity analysis indicates positive project performance indicators without consideration of the one fatality event as well (B/C of 1.1 and NPV of $61,000). Community and social implications were deemed to be moderate given the severance and more circuitous travel patterns.

3.3 Frontage Roads

A summary of the MAE for the south side frontage road is offered in Table 2 and the north side frontage road in Table 3. For the purposes of this analysis, FHWA accident reduction factors were utilized assuming that the 6 accesses were reduced to 1 on the south side, and 3 accesses were reduced to 1 on the north side, and the safety benefits were accrued accordingly. Under the circumstances, this is thought to represent a fairly conservative methodology given the nature of the existing driveways in question (low volume farm driveways). The assessment of future benefit assumed the improved four lane cross-section and the construction was assumed to occur in 2004 (note the discounted project cost). All performance benefits were assumed to be safety related, for reasons as described earlier.

Table 2 – MAE Summary for the South Side Frontage Road

Account	Result
Financial	
Project Cost	$700,000
Discounted Costs (6% for 25 Years)	
Project Cost	$660,000
Salvage Value	$130,000
Life Cycle Cost	$530,000
Customer Service (6% for 25 Years)	
Reduced Travel Time Cost	$0
Reduced Vehicle Operating Cost	$0
Reduced Accident Costs	$144,680
Total User Benefits	$144,680
Community Social	Moderate
Economic (6% for 25 Years)	
Net Present Value	- $385,000
Benefit Cost Ratio	0.3
NPV Project Cost Ratio	-0.7
Environmental	None

Table 3 – MAE Summary for the North Side Frontage Road

Account	Result
Financial	
Project Cost	$700,000
Discounted Costs (6% for 25 Years)	
Project Cost	$660,000
Salvage Value	$130,000
Life Cycle Cost	$530,000
Customer Service (6% for 25 Years)	
Reduced Travel Time Cost	$0
Reduced Vehicle Operating Cost	$0
Reduced Accident Costs	$8,700
Total User Benefits	$8,700
Community Social	Moderate
Economic (6% for 25 Years)	
Net Present Value	- $521,000
Benefit Cost Ratio	0.02
NPV Project Cost Ratio	-1.0
Environmental	None

Project performance indicators suggest challenging project justification circumstances in both cases. This is typically the case with frontage roads, as their significant cost outweigh the benefits where limited historic accident activity has occurred (or limited information is available to this effect). Optimal timing analysis from a benefit-cost perspective would suggest improved economic indicators beyond 2010, however, they remain below the desirability thresholds at all future horizons.

Anecdotal benefit and professional judgement should be used to supplement these results. As noted previously, consideration of the frontage road concepts is based upon design consistency and context sensitive considerations, and professional judgement. Increasing the capacity and travel speed along this section of Highway 1 by converting it to an expressway standard can significantly change the historic trend for the worse. Community and social implications were deemed to be moderate given the severance and more circuitous travel patterns. Community support exists for the implementation of both frontage roads.

3.4 Concrete Median Barrier at Offset Diamond at White Lake Road

A summary of the MAE for the CMB at the offset diamond is offered in Table 4. For the purposes of this analysis, FHWA accident reduction factors were utilized in combination with factors derived from the Minnesota Department of Transportation relating to intersection type and number of conflict points on rural highways. The assessment of future benefit assumed the improved four lane cross-section and the construction was assumed to occur in 2004 (note the discounted project cost). Project assumptions (and costs) assumed approximately 600 m of CMB and energy attenuators at each end. All performance benefits were assumed to be safety related, for reasons as described earlier.

Table 4 – MAE Summary for the CMB at Offset Diamond at White Lake Road

Account	Result
Financial	
Project Cost	$148,000
Discounted Costs (6% for 25 Years)	
Project Cost	$140,000
Salvage Value	$29,000
Life Cycle Cost	$111,000
Customer Service (6% for 25 Years)	
Reduced Travel Time Cost	$0
Reduced Vehicle Operating Cost	$0
Reduced Accident Costs	$347,110
Total User Benefits	$347,110
Community Social	Low
Economic (6% for 25 Years)	
Net Present Value	$237,000
Benefit Cost Ratio	3.1
NPV Project Cost Ratio	2.1
Environmental	None

Given the relatively low cost, this improvement option presents viable project performance indicators indicating a sound case for investment based upon the available information. The project is easily implemented and has low community, social and environmental implications.

3.5 Multiple Account Evaluation Summary

Table 5 provides a summary of the MAE results for all four (4) improvement options.

Table 5 - MAE Summary Table

Account	Close Kirkpatrick Intersection	South Side Frontage	North Side Frontage	CMB @ Offset Diamond Over 600 m
Financial				
Project Cost	$800,000	$700,000	$700,000	$148,000
Discounted Costs(6% for 25 Years)				
Project Cost	$755,000	$660,000	$660,000	$140,000
Salvage Value	$158,000	$130,000	$130,000	$29,000
Life Cycle Cost	$597,000	$530,000	$530,000	$111,000
Customer Service (6% for 25 Years)				
Reduced Travel Time Cost	$28,000	$0	$0	$0
Reduced Vehicle Operating Cost	$11,000	$0	$0	$0
Reduced Accident Costs	$17,501,600	$144,680	$8,700	$347,110
Total User Benefits	$17,540,600	$144,680	$8,700	$347,110
Community Social	Moderate	Moderate	Moderate	Low
Economic (6% for 25 Years)				
Net Present Value	$16,943,600	- $385,000	- $521,000	$237,000
Benefit Cost Ratio	29.4	0.3	0.02	3.1
NPV Project Cost Ratio	28.4	-0.7	-1.0	2.1
Environmental	None	None	None	None

3.6 Sensitivity

A sensitivity analysis was conducted to test the sensitivity of the following:

- Discount rate (4%, 8% and 10%)
- Cost estimate (50%, 150%)
- Traffic growth rates (1.0%, 3.5%)

The results are presented in the ensuing Tables.

Table 6 - Sensitivity Analysis – Closure of Kirkpatrick Road Intersection

Discount Rate	**6%**	**4%**	**8%**	**10%**
Discounted Cost	$755,000	$769,000	$741,000	$727,000
Salvage Value	$158,000	$250,000	$101,000	$65,000
Life Cycle Cost	$597,000	$519,000	$640,000	$662,000
User Benefits	$17,540,600	$21,595,000	$14,471,000	$12,186,000
Net Present Value	$16,943,600	$21,076,000	$13,831,000	$11,523,000
Benefit Cost Ratio	29.4	28.4	19.7	16.8
Cost Estimate		**50%**	**150%**	
Project Cost	$800,000	$400,000	$1,200,000	
Discounted Project Cost	$755,000	$377,500	$1,132,500	
Salvage Value	$158,000	$79,000	$237,000	
Life Cycle Cost	$597,000	$298,500	$895,500	
User Benefits	$17,540,600	$17,540,600	$17,540,600	
Net Present Value	$16,943,600	$16,943,600	$16,943,600	
Benefit Cost Ratio	29.4	58.6	19.5	
Traffic Growth Rate	**1.8%**	**1.0%**	**3.5%**	
Life Cycle Cost	$597,000	$597,000	$597,000	
User Benefits	$17,540,600	$15,500,000	$19,065,000	
Net Present Value	$16,943,600	$14,903,000	$18,468,000	
Benefit Cost Ratio	29.4	26.0	31.9	

The analysis indicates that the conclusions reached are not overly sensitive to a reasonable range of changes in traffic growth, cost estimates and discount rate.

Table 7 - Sensitivity Analysis – South Side Frontage Road

Discount Rate	**6%**	**4%**	**8%**	**10%**
Discounted Cost	$660,000	$673,000	$648,000	$636,000
Salvage Value	$130,000	$210,000	$82,000	$52,000
Life Cycle Cost	$530,000	$463,000	$566,000	$584,000
User Benefits	$144,680	$180,000	$119,000	$100,000
Net Present Value	-$385,320	-$283,000	-$447,000	-$484,000
Benefit Cost Ratio	0.27	0.39	0.21	0.17
Cost Estimate		**50%**	**150%**	
Project Cost	$700,000	$350,000	$1,050,000	
Discounted Project Cost	$660,000	$330,000	$990,000	
Salvage Value	$130,000	$65,000	$195,000	
Life Cycle Cost	$530,000	$265,000	$795,000	
User Benefits	$144,680	$144,680	$144,680	
Net Present Value	-$385,320	-$120,320	-$650,320	
Benefit Cost Ratio	0.27	0.55	0.18	
Traffic Growth Rate	**1.8%**	**1.0%**	**3.5%**	
Life Cycle Cost	$530,000	$530,000	$530,000	
User Benefits	$144,680	$128,000	$190,000	
Net Present Value	-$385,320	-$402,000	-$340,000	
Benefit Cost Ratio	0.27	0.24	0.36	

The analysis indicates that the conclusions reached are not overly sensitive to a reasonable range of changes in traffic growth, cost estimates and discount rate.

Table 8 - Sensitivity Analysis – North Side Frontage Road

Discount Rate	**6%**	**4%**	**8%**	**10%**
Discounted Cost	$660,000	$673,000	$648,000	$636,000
Salvage Value	$130,000	$210,000	$82,000	$52,000
Life Cycle Cost	$530,000	$463,000	$566,000	$584,000
User Benefits	$8,700	$11,000	$7,000	$6,000
Net Present Value	-$521,300	-$452,000	-$559,000	-$578,000
Benefit Cost Ratio	0.02	0.02	0.01	0.01
Cost Estimate		**50%**	**150%**	
Project Cost	$700,000	$350,000	$1,050,000	
Discounted Project Cost	$660,000	$330,000	$990,000	
Salvage Value	$130,000	$65,000	$195,000	
Life Cycle Cost	$530,000	$265,000	$795,000	
User Benefits	$8,700	$8,700	$8,700	
Net Present Value	-$521,300	-$256,300	-$786,300	
Benefit Cost Ratio	0.02	0.03	0.01	
Traffic Growth Rate	**1.8%**	**1.0%**	**3.5%**	
Life Cycle Cost	$530,000	$530,000	$530,000	
User Benefits	$8,700	$8,000	$11,000	
Net Present Value	-$521,300	-$522,000	-$519,000	
Benefit Cost Ratio	0.02	0.02	0.02	

The analysis indicates that the conclusions reached are not overly sensitive to a reasonable range of changes in traffic growth, cost estimates and discount rate.

Table 9 - Sensitivity Analysis – CMB at Offset Diamond at White Lake Road

Discount Rate	**6%**	**4%**	**8%**	**10%**
Discounted Cost	$140,000	$142,000	$137,000	$135,000
Salvage Value	$29,000	$46,000	$19,000	$12,000
Life Cycle Cost	$111,000	$96,000	$118,000	$123,000
User Benefits	$347,110	$428,000	$287,000	$242,000
Net Present Value	$236,110	$332,000	$169,000	$119,000
Benefit Cost Ratio	3.13	4.46	2.43	1.97
Cost Estimate		**50%**	**150%**	
Project Cost	$148,000	$74,000	$222,000	
Discounted Project Cost	$140,000	$70,000	$210,000	
Salvage Value	$29,000	$14,500	$43,500	
Life Cycle Cost	$111,000	$55,500	$166,500	
User Benefits	$347,110	$347,110	$347,110	
Net Present Value	$236,110	$291,610	$180,610	
Benefit Cost Ratio	3.13	6.25	2.08	
Traffic Growth Rate	**1.8%**	**1.0%**	**3.5%**	
Life Cycle Cost	$111,000	$111,000	$111,000	
User Benefits	$347,110	$307,000	$452,000	
Net Present Value	$236,110	$196,000	$341,000	
Benefit Cost Ratio	3.13	2.77	4.07	

The analysis indicates that the conclusions reached are not overly sensitive to a reasonable range of changes in traffic growth, cost estimates and discount rate.

3.7 Implementation

The options, if funded, are expected to be constructed over two construction seasons in concert with the overall project. This section provides a brief summary of the implementation issues and assesses coordination and technical risk issues.

3.7.1 Timing and Staging

The timing plan for the overall project is roughly characterized as follows:

- Design, Property Acquisition and Environmental Assessment/Mitigation – 2003/04
- Construction – 2003/04, 2004/05

While there is little opportunity to stage the overall project differently, the options considered within this report can be implemented separately at a later date. While improvement option costs are small in the overall project context, they will increase if undertaken separately at a later date due to increased start up costs as well as a more challenging public forum (discussed in the proceeding section).

Additionally, implementing the options at a later date introduces impacts to the roadway users and exposes traffic and working crews to construction zone hazards again at a later date, which is not quantified in the analysis, but is a significant consideration.

3.7.2 Coordination with Other Projects and Programs

The implementation of these improvement options in conjunction with the overall roadway upgrade project is consistent with the notion that costs associated with such minor operational improvements can be mitigated to an extent (for example, having grading equipment in the vicinity of the Kirkpatrick Road intersection during reconstruction would add significant efficiencies to undertaking the improvement option of closing the intersection). Waiting for other future maintenance or rehabilitation initiatives to implement these options will effectively increase their cost and introduce added potential for public opposition. Upgrades of the nature being described are consistent with the corridor planning initiatives for Highway 1 and primary corridor preservation initiatives in general.

The opportunity cost savings associated with implementation during the larger overall project have been estimated in Table 10, based upon a total construction cost of $1.2M (excluding property) for all four (4) improvement options.

Table 10 – Estimated Cost Savings With Concurrent Implementation

Cost Category	Savings
Mobilization (5%)	$ 60,000
Traffic Control (5%)	$ 60,000
Unit Prices (10%)	$ 120,000
Administration	$ 20,000
Total	**$ 260,000**

As noted in Table 10, significant savings or economies of scale can be expected in the form reduced overall contract administration as separate contracts for each or all of the identified improvements would be required for later implementation, leveraged costs for traffic control and equipment mobilization and reduced unit rates (note that due to availability limitations, unit rates have gone up 10% on more recent assignments such as the Swan Lake improvements).

3.7.3 Technical Risks

Given the terrain and previous work that has been completed in the area, the technical risks associated with these improvement option projects are minimal. The ALR represents the most significant land use risk since not all property has been acquired (for all but the CMB installation at White Lake Road, which occurs entirely within existing ROW), and some of the remaining property to be purchased is within the ALR.

The significant amount of road-building activity currently taking place in British Columbia represents a potential cost-control risk. With this level of activity, there is a risk of prices increasing with time (as has been shown to be the case at Swan Lake), further supporting shorter-term implementation. The sensitivity analysis showed that similar overall project performance conclusions can be reached when costs are increased by up to 50%.

Public sentiment regarding the improvement options should not pose a significant threat to the implementation of the options if they are undertaken in conjunction with the overall project. To date, support for the improvement options as described is evident.