

Infrastructure Canada

180 Kent Street / rue Kent 11th Floor / 11ième étage Ottawa, Ontario K1P 0B6

CUH# 229001
PECEIVED MINISTER'S OFFICE MINISTER OF TRANSPORTATION
AUG 0 6 2014
ORAFT REPLY FYL FILE

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Date AUG 0 6 2014

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то	Name of addressee Nom du destinations The Honourable Ted Stone, H.L.A. Minister of Transportation & Infrastructure	Facaimite no. Nº de télécopleur (250)356 - 2290
À	Government of British Columbia	# of pages, cover sheet included / # de pages, couverture comprise
FROM	Name of sender Nom de l'expéditeur The Honourable Denis Lebel Hin ister of Infrastructure, Goc (613)952-1690	Telephone no. № de téléphone (613) 952 - 1703

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Signature

Trans-Canada Highway Halakwa Bridge Project

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FTC/FCC 159-18188 (Rev. 1994/08) Word

M:\Finance Branch\Template\Fax transmittal

Cabinet du ministre de l'Infrastructure, des Collectivités et des Affaires intergouvernementales et ministre de l'Agence de développement économique du Canada pour les régions du Québec



Office of the Minister of Infrastructure, Communities and Intergovernmental Affairs and Minister of the Economic Development Agency of Canada for the Regions of Quebec

Otiews, Canada K1A 1M8

AUG D 6 2014

The Honourable Todd Stone, M.L.A.
Minister of Transportation and Infrastructure
Government of British Columbia
PO BOX 9055
Stn. Prov. Govt
Victoria, British Columbia V8V 9E2

Dear Minister Stone:

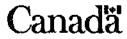
Further to the joint announcements on July 25, 2014, regarding the Trans-Canada Highway Malakwa Bridge project with the Province of British Columbia, I am pleased to formally advise you that the Government of Canada has identified the project as a priority for funding consideration under the Building Canada Fund-Major Infrastructure Component.

Under this program, the Government of Canada will consider an investment of up to 50 percent of the project's total eligible costs, to a maximum federal contribution of \$13 million.

While the Government of Canada is pleased to consider this project a priority for funding, I must impress upon you that this letter does not signify funding approval. More specifically, any potential federal funding of this project will be conditional upon:

- The completion of a federal project review that results in a determination that the project meets the Building Canada plan requirements. To this end, I understand your officials have already provided the information necessary for federal officials to undertake this project review;
- Fulfilling, where applicable, the requirements of the Canadian Environmental Assessment Act, 2012 and the requirements for Aboriginal consultations under section 35 of the Constitution Act, 1982;
- Upon the start of construction activities and/or other appropriate project milestones, the Province of British Columbia will ensure that signage is erected, which clearly displays current Government of Canada and Economic Action Plan branding in prominent locations at the project site. The Government of Canada will further confirm and communicate additional requirements and expectations from time to time in this respect; and

...2



The signing of a contribution agreement that will detail the project elements, schedule, costs and funding parameters.

I must also inform you that any project costs incurred before the federal approval-in-principle are ineligible for federal reimbursement. Further, any construction that begins before federal approval-in-principle could jeopardize that proposed funding. Should you choose to move forward with issuing a bid solicitation ahead of receiving the project's approval-in-principle, the document should clearly state that the awarding of any resulting contract is subject to federal funding being secured. Awarding of all contracts should only take place after you have been informed of federal approval-in-principle of funding for the project. The Government of Canada will have no obligation to enter into a contribution agreement or to reimburse any costs associated with a project for which a contract has been awarded ahead of federal approval-in-principle, as signalled through a letter from us.

Thank you for your collaboration to date, and I look forward to working with you on this important project.

Denis Lebel, P.C., M.P.

ours sincerely.

Ministre de l'Infrastructure, des Collectivités et des Affaires intergouvernementales et ministre de l'Agence de développement économique du Canada pour les régions du Québec

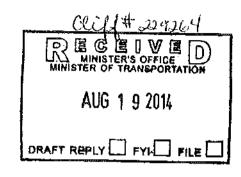


Minister of Infrastructure, Communities and Intergovernmental Affairs and Minister of the Economic Development Agency of Canada for the Regions of Quebec

1 2011

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The Honourable Todd Stone, M.L.A.
Minister of Transportation and Infrastructure
Government of British Columbia
Room 306
Parliament Buildings
Victoria, British Columbia V8V 1X4



Dear Minister Stone:

I am pleased to inform you of the federal approval-in-principle of funding for the Malakwa Bridge Replacement and Improvements project on the Trans-Canada Highway in British Columbia. This approval is given following a successful review of the project under the terms and conditions of the Building Canada Fund – Major Infrastructure Component (BCF-MIC).

As a result of this review, federal funding for this project from the BCF-MIC will be up to 50 percent of the total eligible project costs, to a maximum federal contribution of \$13,000,000 under this program.

Federal funding for the project from all sources (including funding from the BCF as well as funding from any other federal programs) cannot exceed 50 percent of the project's total eligible costs.

With this approval-in-principle, eligible costs as determined under the terms and conditions of the Building Canada Fund, and incurred as of the date of this letter, will be eligible for federal reimbursement, subject to the timely execution of a contribution agreement. If a contribution agreement is not signed, the Government of Canada will not reimburse any costs incurred. Once signed, the contribution agreement represents the final federal approval of the project.

Please note that the Government of Canada cannot contribute more than 15 percent of its funding towards non-capital or "soft cests". These costs include planning and assessment costs specified in the contribution agreement, for example, those related to environmental planning, surveying, engineering, architectural supervision, testing and management consulting services. More specifically, the Government of Canada will not contribute more than \$1,950,000 in soft costs.

As we move to the contribution agreement stage, the following conditions will also apply to the project:

 Regardless of the outcome of any of the project tendering processes, all inetigible costs, cost increases, any costs associated with funding shortfalls, and any costs related to the ongoing operation and maintenance of the project, will be the responsibility of the Province of British Columbia;

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- Any costs incurred prior to the date of this letter are ineligible for reimbursement;
- Any costs associated with a contract that has been executed prior to the date of this letter are ineligible for reimbursement;
- The Province of British Columbia will satisfy the Government of Canada with respect to the competitive and transparent tendering process to be established;
- The Province of British Columbia and the Government of Canada will work to complete an amendment to the existing contribution agreement in a timely manner and to this end the Province of British Columbia will provide verified cost estimates and projected cash flows broken down by fiscal year for all project components. The Province of British Columbia will also provide detailed and final design information, as this information becomes available; and
- The Province of British Columbia agrees to produce and erect temporary signage a minimum of 90 days before the start of construction or within 30 days after receipt of the accompanying letter from the Minister, whichever is later, at the project site acknowledging the federal government's contribution to the project, the cost of which will be an eligible cost under the contribution agreement. The signage will be produced in accordance with the design requirements to be provided by the Government of Canada, will be at least equivalent in size and prominence to other partners' signage and remain in place until 90 days after construction is completed.

My officials have informed me that the Province of British Columbia is targeting to begin construction on the project in fall 2014 with a view to completing construction by the end of fall 2016. Please note that the Province of British Columbia will be required to notify me in writing should delays of more than six months be expected in these start or completion dates.

The existing Agreement Monitoring Committee, which was established under the Canada-Province of British Columbia Building Canada Fund Agreement for National Highway System Infrastructure Projects, will oversee the projects' progress.

Thank you for your collaboration to date. I look forward to working with you on this project.

Yours sincerely,

Denis Lebel, P.C., M.P.

From: Marr, David TRAN:EX

Sent: Sunday, December 21, 2014 12:04 PM

To: Rutherford, Michael **Subject:** residual old BCF funds

Attachments: Upper Skeena Rec Centre Project Sheet 2014-11-14.docx; Hwy 1 - 216th Ave

Interchange 2014-08-26.docx

Hi Michael

Updated Numbers

• Savings/de-commitments under Communities Component have increased from \$.13,s.17 | believe that Christian Judd has advised accordingly, but do you need a new letter (ADM to ADM) to formalize?

• Another \$.13,\$.17 in project savings (West Coast Express project) under the Public Transit project Contribution Agreement have been confirmed and I believe that Transport Canada has, or will be, advising accordingly. Do we need to do another amendment to the CA to release the funds or is a schedule revision sufficient?

With respect to the projects put forward for consideration

s.13,s.16,s.17

David

Page 002 to/à Page 008

Withheld pursuant to/removed as

s.16;s.17

From: Marr, David TRAN:EX

Sent: Friday, May 16, 2014 8:57 AM

To: 'Rutherford, Michael'

Subject: as discussed: residual EBCF funds

Attachments: draft candidates list EBCF residual funds.xlsx

Michael

As discussed, our understanding of the residual funding under existing Building Canada Fund and the candidate projects list

David

s.16,s.17

Candidate Projects:

s.16,s.17

s.13,s.16,s.17

From: Marr, David TRAN:EX

Sent: Friday, February 27, 2015 11:35 AM

To: 'Rutherford, Michael' **Subject:** BCF BC priorities

Attachments: Scan_MPS005520150226.pdf

Michael

For your information; I believe that the attached is the basis for some political discussions commencing next week David

Page 013 to/à Page 014

Withheld pursuant to/removed as

s.16;s.13;s.17

From: Marr, David TRAN:EX

Sent: Wednesday, October 29, 2014 2:38 PM

To: 'Rutherford, Michael'

Subject: BCF-MIC

Attachments: Residual BCF Oct 2014.pdf

Michael

Priorities for residual funds under BCF-MIC

David

Page 016

Withheld pursuant to/removed as

s.16;s.13;s.17

From: Marr, David TRAN:EX

Sent: Friday, January 23, 2015 5:38 PM

To: Hallas, Mike J TRAN:EX

Subject: FW: Follow up questions on Hwy 77 Fort Nelson, Hwy 1 Hoffman's Bluff to Chase Creek,

and Hwy 1 - 216th Street

From: Wadasinghe, Cheryl [mailto:Cheryl.Wadasinghe@infc.gc.ca]

Sent: Friday, January 23, 2015 1:50 PM

To: Marr, David TRAN:EX

Cc: Rutherford, Michael; Chappell, Tegan; O'Connell, Cara; Ruffilli, Dean

Subject: Follow up questions on Hwy 77 Fort Nelson, Hwy 1 Hoffman's Bluff to Chase Creek, and Hwy 1 - 216th Street Hi David,

We are working through the initial reviews for several of the project submissions you sent us in December. In order to complete them we have identified some areas where we require additional information. Please see questions below – once we hear back from you we will be in a position to route our reviews to seek the Minister's agreement to prioritize these projects.

PTIC-NRP: Highway 77 - Fort Nelson River Bridge

In the description of the work to be completed as a part of the project, it is stated that the project will entail "replacing the single lane Acrow bridge with steel girders and a two lane concrete deck". Can you please clarify whether existing girders will also be replaced, or if the work only includes adding girders?

Can you please briefly describe how the construction of the second lane will affect the life of the existing asset? With respect to the benefits generated as a result of the project:

- Can you please provide more detail on how the project relates to new or significantly expanded large-scale development of natural resources, and
- How it represents opportunities for significant incremental economic benefit?

Further, can you share any information on the number and percentage of vehicles that must be diverted as a result of the bridge's inability to accommodate heavy and/or wide loads?

PTIC-NRP: Highway 1 - Hoffman's Bluff to Chase Creek

With respect to the negotiations with the Neskonlith Indian Band, can you please describe the planned process to for acquiring land and identify whether you anticipate any significant project delay risks?

In the list of prioritized projects received from the Province, Highway 1 Chase Creek Road to Jade Mountain is also listed. This project appears to abut the Hoffman's Bluff Project. Could you please share the rationale behind why these were not proposed as two components of one project?

BCF-MIC: Highway 1 – 216th street Interchange

Could you please provide a breakdown of eligible and ineligible costs for each of the two components (interchange and 6-laning extension)? It would seem that the project information sheet calculated the federal share based on 50% of total project costs for each component instead of eligible costs.

Thanks very much and have a great weekend!

Cheryl

Cheryl Wadasinghe

Principal Advisor, Transportation :: Conseiller principal, Transport

Economic and Community Initiatives :: Priority Initiatives, Policy and Communications Branch Suite 1100, 180 Kent St. Ottawa, ON K1P 0B6 :: Suite 1100, 180, rue Kent, Ottawa, ON K1P 0B6

cheryl.wadasinghe@infc.gc.ca

NEW ** Telephone :: Téléphone 613.946.2288 **

Facsimile:: Télécopieur 613.960.9649

www.infrastructure.gc.ca



Canadä

From: Marr, David TRAN:EX

Sent: Thursday, January 29, 2015 5:20 PM

To: 'Wadasinghe, Cheryl'
Cc: Hallas, Mike J TRAN:EX

Subject: Highway 1 - Hoffman's Bluff to Chase Creek - Fed Question

Cheryl

Re: query on Hwy 1 Hoffman's Bluff to Chase Creek

David

s.13,s.16,s.17

From: Marr, David TRAN:EX

Sent: Wednesday, December 24, 2014 11:21 AM

To:Rutherford, MichaelCc:Hallas, Mike J TRAN:EXSubject:New BCF project information

Attachments:

s.17

Michael

Merry Christmas and Happy New Year to you and yours Attached is project information for:

•

• s.17

•

David

Page 021 to/à Page 043

Withheld pursuant to/removed as

s.16;s.17

From: Marr, David TRAN:EX

Friday, February 13, 2015 8:19 AM Sent:

'Wadasinghe, Cheryl' To:

'Rutherford, Michael'; 'Chappell, Tegan' Cc: RE: Question regarding Hwy 1 - Illecillewaet Subject:

Hi Cheryl

s.13,s.16,s.17

From: Wadasinghe, Cheryl [mailto:Cheryl.Wadasinghe@infc.gc.ca]

Sent: Wednesday, February 11, 2015 1:44 PM To: Marr, David TRAN:EX

Cc: Rutherford, Michael; Chappell, Tegan **Subject:** Question regarding Hwy 1 - Illecillewaet

Hi David,

Hope all is well with you.

We will shortly be completing our initial review for the above project, and I am noting that this project seems very similar to a comparable project that was prioritized by BC under BCF-MIC in 2013. Noting the former proposal was costed at \$26M and that this one is costed at \$35M, and there are slightly different project components. We may get some questions about this as we go through approvals. My sense is the difference is due to the conceptual planning work that was undertaken after 2013, which redefined the project scope, and as such revised cost estimates. If you could confirm whether this is the case, or if there is a different explanation, that would be great. Any additional details much appreciated.

Best regards,

Cheryl

Cheryl Wadasinghe

Principal Advisor, Transportation :: Conseiller principal, Transport

Economic and Community Initiatives :: Priority Initiatives, Policy and Communications Branch Suite 1100, 180 Kent St. Ottawa, ON K1P 0B6 :: Suite 1100, 180, rue Kent, Ottawa, ON K1P 0B6

cheryl.wadasinghe@infc.gc.ca

NEW ** Telephone :: Téléphone 613.946.2288 **

Facsimile :: Télécopieur 613.960.9649

www.infrastructure.gc.ca





Page 046 to/à Page 267

Withheld pursuant to/removed as

s.16;s.17

Ministre de l'Infrastructure, des Collectivités et des Affaires intergouvernementales et ministre de l'Agence de développement économique du Canada pour les régions du Québec



Minister of Infrastructure,
Communities and Intergovernmental Affairs
and Minister of the Economic Development Agency
of Canada for the Regions of Quebec

Ottawa, Canada K1A 1M8

AUG 1 1 2014

The Honourable Todd Stone, M.L.A.
Minister of Transportation and Infrastructure
Government of British Columbia
Room 306
Parliament Buildings
Victoria, British Columbia V8V 1X4

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As a result of this review, federal funding for this project from the BCF-MIC will be up to 50 percent of the total eligible project costs, to a maximum federal contribution of \$13,000,000 under this program.

Federal funding for the project from all sources (including funding from the BCF as well as funding from any other federal programs) cannot exceed 50 percent of the project's total eligible costs.

With this approval-in-principle, eligible costs as determined under the terms and conditions of the Building Canada Fund, and incurred as of the date of this letter, will be eligible for federal reimbursement, subject to the timely execution of a contribution agreement. If a contribution agreement is not signed, the Government of Canada will not reimburse any costs incurred. Once signed, the contribution agreement represents the final federal approval of the project.

Please note that the Government of Canada cannot contribute more than 15 percent of its funding towards non-capital or "soft costs". These costs include planning and assessment costs specified in the contribution agreement, for example, those related to environmental planning, surveying, engineering, architectural supervision, testing and management consulting services. More specifically, the Government of Canada will not contribute more than \$1,950,000 in soft costs.

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 an amendment to the existing contribution agreement in a timely manner and to this end
 the Province of British Columbia will provide verified cost estimates and projected cash
 flows broken down by fiscal year for all project components. The Province of
 British Columbia will also provide detailed and final design information, as this
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- The Province of British Columbia agrees to produce and erect temporary signage a minimum of 90 days before the start of construction or within 30 days after receipt of the accompanying letter from the Minister, whichever is later, at the project site acknowledging the federal government's contribution to the project, the cost of which will be an eligible cost under the contribution agreement. The signage will be produced in accordance with the design requirements to be provided by the Government of Canada, will be at least equivalent in size and prominence to other partners' signage and remain in place until 90 days after construction is completed.

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The existing Agreement Monitoring Committee, which was established under the Canada-Province of British Columbia Building Canada Fund Agreement for National Highway System Infrastructure Projects, will oversee the projects' progress.

Thank you for your collaboration to date. I look forward to working with you on this project.

Yours sincerely,

Denis Lebel, P.C., M.P.



July 18, 2014

Jeff Moore, Assistant Deputy Minister Policy and Communications Infrastructure Canada 180 Kent Street, Suite 1100 Ottawa ON K1P 0B6

Reference: 228692

Dear Assistant Deputy Minister Moore:

Re: Contribution Agreement for Core National Highway System Projects Building Canada Fund – Major Infrastructure Component

I am writing to advise that we are forecasting approximately \$2.275 million in unleveraged federal funds against the \$187.089 million allocated under the Canada-British Columbia Contribution Agreement for Core National Highway System Projects.

This is based on our assessment of final eligible costs as the associated projects are complete, or in the case of Highway 97 Winfield to Oyama, substantially complete. The breakdown by project is outlined in the following table:

Dustant	Federal Contribution		
Project	Maximum	Forecasted	Unleveraged
Hwy 1 Clanwilliam Overhead	\$12,026,605.73	\$11,735,248.24	\$291,357.49
Hwy 1 Donald Bridge and Overhead	\$25,544,001.13	\$25,391,484.14	\$152,516.99
Hwy 97 Winfield to Oyama	\$26,829,973.96	\$24,998,938.64	\$1,831,035.32
		Total:	\$2,274,909.80

.../2

Fax: 250 387-7671

We are prepared to amend the Contribution Agreement to release the \$2,274,909.80 in federal funds from these projects for reallocation to other provincial priorities. This would augment the unallocated federal funds remaining under the Major Infrastructure Component of the Building Canada Fund and allow the advancement of new infrastructure projects and the realization of the associated economic benefits.

Sincerely

Kevin Richter

Assistant/Deputy Minister

Infrastructure and Major Projects Department

Copy to:

Grant Main, Deputy Minister

Nancy Bain, Assistant Deputy Minister Finance and Management Services



Infrastructure Canada

180 Kent Street / rue Kent 11th Floor / 11ième étage Ottawa, Ontario K1P 0B6

Cliff 229001
PECEIVED MINISTER'S OFFICE MINISTER OF TRANSPORTATION
AUG 0 6 2014
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FACSIMILE SERVICE // SERVICE DE TÉLÉCOPIEUR

Date AUG 0 6 2014

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Trans-Canada Highway Halakwa Bridge Project

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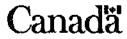
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While the Government of Canada is pleased to consider this project a priority for funding, I must impress upon you that this letter does not signify funding approval. More specifically, any potential federal funding of this project will be conditional upon:

- The completion of a federal project review that results in a determination that the project meets the Building Canada plan requirements. To this end, I understand your officials have already provided the information necessary for federal officials to undertake this project review;
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Thank you for your collaboration to date, and I look forward to working with you on this important project.

Denis Lebel, P.C., M.P.

ours sincerely.



Ottawa, Canada K1P 0B6

AUG 1 4 2014

Kevin Richter
Assistant Deputy Minister
Infrastructure and Major Projects Department
Minister of Transportation and Infrastructure
PO BOX 9850 Stn
Victoria BC V8W 9T5



Dear Mr. Richter:

Thank you for your letter of July 17, 2014, requesting the release of \$2,274,909.80 of unleveraged funding in the Canada-British Columbia Contribution Agreement for Core National Highway System Projects, under the Major Infrastructure Component of the Building Canada Fund (BCF-MIC).

I am writing to confirm that federal officials will reduce the federal contribution agreement by \$2,274,909.80. Subsequently, this amount will be returned to British Columbia's provincial allocation under BCF-MIC and will be made available for other infrastructure priorities identified by the Province of British Columbia. Transport Canada representatives will collaborate with provincial representatives in order to initiate the necessary amendments under the current agreement.

Thank you for your collaboration to date. I look forward to continuing to work together on infrastructure priorities for British Columbia.

Yours sincerely,

Jeff Moore

Assistant Deputy Minister Policy and Communications

cc. Jane Weldon Director General

Surface Infrastructure Programs

Transport Canada

Canada

4. - 41365

Page276 of 350 TRA-2015-51434



July 18, 2014

Jeff Moore, Assistant Deputy Minister Policy and Communications Infrastructure Canada 180 Kent Street, Suite 1100 Ottawa ON K1P 0B6 Reference: 228692

Dear Assistant Deputy Minister Moore:

Re: Contribution Agreement for Core National Highway System Projects Building Canada Fund - Major Infrastructure Component

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Hwy 97 Winfield to Oyama	\$26,829,973.96	\$24,998,938.64	\$1,831,035.32
		Total:	\$2,274,909.80

.../2

Fax: 250 387-7671

Location:

We are prepared to amend the Contribution Agreement to release the \$2,274,909.80 in federal funds from these projects for reallocation to other provincial priorities. This would augment the unallocated federal funds remaining under the Major Infrastructure Component of the Building Canada Fund and allow the advancement of new infrastructure projects and the realization of the associated economic benefits.

Sincerely

Kevin Richter

Assistant/Deputy Minister

Infrastructure and Major Projects Department

Copy to:

Grant Main, Deputy Minister

Nancy Bain, Assistant Deputy Minister Finance and Management Services



Highway 1: Malakwa Bridge and Four-Laning Business Case



David Retzer
BC Ministry of Transportation and Infrastructure
Southern Interior Region
June 03, 2014



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1. EXECUTIVE SUMMARY

BACKGROUND

Malakwa Bridge is located on the Trans Canada Highway #1 (TCH) approximately 20km east of Sicamous and 50km west of Revelstoke. The TCH has been identified by the Province of British Columbia as the primary east-west route for the movement of people and goods. It is crucial that this corridor performs to high standards of safety, reliability and efficiency. The TCH also has a larger significance as Canada's national highway, extending 7800km to connect the nation from coast to coast.

The section of the TCH between Cache Creek and the Alberta border is part of a provincial long-term 4-laning strategy. It has been the subject of a number of studies and reports, including the *Trans Canada Highway No.1 Investment Strategy Kamloops to Golden (Urban Systems, 2005)*, which identified replacing Malakwa Bridge as a priority improvement.



FIGURE 1: MALAKWA BRIDGE LOCATION

The average annual daily traffic (AADT) taken from a permanent count station 5km north of Malakwa Bridge (P-22-1) is approximately 6,000 vehicles/day (vpd), with summer traffic nearly 10,900vpd. The high summer traffic peaking is indicative of the TCH's role in providing tourist access to a variety of



destinations including the Rocky Mountains. Trucks comprise approximately 30% of total traffic.

The scope of this business case is to evaluate options for the replacement of Malakwa Bridge and 4-laning approximately 3.1 km of highway.

DEFICIENCIES

Malakwa Bridge is a narrow steel truss bridge, constructed in 1953. It is nearing the end of its service life and is showing signs of structural deterioration. In addition, its lack of shoulders, narrow lanes and low clearance creates a safety hazard for motorists and also prevents easy snow clearing during winter months. The combination of a narrow structure and its location at the end of a curve result in approaching vehicles crowding the centerline, increasing the risk of head-on collisions.

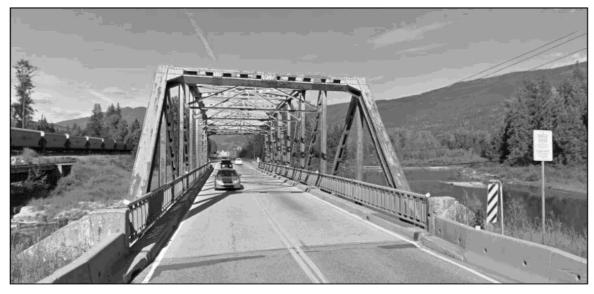


FIGURE 2: MALAKWA BRIDGE

Between 2002 and 2011 there were 34 collisions within the study area (Landmark Kilometer Inventory 20.1-22.9); including 10 at Malakwa Bridge. This number includes two fatalities both of which occurred in 2011. The narrow width of the bridge in relation to the surrounding roadway adds a considerable collision risk. This risk became realized in April, 2011 when two passing tractor trailers clipped one another on Malakwa Bridge. The crash resulted in one fatality and damaged three bridge beams, closing the TCH for approximately 19 hours while repairs and cleanup were undertaken. A coroner's report was prepared following this fatal crash, and it was stated that "The configuration of the bridge and the lack of painted



lines were contributory factors [to the crash]". Following this report, the Ministry of Transportation committed to safety improvements at the site, including "Planning for the upgrading of the bridge to normal highway dimensions" More recently, a collision on August 19, 2011 involving a motorcycle which rear ended a semi slowing on approach to the bridge also ended in fatality.

The crash in April 2011 which damaged the bridge structure illustrates a real danger of catastrophic bridge failure. A similar event occurred on a bridge over the Skagit River in Washington on Interstate 5. The Skagit River Bridge is a 58 year old truss structure. In May 2013 a truck with an oversized load struck the bridge which caused one of the spans to collapse into the river.



FIGURE 3: SKAGIT RIVER BRIDGE

This collapse severed the main highway through Washington and caused the approximately 70,000 vehicles per day to detour around the bridge for a month as repairs were undertaken a temporary structure was put in place. Detours around this bridge were fairly easily accessible and if a similar event were to happen at the Malakwa Bridge, the detour times would be orders of magnitude longer, as traffic would have to divert to another highway altogether. Travel times for vehicles traveling from the BC interior to Golden or Alberta, for example, would be forced to take detours of 4 hours or greater. Malakwa Bridge is a vital link to the lifeline of the province and any failure would be devastating to the



economy of British Columbia. A conservative estimate of a 1 in 75 year probability for catastrophic bridge failure was assumed for benefit-cost calculations. This generated a net cost of \$8.9M to road users who were forced to detour around the bridge during the repair period. However, sensitivity analysis was run on a 1 in 25 year scenario, which would incur road users \$25.7M in additional time and vehicle operating costs. In either scenario, it is clear that the risk and cost to road users is great. Improvement measures should be undertaken to reduce the reliability risk associated with this ageing structure.

REPLACEMENT STRATEGY

Malakwa Bridge is one of two remaining 1950's era steel truss bridges on the Trans Canada Highway. Malakwa Bridge was identified as a priority in the 2004 TCH Bridge Strategy. This strategy was based upon replacing aging and deteriorating structures that were the difficult, risky and expensive to rehabilitate. Structures already replaced in the TCH corridor include: Yoho and Park Bridges in the Kicking Horse Canyon, Clanwilliam O/H, Donald Bridge and Railway O/H. Malakwa and North Fork Bridges are the next priorities for replacement.

The Bridge Assessment System II (BAS II) is a methodology designed to rank a structure's sufficiency in terms of its condition and functionality. BAS II indices can be used as a tool for prioritizing structures for repair, rehabilitation or replacement. This consistent approach of calculating the index for bridge condition enables the ministry to track network condition trends with time. Malakwa Bridge is the 69th ranked BASII priority in the provincial inventory out of 4,160 large structures including bridges, culverts and retaining walls. It is the second ranked bridge structure on the Trans Canada and the third on the National Highway System, behind only Hwy 97N Quesnel O/H and Hwy 1 North Fork Bridge. All higher ranked structures are primarily on low volume side roads, or are timber structures or retaining walls and do not serve the same role and function of the TCH in terms of goods and people movement.

The bridge is in significant need of repair. Although bridge rehabilitation is not the recommended investment strategy, the following costs for rehabilitation requirements would be required to keep the bridge in service over the next 25 years:



Rehabilitation Description	Year Required	Cost Estimate (\$)	Duration (months)	Rationale / Comments
Removal of corrosion from steel members	2015	\$2.0M	2-3 months	Extensive rust and corrosion. Detour structure required; Integration with re-decking. Any member with major cross sectional loss will have to be replaced.
Full depth deck replacement including deck joints	2015	\$900k	6-8 weeks	Detour structure required; Integration with painting.
Detour bridge and approaches	2015	\$1.0M	2-3 weeks construction, plus duration of rehab works	Detour bridge required to maintain traffic flow during rehabilitation works. 2 Lanes, across, pier in middle, paved approaches
Bearing replacement	2015	\$100k	1 week	Jack up bridge and replace corroded, non-functioning bearings
Abutment rehabilitation	2015	\$200k	1-2 weeks	Stabilize and reset abutment rotation/movement
TOTAL		\$4.2M	4+ months	

The total for rehabilitation and detour construction is approximately \$4.2M and will be required in 2015. Rehabilitation works are not only expensive, but pose many risks to the environment including the fish bearing stream, and creates challenges for motorists. For instance, the existing paint primer is lead-based. Preparing the steel for re-painting as well as the re-painting itself would require full negative-pressure encapsulation (i.e. vacuum) of each member or section of structure to be painted to minimize risk to the Eagle River and related habitat and species below. In addition to the environmental risks, there are also human health risks associated with this hazardous procedure.

The rehabilitation works required dictate the use and construction of a detour bridge and associated approach tie-ins back to the Trans Canada Highway. Undertaking the rehabilitation works while maintaining single lane alternating traffic over the existing bridge is not feasible in the summer season given the high volumes of traffic utilizing the corridor. These works cannot be undertaken in the lower volume winter months due to cold winter weather and temperatures. Given the very narrow deck, construction staging for portions of the rehabilitation would require most of the available deck width.



The narrow 3.6m travel lanes and lack of shoulders pose a serious safety and reliability risk to the traveling public, including motorists, commercial vehicles and more vulnerable users such as pedestrians and cyclists.. Rehabilitating the existing structure would come at substantial cost and would prolong these safety hazard caused by bridge geometry and alignment. These conditions are further aggravated in the winter when snow build-up within the shoulders narrows the lanes even more, forcing vehicles into the centre of the roadway. Snow build-up is particularly severe on the steel truss bridges as the vertical truss members also prevent effective clearing to occur. Again, this is particularly troublesome when considering the high number of large heavy vehicles which rely on the corridor. A heavy truck collision with the bridge could result in severe damage that could require the bridge to be closed for repair or replacement – this would effectively close the entire Trans Canada Highway corridor through British Columbia and require lengthy detours.

Given that the structure is an overhead truss the existing geometric deficiencies in terms of narrow lane widths and non-existent shoulders cannot be improved as part of a rehabilitation strategy. The overhead nature of the structure design precludes these types of upgrades.

Malakwa and North Fork Bridge are the last two overhead truss structures on the Trans Canada Highway corridor through British Columbia. This places limitations on the transportation industry as large loads must bypass this corridor. Removing the load size impediments resulting from the physical limitations of the overhead truss design will benefit commercial truck transportation and is consistent with the Pacific Gateway Strategy of the Highway 1 through British Columbia. These height restricted structures are prone to vehicular impact from over-height vehicles, which can cause major traffic delay and expensive rehabilitation of damaged members.

Revising our investment strategy to focus rehabilitation on Malakwa Bridge would take much needed funding away from the preservation of other structures on the corridor which can be prolonged more effectively with rehabilitation works. Similarly, rehabilitation will not improve safety for the motoring public nor decrease risks associated with heavy vehicle collisions that could take the structure out-of-service. For these reasons, full replacement is considered necessary. Replacing and upgrading Malakwa Bridge and the approaches to a 4-lane standard consistent with the Provincial TCH 4-laning strategy is deemed the recommended course of action.



COST-BENEFIT

The benefit-cost ratio of this project is 1.3 with a net present value of \$4.9M. The total benefits of the Malakwa Bridge and 4-Laning project, discounted to current year, are \$23.2M. This includes safety benefits of \$7.5M, a net travel time/vehicle operating cost benefit of \$1.7M and a reliability benefit of \$14.1M. The project budget of \$35M includes approximately \$7.1M in spent and committed dollars. This includes planning, engineering, environmental costs, property acquisition and other committed costs. The benefit-cost evaluation calculates return on future investment and does not include these spent dollars. The total discounted costs equate to \$18.3M after including salvage value and avoided rehabilitation costs are included.

Additionally, this project also provides non-monetized benefit of upgrading the structure and surrounding roadway to a standard in line with the Trans Canada Highway strategy. The risk of a catastrophic bridge failure is greatly increased if no upgrades are undertaken. The opportunity costs of no action are significant.

Conclusion

Increasing volumes of commercial and recreational vehicles are highlighting the necessity for the Trans Canada Highway corridor to be upgraded. The Malakwa Bridge Project is a priority project within this corridor due to the risk of a catastrophic bridge failure with the exceedingly high consequences of closure of the highway severely affecting the national and provincial economies. Difficulties within the corridor have the potential to impact the strategic location of industries as well as the purchasing power of consumers and Canada in terms of trade. Strengthening Canada's position as a trading nation by investing in infrastructure improvements in the Trans Canada Highway Corridor trade is key to securing British Columbia's and Canada's collective economic prosperity now and in the future.



2. BACKGROUND

The proposed Malakwa Bridge replacement and 4-Laning project is located on a section of the Trans Canada Highway #1 which is classified as a primary rural arterial undivided 2 lane highway. Within the study area, the TCH serves as a link between communities such as Sicamous, Revelstoke and Salmon Arm. It also acts as the primary east-west corridor for goods movement, and has heavy tourist traffic in the summer months.

The section of highway under examination has been the subject of a number of reports including:

- Trans Canada Highway No.1 Investment Strategy Kamloops to Golden (Urban Systems, 2005)
- Trans Canada Highway Malakwa Bridge Business Case (CH2M Hill, 2007)
- Trans Canada Highway Malakwa Bridge Planning and Evaluation Study (CH2M Hill, 2007)
- Trans Canada Highway Malakwa Bridge Project Business Case Evaluation (Novatrans, 2007)
 - This business case was more in depth than CH2M Hill reports of the same year. It developed detailed options for replacement and project staging.

These reports identified Malakwa Bridge as a priority improvement and evaluated a number of options for rehabilitation, replacement and four laning.

TRAFFIC VOLUME

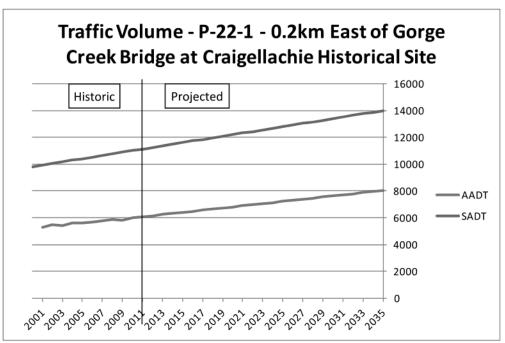


FIGURE 4: HISTORICAL AND PROJECTED AADT



The 2011 AADT was approximately 6000vpd 5km north of Malakwa Bridge at the Craigellachie Historical Site. Over the past 10 years, traffic volumes grew relatively steadily at an average of 1.1% per year. At this growth rate, the AADT is expected to reach over 8,000vpd by 2036, with SADT nearing 14,000vpd. To account for potential future economic growth and investment, a growth rate of 1.5% was used in all benefit-cost analysis.

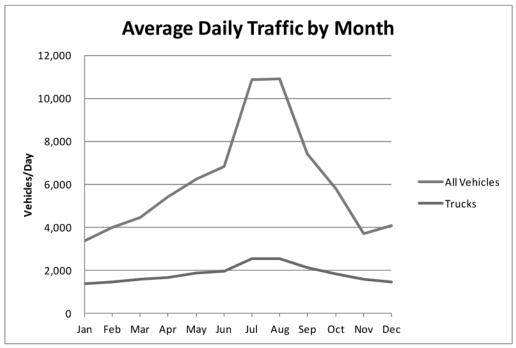


FIGURE 5: TRAFFIC VOLUME BY MONTH

The monthly traffic trend shows significant variation, peaking in the July and August months. The tourist traffic during these summer months inflates the volume to a number nearly three times that of the winter months.

Heavy truck volume varies considerably less throughout the year. However, in a relative sense, it ranges from 23% of overall traffic in July and August to a maximum of 42% in November for a yearly average of approximately 30%. The high level of truck traffic outlines this corridor's important role in goods and resource movement. Maintaining a high level of safety, reliability and efficiency is vital in supporting the economy of British Columbia.

Any load restriction due to a failing structure is unacceptable. The proposed Malakwa Bridge and 4-laning project aims to mitigate this risk and increase safety and mobility as part of the Ministry's vision for this corridor.



3. PROJECT DESCRIPTION

Malakwa Bridge is located on the TCH on Landmark Kilometer Inventory (LKI) 0962 at kilometer 20.76. The proposed section of 4-laning begins at kilometer 20.1 at the end of the current 4-lane section, and extends east to kilometer 23.2 (east of Ackerman Road).



FIGURE 6: CORRIDOR OVERVIEW MAP

FOUR LANING AND ACCESS MANAGEMENT

The design criteria for 4-laning follows the TCH corridor 100km/h standard and includes 3.7m lanes, 2.5m shoulders and a 2.6m flush median.

Access consolidation will be provided throughout the project length. A new full movement intersection will be provided by connecting Dump Rd with the Oxbow Frontage Rd. The Ackerman\Hickson Road will be re configured to two three legged intersections. The north side of Ackerman\Hickson will be accessed from the existing location. The south leg will be relocated 300m to the north and tie in to Cunningham Frontage Road. Full option drawings are provided in Appendix 5.

BRIDGE

Five bridge replacement options (and one sub-option) were identified:

Option 1 (Concept A): Replacement Structure is a new 56.0 m long <u>single span</u> bridge (WBL) and a new 72.0 m long <u>single span</u> bridge upstream (EBL). The superstructure of both bridges is comprised of steel I-girders, with a superstructure depth of 3.2 m. The deck elevation of both bridges is El. 372.9 m



Option 2 (Concept B): Replacement Structure is a new 55.2 m long two span bridge (WBL) and a new 72.0 m long two span bridge upstream (EBL). The piers of the upstream bridge consist of an elevated concrete cap supported on a single row of 610 mm steel pipe piles. The superstructure of both bridges is comprised of concrete I-girders, with a superstructure depth of 2.1 m. The deck elevation of both bridges is El. 371.8 m

Option 3 (Concept C): Replacement Structure is a new 55.2 m long two span bridge (WBL) and a new 97.5 m long three span bridge upstream (EBL). The piers of the both bridges consist of elevated concrete caps supported on a single row of 610 mm steel pipe piles. The superstructure of both bridges is comprised of concrete I-girders, with a superstructure depth of 2.1 m. The deck elevation of both bridges is El. 371.8 m

Option 3a (Concept C): Single clear 49.3m span steel structure for the westbound lane, and a 97.5m three span steel structure (24.75m-48.0m-24.75m) which consists of two intermediate piers (one in river) for the eastbound lane at Malakwa Eagle River crossing.

Option 4 (Concept D): Replacement Structure is a new 56.0 m long two span bridge (WBL) and a new 86.0 m long three span bridge upstream (EBL). The piers of the both bridges consist of elevated concrete caps supported on a single row of 610 mm steel pipe piles. The superstructure of both bridges is comprised of concrete box girders, with a superstructure depth of 1.3 m. The deck elevation of both bridges is El. 371.0 m

Option 5 (Concept E): Replacement Structure is a new 54.05 m long three span bridge (WBL) and a new 88.0 m four span bridge upstream (EBL). The piers of the both bridges consist of elevated concrete caps supported on a single row of 610 mm steel pipe piles. The superstructure of both bridges is comprised of concrete box girders, with a superstructure depth of 1.0 m. The deck elevation of both bridges is El. 370.7 m

The preferred option is 3a. This is a refined concept from Option 3, eliminating a river pier from the original 2-span 55.2m westbound structure, and with an increased centre span from 37.5m to 48m at the eastbound structure. This option potentially presents a good balance between cost, constructability, hydraulics, geometric requirement and environmental impacts.

The design stage of this project has been completed. Highway design, bridge design and property acquisition was carried out in 2012/13, and the projected tender date is summer 2014.

The estimated total project cost is \$35M. This includes \$23.8M for road/bridge construction and supervision and \$3.9M for property acquisition. Engineering, project management and are all additional costs to construction. A contingency of \$2.0M has been be applied to these costs to come up with the total project cost.



4. MULTIPLE ACCOUNT EVALUATION

A multiple account evaluation (MAE) was conducted for the project. This evaluation framework includes five accounts:

- Financial describes the project costs, including engineering, construction maintenance and rehabilitation.
- Customer Service describes the expected benefits to users. Time, accident and vehicle operating cost savings are included in this account.
- Economic describes the magnitude and significance of the broader economic impacts of the project.
- Environmental describes water, air, natural habitats, recreation and archaeological impacts.
- Social describes indirect impacts on communities and residents.

The financial and customer service accounts are quantified in dollar terms. Incremental benefits and costs are calculated over a 25 year planning period and discounted at a rate of 6% to calculate the benefit cost ratio and net present value. The inputs used in the analyses are shown in the following table:



4.1. GENERAL ASSUMPTIONS

	Malakwa 4-Laning	Malakwa Bridge
Segment	962	962
from LKI	20.1	20.70
to LKI	23.2	20.76
Length (km)	3.1	0.056
	Traffic	2
Perm Count	P-22-1EW	P-22-1EW
Segment	962	962
Location (LKI)	25.4	25.4
AADT (2010)	6085	6085
Projected Growth	1.50%	1.50%
Historical Growth %	1.10%	1.10%
Historical Growth (AADT/yr)	95	95
% Trucks	30%	30%
	Base Ca	se
Posted km/hr	100	100
Cross section	RAU2	RAU2
Lane width (m)	3.6	3.6
Median width (m)	0	0
Shoulder width (m)	2.5	0
	Proposed	Case
Posted km/hr	100	100
Cross section	RAU4	RAU4
Lane width (m)	3.7	3.7
Median width (m)	2.6	2.6
Shoulder width (m)	2.5	2.5

TABLE 1: GENERAL ASSUMPTIONS

4.2. FINANCIAL ACCOUNT

Construction Costs – The current construction cost estimate is \$23.8M for road/bridge construction. A contingency of \$2.0M will be applied for benefit-cost calculations

Sunk Costs - The project budget of \$35M includes approximately \$7.1M in spent and committed dollars. This includes planning, engineering, property acquisition, environmental costs, and committed costs such as water and sewer upgrades. Should this project not go forward, the majority of this would be throwaway cost. These sunk costs have not been included in the benefit-cost calculations.



Property Costs – Property acquisitions have been completed. Eleven properties are impacted by this project.

Annual Maintenance Costs – Annual highway maintenance costs were estimated at \$4000 per lane-kilometer, based on existing Ministry of Transportation maintenance contracts that expire in 2013.

Resurfacing Costs – Resurfacing costs for the highway were estimated using a rate of \$125,000 per lane-kilometer, assuming resurfacing at 15-year intervals. This section of highway is scheduled for resurfacing in 2022.

Pavement condition ratings (PCR) were determined from the Roadway Pavement Management System (RPMS):

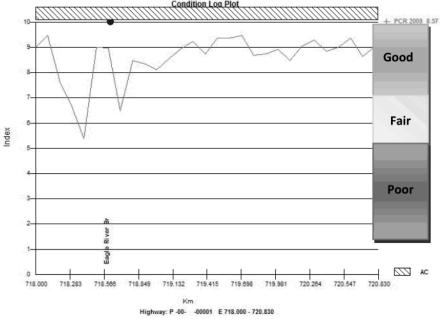


FIGURE 7: PAVEMENT CONDITION HISTOGRAM

PCR ratings over 7 are considered good, while under 7 is considered fair.

This study area was repaved in 2007 as part of the annual resurfacing program. The pavement condition is generally good throughout the study area, with two rough spots at either side of Malakwa Bridge. This is common at bridge approaches.

Avoided Rehabilitation Costs – By replacing Malakwa Bridge, an estimated \$4.2M of rehabilitation works can be avoided, as outlined in the following table:



Rehabilitation Description	Year Required	Cost Estimate (\$)	Duration (months)	Rationale / Comments
Removal of corrosion from steel members	2015	\$2.0M	2-3 months	Extensive rust and corrosion. Detour structure required; Integration with re-decking. Any member with major cross sectional loss will have to be replaced.
Full depth deck replacement including deck joints	2015	\$900k	6-8 weeks	Detour structure required; Integration with painting.
Detour bridge and approaches	2015	\$1.0M	2-3 weeks construction, plus duration of rehab works	Detour bridge required to maintain traffic flow during rehabilitation works. 2 Lanes, across, pier in middle, paved approaches
Bearing replacement	2015	\$100k	1 week	Jack up bridge and replace corroded, non-functioning bearings
Abutment rehabilitation	2015	\$200k	1-2 weeks	Stabilize and reset abutment rotation/movement
TOTAL		\$4.2M	4+ months	

The cost of the rehabilitation is approaching the estimated cost of a new bridge structure and will provide none of the safety and reliability benefits associated with the proposed option.

Salvage Value – In calculating salvage value, it was assumed that project elements including project management, planning and design and contingencies have service lives of 0 years. Structures were assumed to have a service life of 75 years. All other construction was assumed to have a service life of 50 years. All property acquisition costs assume a service life of 100 years. Highway resurfacing was assumed to have a service life of 15 years.

Life Cycle Cost – The life-cycle cost considers construction cost, salvage value, rehabilitation and maintenance costs. A discount rate of 6% over the 25-year analysis was applied.

4.3. Customer Service Account

Cost Benefit Analysis (CBA) has been undertaken for the preferred option as the primary evaluation tool. Highway Capacity Software (HCS) was used to estimate travel speeds in the base and proposed case.

Travel Time and Vehicle Operating Costs – Estimates of travel time and vehicle operating costs were evaluated using the Ministry's ShortBen spreadsheet. Hourly volumes were taken from perm count



station P-22-1 for the entire calendar year. These volumes were then ranked by magnitude. Low, shoulder and peak hourly volumes were estimated as an average of the following hourly volume ranges:

Low: <2% of AADT
Shoulder: 3-9% of AADT
Peak: >10% of AADT

Travel speed increases for each volume range were estimated using the HCS outputs for 2 lane vs. multilane. Value of travel time was estimated assuming \$29.16 per hour for trucks and \$15.94 per passenger vehicle occupant. Typical occupancy rates of 1.0 for trucks and 1.3 for cars were applied.

Reliability

Additional travel time savings may be realized due to avoided highway closures. In 2011 alone there were two collisions at Malakwa Bridge which caused extensive closures. Vehicles wishing to travel through the project area would have to take detours of up to 6 hours in length. Additionally, some drivers may choose to avoid a trip altogether.

Due to the uncertain and infrequent nature of these events, and the unpredictability of driver behavior, it was assumed that the total closure time was the most accurate predictor of driver delay. Closure times were averaged from DriveBC data over the 6 year period between 2005 and 2011. On average there were 4.4 hours of closures per year. These closures were concentrated at Malakwa Bridge, and were assumed to be eliminated with the construction of a wider 4-lane structure. A 2x travel time value multiplier for trucks and passenger vehicles was applied (TTI 1997, UBCS Guidebook P.37).

Based on the age of the bridge, its geometric deficiencies and the overhead truss style construction, there is also a risk of catastrophic failure due to vehicle impact. An event occurred on a similar structure on the Interstate 5 in Washington in May 2013. This collapse severed the main highway through Washington and caused the approximately 70,000 vehicles per day to detour around the bridge for a month as repairs were undertaken a temporary structure was put in place. Detours around this bridge were fairly easily accessible and if a similar event were to happen at the Malakwa Bridge, the detour times would be orders of magnitude longer, as traffic would have to divert to another highway altogether. Travel times for vehicles traveling from the BC interior to Golden or Alberta, for example, would be forced to take detours of 4 hours or greater. Malakwa Bridge is a vital link to the lifeline of the province and any failure would be devastating to the economy of British Columbia.

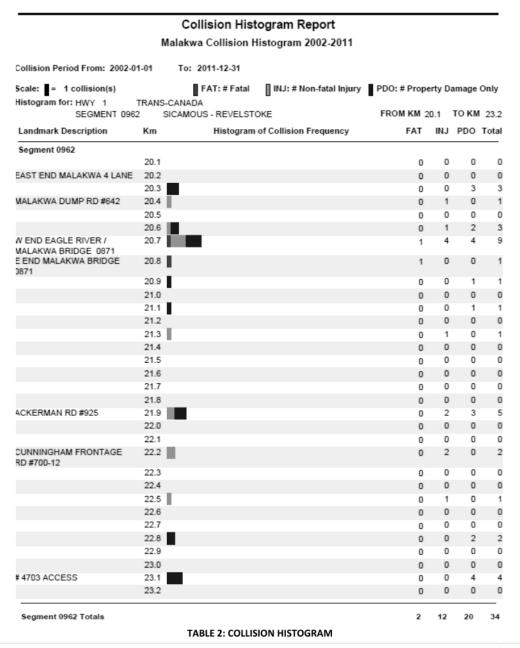
For user cost calculations, a 1 in 75 year probability of a catastrophic failure was assumed. A conservative estimate of an additional 3.75 hours of travel was assumed for all vehicles. Trans Canada traffic would then detour for one month while a temporary structure was put in place. The most common detour routes would be Highway 3 and Highway 5, and increasing the traffic on those corridors would decrease average vehicle speed by an assumed amount of 10km/h. After the temporary bridge is put in place, an 18 month replacement period was estimated for the original structure, where reduced speed limits of 50km/h would be in effect. Although the exact probability of catastrophic failure is unknown, there is



likelihood that the risk is even greater. For sensitivity analysis (Figure 14), a 1 in 25 year scenario was assumed, which outlines the severe magnitude of potential impacts to road users.

Collision Costs – Collision data used in the analysis was extracted from the Collision Information System (CIS) database. The full years between 2002 and 2011 were used to analyze past safety performance.

Default collision cost values were taken from the 2012 MicroBenCost default values (\$6.39M for fatal collisions, \$0.14M for injury collisions and \$11,367 for property damage only collisions).





Collision rates for the study area were estimated using the CIS data. These rates were compared to 2003-2007 provincial average rates to determine relative performance. The SafetyBenCost spreadsheet was utilized to estimate collision reductions using collision modification factors (CMF) as outlined in CMF's for BC (2008). Additional detail is provided in Appendix 5.

Safety Indicators	
Study Area Collision Rate	0.51coll/Mv(km)
Provincial Average Rate	0.48coll/Mv(km)
Provincial Critical Rate	0.92coll/Mv(km)
Collision Severity Index	10.00
Provincial Average Severity	6.20

TABLE 3: SAFETY INDICATORS

The collision rate of this section of highway is just above the provincial average for a rural arterial undivided 2-lane highway. Additionally, the two recent fatalities which occurred in the project area in April and August of 2011 drive the severity above the provincial average.

The existing %fatals for safety benefit calculations was adjusted upward to 3% from the provincial average of 2.55%. This is due to the uncertain and unlikely nature of fatalities. Although two of the 34 collisions were fatals, a larger sample size is needed to have confidence in the actual severity proportions.

The first fatal collision occurred when an eastbound tractor-trailer hauling a wide load side-struck a westbound tractor trailer which then made contact with the side of the bridge. The driver of the westbound vehicle was killed and the TCH was closed for approximately 19 hours while investigation, cleanup and emergency repairs were undertaken. The photo on the following page illustrates the aftermath of the crash.



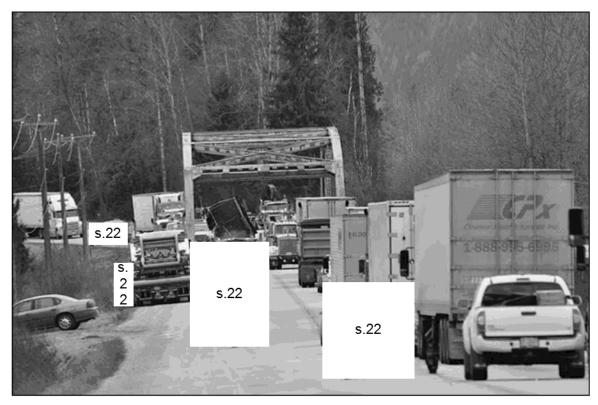


FIGURE 8: FATAL COLLISION APRIL 2011

This collision exemplifies the increased safety risk of the narrow structure, and also the structure's vital importance to the operation of the TCH. As a result of the closure, costly and extensive detours of up to 6 hours were undertaken.

Coroner's Report

A coroner's report was prepared following this fatal crash, and it stated that "The configuration of the bridge and the lack of painted lines were contributory factors [to the crash]". The RCMP Collision Reconstructionist made the following observations "the total width of the bridge deck was 7.3 metres. A standard travel lane has a width of 3.65 metres to 3.7 metres. With a paved shoulder, a standard two-lane roadway would measure 7.3 to 7.4 metres, for a total width of 10.3 to 10.4 metres. This would allow a width of 5.1 to 5.2 metres for each lane. As such, the Eagle River Bridge was 3.0 to 3.1 metres narrower than a normal two-lane roadway." Following this report, the Ministry of Transportation committed to safety improvements at the site, including "Planning for the upgrading of the bridge to normal highway dimensions". A full bridge replacement is the only feasible way to provide appropriate geometry to ensure the future safety of the traveling public.

The full coroner's report can be found in Appendix 7.



More recently, a collision on August 19, 2011 involving a motorcycle which rear ended a semi slowing on approach to the bridge also ended in fatality.

RCMP have also investigated these collisions and identified the following contributing factors: narrow structure, lack of line painting, lack of signage. While flying over the bridge site, they also noticed that most semis and general traffic crowd the center line of the bridge.

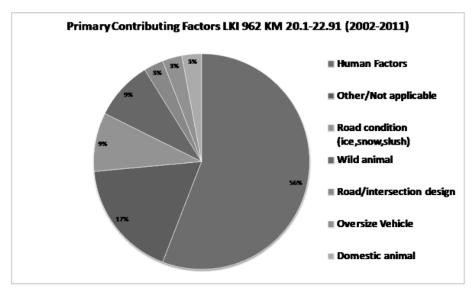


FIGURE 9: PRIMARY CONTRIBUTING FACTORS

Collisions occurring in the study area were largely caused by human factors. The contributing factors classified as "human factors" are also related to the combination of the highway, driving and traffic conditions encountered within the study area.

The most common human factor, "driving too fast for condition" accounted for a total of 6 collisions. The remaining collisions causes were widely dispersed. It is worth noting that one collision which occurred in September 2008 involving a truck\camper with trailer and a bicycle resulted in injury and was attributed to "road\intersection design". This collision occurred approximately 100m west of Malakwa Bridge.



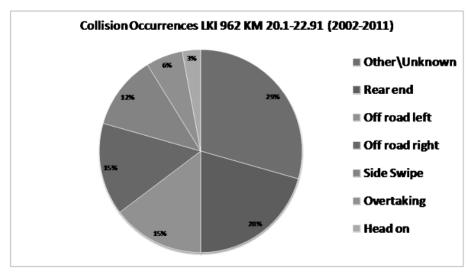


FIGURE 10: COLLISION OCCURRENCES

The most common collision occurrences included rear-enders accounting for five, and off road left and right made up a combined total of 10.

Although trucks make up approximately 30% of the total traffic, collisions involving heavy trucks accounted for over 40% of all collisions. With the exception of the fatality in August 2011, all of the truck collisions occurred in the winter months, between November and March.

The following figure outlines the collision occurrences by month. The collision occurrences peak in the winter months, with a drop off in the spring and a moderate increase during the summer months when tourist traffic is heavier.

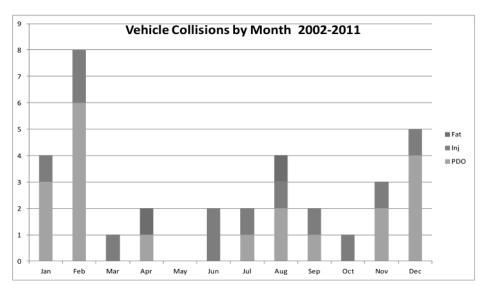


FIGURE 11: VEHICLE COLLISIONS BY MONTH



Level of Service – The level of service and other mobility indicators were calculated using HCS Version 5.5.

Volume Range (vph)	% of AADT	Base Case Travel Speed (km/h)	Base Case LOS	% Time Spent Following (Base Case)	Proposed Case Travel Speed (km/h)	Proposed Case LOS
Low : <152 vph (2% of AADT)	13.1%	92.4	A/B	36%	96.7	A
Shoulder: >= 153 vph to <578 vph (3-9% of AADT)	55.9%	87.1	B/C	54%	96.7	Α
Peak: >= 579 vph (>=10% of AADT)	31.1%	82.3	D	72%	96.7	А

TABLE 4: MOBILITY INDICATORS

The existing level of service ranges from a rating of 'A/B' in the low period to 'D' in the peak period. The low level of service in the high volume period is due to vehicles spending a high proportion of time in queues following other vehicles. The proposed four-laning eliminates this queuing and the level of service is 'A' in all volume scenarios.

Vehicle Operating Cost Savings – Operating costs were estimated using 2012 MoT default values. Using the annual travel time estimates, annual vehicle operating costs were generated for the 25 year analysis period and discounted back to 2012 at 6% per annum.

4.4. ECONOMIC ACCOUNT

The project budget of \$35M includes approximately \$7.1M in spent and committed dollars. This includes planning, engineering, environmental costs, property acquisition and other committed costs. The benefit-cost evaluation calculates return on future investment and does not include these spent dollars.



The following benefit-cost analysis includes all user benefits and project costs over a 25-year analysis period with future values discounted back to present day at a discount rate of 6% per year. Total discounted benefits and costs are approximately \$23.2M and \$18.3M, respectively, equating to a benefit-cost ratio of 1.3.

Proposed Option		
Benefits		
Safety	\$	7,452,318
4-Laning Travel Time	\$	3,548,036
4-Laning Vehicle Operating Costs	-\$	1,878,911
Reliability due to Avoided Closures	\$	5,116,562
Catastrophic Failure Avoidance	\$	8,975,213
Total Discounted Benefits	\$	23,213,218
Costs		
Property Acquisition	N	/A (Property Acquired)
Engineering, Enviro, Planning & Admin	\$	1,728,245
Salvage Value	-\$	4,793,575
Construction and Proj. Man incl. Contingency	\$	26,196,754
Maintenance and Resurfacing	\$	523,489
Avoided Rehabilitation Cost	-\$	3,737,985
Total Discounted Costs	\$	18,336,268
Summary		
Net Present Value (NPV)	\$	4,876,950
Benefit-Cost (B/C) Ratio		1.3

Future Costs and Benefits are Discounted at 6%/year FIGURE 12: COST BENEFIT ANALYSIS

4.5. ECONOMIC DEVELOPMENT ACCOUNT

The TCH has been identified by the Province of British Columbia as the primary east-west route for the movement of people and goods. It is heavily used in commercial trucking with a yearly average of 30% trucks. It is crucial that this corridor performs to high standards of safety, reliability and efficiency. The TCH also has a larger significance as Canada's national highway, extending 7800km to connect the nation from coast to coast.

The section of the TCH between Cache Creek and the Alberta border is part of a provincial long-term 4-laning strategy. Upgrading this section of highway to will provide assured passing opportunity and also address the pinch point associated with the narrow Malakwa Bridge.

It is recommended that the Malakwa Bridge and 4-Laning project be put forward as a candidate in a federal cost-share. This will bring the cost to the province down considerably and increase value for money.



4.6. ENVIRONMENTAL ACCOUNT

A preliminary environmental impact assessment was undertaken by Summit Environmental Consultants Ltd. in 2006. This report concluded that "much of the land in the project area is already highly disturbed by various land use activities including agriculture and the Canadian Pacific Railway, which runs parallel to the TCH through the project area." This report also stated that a more detailed study was necessary to examine "major crossings of known salmonoid streams...as well as a number of smaller crossings, culverts and wetlands of suspected fish-bearing status." As shown in the photo below, there is existing signage next to Malakwa Bridge which identifies the Eagle River as a salmon habitat. Due to this environmentally sensitive area, construction will have to be planned according to environmental windows.



FIGURE 13: EAGLE RIVER

A detailed environmental impact assessment was completed in February, 2014. The assessment and the CEAA documentation were submitted onto the Government of Canada (Transport Canada and Infrastructure Canada) on June 4, 2014.

4.7. SOCIAL ACCOUNT

There social/community effects of this project are generally minimal.

Although no reserves were directly impacted, the project falls within the traditional territory of the Lakes Division, Little Shuswap Indian Band and the Okanagan Indian Band. Provincial First Nations consultation was initiated December 2011 and there has been ongoing consultation since that date to present.



A public open house occurred on September 12, 2012

4.8. FEDERAL OBJECTIVES

As this project is being considered for federal cost sharing, it is necessary that any proposed option meet the Transportation Association of Canada (TAC) standards. For the Trans Canada Highway these standards include a 4-lane 100km/h design. Any new construction must meet these standards. A "do-minimum" scenario of bridge rehabilitation will not meet these federal guidelines due to narrow lane widths and lack of shoulders. Therefore, pursuant to the Trans Canada Strategy and to ensure system consistency, the proposed option of bridge replacement and 4-laning is recommended.

5. MAE SUMMARY

Multiple	e Account Ev	aluation Summary Table
	Hwy 1 Malakwa Bridge And 4-Laning	Comment
Customer Service Account:		
Travel Time Savings	\$3,548,036	
Collision Savings	\$7,452,318	Improved geometrics
Vehicle Operating Cost Savings	-\$1,878,911	Increased costs due to higher speeds
Reliability Savings	\$5,116,562	
Avoided Catastrophic Closure Savings	\$8,975,213	
Total Present Value Benefits	\$23,213,218	
Economic Account:		
Net Present Value	\$4,876,950	
Benefit/Cost Ratio	1.3	
Construction Jobs (person Years)	103	Anticipated employment impact from construction
Environmental Account:		
Carbon Dioxide (tonnes/year)		Higher operating speeds increase emissions
Nitrogen Oxide (tonnes/year)		Higher operating speeds increase emissions
Hydrocarbons (tonnes/year)		Higher operating speeds increase emissions
Rare Plants and Species	Minimize Impact	Minimize impact subject to pending Environmental Assessment
Social Account:		
Community Support	Positive Impact	Posititive feedback from the community
Other Factors/Risks:		
Utilities	Minimize Impact	Coordinate construction schedule early in process
First Nations	Minimize Impact	
CN	Minimize Impact	CN Rail Crossing at Ackerman Road

TABLE 5: MAE TABLE



6. RISKS AND SENSITIVITY ANALYSIS

6.1. SENSITIVITY ANALYSIS

Sensitivity analysis was undertaken on all key input assumptions:

- Baseline of 6% discount rate and 1.5% traffic growth
- Discount rates of 4% and 10% Construction cost +/-25%
- Construction cost -25%/+25%
- Traffic growth rate of 1.0% and 2.0%
- Catastrophic failure event probability 1 in 25 years at 6% and 10% discount rates

		% Discount e (Baseline)	% Discount Rate	10	0% Discount Rate	c	-25% onstruction Costs	c	+25% onstruction Costs	Tra	affic Growth 1%	Tra	affic Growth 2%	Faile	Catastrophic ure 1 in 25 Year Event @ 6% iscount Rate	 Catastrophic ilure 1 in 25 Year Event @ 10% Discount Rate
Total Discounted Costs	\$	18,336,268	\$ 15,457,138	\$	20,358,500	\$	13,890,606	\$	22,781,930	\$	18,336,268	\$	18,336,268	\$	18,336,268	\$ 20,358,500
Total Discounted Benefits	\$	23,213,218	\$ 28,803,437	\$	16,331,757	\$	23,213,218	\$	23,213,218	\$	22,926,092	\$	23,717,174	\$	39,963,644	\$ 28,225,682
NPV	\$	4,876,950	\$ 13,346,300	-\$	4,026,744	\$	9,322,612	\$	431,288	\$	4,589,824	\$	5,380,906	\$	21,627,376	\$ 7,867,182
B/C Ratio	L	1.3	1.9		0.8		1.7		1.0		1.3		1.3		2.2	1.4

FIGURE 14: SENSITIVITY ANALYSIS

The results of the sensitivity analysis show that benefit-cost ratios and net present values are generally very good across nearly every scenario. The B/C only ratio dips below 1.0 in the 10% discount rate scenario. However, if a less conservative 1 in 25 year catastrophic failure event is assumed, even at a 10% discount rate, the B/C ratio and NPV are 1.4 and \$7.8M, respectively.

6.2. CRITICAL RISK FACTORS

The project falls within the traditional territory of the following bands:

- Lakes Division (Adams Lake Indian Band, Neskonlith Indian Band, Splats'in First Nation)
- Little Shuswap Indian Band
- Okanagan Indian Band

Consultation has been initiated and discussion will continue as the project moves forward.

The CP Railway runs adjacent to the TCH throughout the majority of the project area. Property negotiations with CP are high risk. Impacts to CP Rail properties should be avoided if possible.





FIGURE 15: RAIL CROSSING AT HICKSON RD

This project is located in an area where construction risk is expected to be low. However, design is in an early stage, thus costs are based on limited information. Inflation and other supply and demand factors may become an issue with respect to tender prices should this project advance. Oil and steel prices are recent examples of inflation risk impacting construction projects. The supply of contractors in relation to the demand for their service can also pose a risk in terms of potential prices. These factors can be difficult to forecast and are not accounted for in this analysis.

Should this project advance at a future date, all unit costs should be re-examined in light of current trends and anticipated supply and demand factors of that date.

A significant risk to this project is disruption to vehicles during construction. This includes excessive delays due to highway closures which creates public discontent and impacts the movement of commercial goods. Sound investigation and prediction of closures must be undertaken. Consultation with stakeholders and communication with the public should be carried out to determine adequate traffic management during construction. The magnitude of this risk will be minimal as the proposed option is



construction off-line. Additionally, the recommended bridge option consists of separate structures for the east and westbound directions. This will allow the majority of work to be carried out offline, which will minimize closure time.

7. Project Implementation

7.1. PROJECT SCHEDULE

Project Initiation meeting	May 17, 2011
50% Functional Hwy Design / 50% Conceptual Bridge Design	July 10, 2012

Value Audit – Hwy Design/Bridge Design

Open House

Deliverable

100% Functional Hwy Design /100% Conceptual Bridge Design

Final Property Acquisition Plans

100% Detailed Design

Tender Package

May 17, 2011	
July 10, 2012	
August 28, 2012	
September 12, 2012	
October, 2012	
October, 2012	
July, 2013	

June, 2014

Projected Completion Date

7.2. PROCUREMENT METHOD

This project will be delivered by traditional tender. The proposed schedule is not of significant magnitude to warrant delivery through a concessionaire. Additionally, a complex bridge project is not conducive to day labour.

7.3. IMPLEMENTATION

As illustrated in the following table, the total estimated project budget is approximately \$35M with the majority of cash flow beginning in 2013. The costs have been broken down by type and eligible federal contributions have been calculated.



Highway 1 Malakwa Bridge

Highway 1 Malakwa Bridge	As of June 06, 2				
	Prior Years	2014/15	2015/16	2016/17	Total
A Non-Eligible Costs					
Project Management	\$9,504	\$20,000	\$0	\$0	\$29,504
Planning	\$45,000	\$0	\$0	\$0	\$45,000
Corporate Services	\$1,199,985	\$800,000	\$0	\$0	\$1,999,985
Engineering	\$1,498,635	\$186,000	\$0	\$0	\$1,684,635
Property Acquisition	\$2,550,557	\$102,500	\$10,000	\$10,000	\$2,673,057
Construction (cont. admin)	\$113,050	\$59,000	\$0	\$0	\$172,050
Environmental	\$485,869	\$0	\$0	\$0	\$485,869
Contingency					\$0
Sub-Total	\$5,902,600	\$1,167,500	\$10,000	\$10,000	\$7,090,100
B Eligible Costs			•	•	
Project Management		\$0	\$20,000	\$17,400	\$37,400
Engineering External (McElhanney (Bridge), geotech, Watson)		\$22,000	\$125,000	\$125,000	\$272,000
First Nations Accommodation*, Water & Sewer (Trailer Park)		\$1,000,000	\$150,000	\$100,000	\$1,250,000
Construction Supervision		\$923,000	\$1,000,000	\$500,000	\$2,423,000
Construction		\$7,100,000	\$8,050,000	\$6,132,500	\$21,282,500
Environmental External (Arch, Enviro Mitigation Work)		\$305,000	\$300,000	\$40,000	\$645,000
Contingency				\$2,000,000	\$2,000,000
Eligible Costs Sub-Total	\$0	\$9,350,000	\$9,645,000	\$8,914,900	\$27,909,900
Project Total	\$5,902,600	\$10,517,500	\$9,655,000	\$8,924,900	\$35,000,000
Federal Contribution 50% of B	\$0	\$4,675,000	\$4,822,500	\$3,502,500	\$13,000,000
Provincial Share	\$5,902,600	\$5,842,500	\$4,832,500	\$5,422,400	\$22,000,000

TABLE 6: PROJECTED CASH FLOW AND FEDERAL CONTRIBUTION

Property acquisition began early in 2013 with construction planned to commence in 2014. The bridge and 4-laning project will encompass 3 construction seasons, with completion in 2016/17.

Risks include the timing of funding approval and the need to coordinate bridge construction according to environmental windows and regulations.

^{*}Contractual obligations with First Nations



8. CONCLUSION

The total benefits of the Malakwa Bridge and 4-Laning project, discounted to current year, are \$23.2M. This includes safety benefits of \$7.5M, a net travel time/vehicle operating cost benefit of \$1.7M and a combined reliability benefit of \$14.1M.

The cost\benefit ratio of this project is 1.3 with a net present value of \$4.9M. The safety and reliability benefits of this project outweigh the costs and therefore it is recommended to proceed with replacing Malakwa Bridge and 4-Lane the adjacent roadway as part of the provincial strategy for the Trans-Canada Highway. This project will address a major safety and reliability concern at Malakwa Bridge and play a large part in ensuring reliable and efficient movement of people and goods through this vitally important corridor.



Appendix 1. ENVIRONMENTAL

The following table was taken from the 2006 Summit Environmental Consultants Ltd. Preliminary Environmental Impact Assessment from Malakwa to Perry River.

1 II II	English Name	BC Status	COS- EWIC	Last seen within 20 Km**	Obs-erved October, 2006***	Habitat Requirements
Mammals				Km	2000	
Corynorhinus	Townsend's Big-eared	Blue				Roosts in caves or cave-like roosts; forages in arid areas
Iownsendii	Bat	Ditte				and at conifer forest edges
Gulo gulo luscus	Wolverine, luscus subspecies	Blue	SC (May 2003)			Higher elevations and talus areas, very wide range
Martes pennanti	Fisher	Blue	2003)			Forage in diverse habitats; usually natal dens in large cavities in cottonwoods
Myotis	Northern Long-eared	Blue				Inhabits forested areas, especially mines, caves and
Septentrionalis Ovis canadensis	Myotis Bighorn Sheep	Blue				tunnels, but also open areas Grasslands and shrublands adjacent to escape terrain (e.g.
				s.18	-	cliffs, talus slopes)
				s.18	3	
Ursus arctos	Grizzly Bear	Blue	SC (May 2002)			Wide ranging: inhabits alpine tundra and subalpine mountain forests; attracted to salmon spawning and caribou calving areas
Birds	Lo . Pr	Time	_	_		In
Ardea herodias herodias	Great Blue heron, herodias subspecies	Blue				Forages in wetland areas. Nests in large trees.
Asio flammeus	Short-eared Owl	Blue	SC (May 1994)			Nests in open treeless areas such as grassland, rangelands dry marshes, farmlands, low arctic tundra, brushy fields and forest clearings
Botaurus	American Bittern	Blue				Breeds in marshes of 2.5 ha or more with open water and
lentiginosus						dense graminoid or shrubby vegetation
Dolichonyx	Bobolink	Blue				Nests in fields of tall grass
orgaivorus	D 0 B	Dit	-			E i e e
Hirundo rustica	Barn Swallow	Blue				Forages in open areas, frequently near water; nests under the overhang of a building, bridge or cliff
			2000)	s.18	Ī	
	Band-tailed Pigeon	Blue	2000)		Ī	Inhabits temperate and mountain coniferous and mixed
sciata			2000)		Ī	Inhabits temperate and mountain coniferous and mixed forests and woodlands
ciata ptiles and Amph	bians	Blue		s.18	3	forests and woodlands
atagioenas sciata eptiles and Amphi trysemys picta	bians Painted Turtle	Blue	2000) E/SC (Apr 2006)	S.18 Eagle River, 2002	Ī	
ptiles and Amph rysemys picta meces	bians Painted Turtle	Blue Blue	E/SC (Apr	S.18	3	forests and woodlands
sciata eptiles and Amphi	bians Painted Turtle	Blue Blue	E/SC (Apr 2006) SC (May	S.18 Eagle River, 2002 Shuswap Lake,	3	forests and woodlands Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs
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sciata eptiles and Amphi rysemys picta meces iltonianus	bians Painted Turtle Western Skink Chiselmouth	Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May	S.18 Eagle River, 2002 Shuswap Lake, 1969 Mara Lake,	3	forests and woodlands Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in smal
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ciciata ptiles and Amphi prysemys picta meces iltonianus sh rrocheilus utaceus ottus hubbsi ivelinus nfluentus vertebrates oodonta ttalliana	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculpin Bull Trout Winged Floater (Freshwater Clam)	Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May	S.18 Eagle River, 2002 Shuswap Lake, 1969 Mara Lake, 1964	•	forests and woodlands Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in sma to medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rive Bottom of deep pools in cold rivers and large tributary streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C.
ciciata ptiles and Amphi prysemys picta uneces iltonianus sh hrocheilus utaceus ottus hubbsi livelinus influentus vertebrates odonta ttalliana sssaria truncanta	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculoin Bull Trout Winged Floater (Freshwater Clam) Attenuate Fossaria (Snail)	Blue Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May	S.18 Eagle River, 2002 Shuswap Lake, 1969 Mara Lake, 1964	•	forests and woodlands Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in sma to medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rive streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C. Prefers water bodies with mud bottoms
ciata ptiles and Amphi ptiles and Amphi prysemys picta meces iltonianus sh rocheilus staceus status hubbsi hvelinus influentus vertebrates odonta ntalliana sssaria truncontala mphillia comelus	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculpin Bull Trout Winged Floater (Freshwater Clam) Attenuate Fossaria (Snail) Pale Jumping-slug (Slug)	Blue Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May 2000)	S.18 Eagle River, 2002 Shuswap Lake, 1964 Mara Lake, 1964 S.18	3	Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in smatto medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rivers and large tributary streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C. Prefers water bodies with mud bottoms Found in dry to moist coniferous forests, lives near mos stumps, rocks and logs and in leaf litter
ptiles and Amphi prysemys picta meces iltonianus sh rocheilus utaceus ottus hubbsi ivelinus influennis vertebrates oodonta ttalliana mssaria truncontala emphillia comelus	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculpin Bull Trout Winged Floater (Freshwater Clam) Attenuate Fossaria (Snail) Pale Jumping-slug (Slug)	Blue Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May 2000)	S.18 Eagle River, 2002 Shuswap Lake, 1964 Mara Lake, 1964 S.18	3	forests and woodlands Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in sma to medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rive streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C. Prefers water bodies with mud bottoms Found in dry to moist coniferous forests, lives near mos
ciciata and Amphi rysemys picta meces iltonianus sh rocheilus utaceus ottus hubbsi ivelinus influentus vertebrates oodonta ttalliana ttalliana temphillia camelus OSEWIC provides in recorded within	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculvin Bull Trout Winged Floater (Freshwater Clam) Attenuate Fossaria (Snail) Pale Jumping-slug (Slug) federal designations for sy	Blue Blue Blue Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May 2000) risk: E=En esh painted	S.18 Eagle River, 2002 Shuswap Lake, 1964 Mara Lake, 1964 S.18 dangered; SC-Splaturtle shell was	s · · · · · · · · · · · · · · · · · · ·	Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in smatto medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rivers and large tributary streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C. Prefers water bodies with mud bottoms Found in dry to moist coniferous forests, lives near mos stumps, rocks and logs and in leaf litter
ciciata and Amphi rysemys picta meces iltonianus sh rocheilus utaceus ottus hubbsi ivelinus influentus vertebrates oodonta ttalliana ttalliana temphillia camelus OSEWIC provides in recorded within	bians Painted Turtle Western Skink Chiselmouth Columbia Mottled Sculpin Bull Trout Winged Floater (Freshwater Clam) Attenuate Fossaria (Snail) Pale Jumping-slug (Slug) federal designations for st 20 km of the project area.	Blue Blue Blue Blue Blue Blue Blue Blue	E/SC (Apr 2006) SC (May 2002) NAR (May 2003) SC (May 2000) risk: E=En esh painted	S.18 Eagle River, 2002 Shuswap Lake, 1964 Mara Lake, 1964 S.18 dangered; SC-Splaturtle shell was	s · · · · · · · · · · · · · · · · · · ·	Found in lakes, ponds, slow-moving streams Grassland, open forests, rocky areas near streams; digs burrows in soil Flowing pools to fast water over sand and gravel in sma to medium rivers and lake margins Isolated streams, upstream tributaries and mainstem rive streams; also large coldwater lakes and reservoirs. Lakes and slow rivers in southern B.C. Prefers water bodies with mud bottoms Found in dry to moist coniferous forests, lives near mos stumps, rocks and logs and in leaf litter T—Threatened; NAR—Not at Risk. **These species have



Appendix 2. Cost Benefit Analysis Spreadsheets

The cost benefit analysis was undertaken utilizing the SafetyBenCost spreadsheet. The spreadsheet analysis was undertaken on two different spreadsheet tabs and then summarized into a final combined result.

The intersections and 4-laning segments were calculated using separate spreadsheets. All project costs were included in the 4-laning spreadsheet.



4-LANING SAFETY BENCOST



User Input Value V tratting with a previous project ensure old input values are deleted. Calculated Value Ladvade by Value		Notes:
Convert Year 2012 Construction Year 3888.8 Search Farior (styl 34		Fature costs are discounted to the end of the carrent year for IVC analysis Construction is assumed to coop in the carrent year + 1 (ppt cally the leaser of: 38 years or the service life of the improvement)
Base Case - Opening Year	Proposed Case - Opening Year	
Page	No. 1	Sparing per anumed to sour I per d'eur the constructe per per differt in relean segared in ent the Deleventh I personale et encentrerei per differt in relean segared in ent the Deleventh I personale et encentrerei per voir Viro segared or 15 m. The segared or 15 m. The segared or 15 m. ADT is expected expected to the time of the personal to the personal to the personal to personal to the segared or ADT in expect any personal to each the personal to the personal to ADT in expected expected expected to the personal to the personal to ADT in expected expected expected to the personal to the personal to ADT in expected expected expected to the personal to ADT in expected expected expected to ADT in expected expected to the personal to The ADT in expected expected to the personal to The ADT in expected expected to The ADT in expect
Pediatric Colland Facetree prints (Fine Applicated from English Colland Facetree prints (Fine Applic	Part Confidence Processor Confidence Processor	Free CPMs with her free control of the control of t
Companies Off by Marketin Deep Features	Companie Offire Entwick-Companie Caregoria (1980 - 1980 -	Pren CMF werkshivest then CMF werkshivest Introduction from the CMF with 5.8 alsoinest if againstick is Carectoix CMF (Programs/from their CMFAINT 6.8 alsoinest if againstick is Carectoix CMF (Programs/from their CMFAINT 6.8 alsoinest if againstick is Carectoix CMFAINT 6.8 alsoinest if against it carectoix CMFAINT 6.8 alsoinest it against it aga
	Proposed Case - Interior Year	production par + mankaghments period?) production of the producti
Pro	10	Ton (CM anticher)
Carceptic Off In Selected Design Features Carceptic Off In Selected Design Features Carceptic Off In Selected Design Features Carceptic Off In Selected Design Carceptic Off In Selec	Company Column Co	PremOM weishheit, austressams seless auspestig gest fremOM weishheit, austressams seless auspestig gest fremOM weishheit, austressams seless auspestig gest fremOM weisheit (1.4 sejaminat in zepätabla) a Carponia CM frequency fremBasi OM select. 3. sejaminat in zepätabla) a Carponia CM frequency fremBasi OM select. 3. sejaminat in zepätabla) a Carponia CM
Base Case - Horizon Year	Proposed Case - Horizon Year	
		production over leavily production of the control o
Product of California Preserve con Figure 17th A productions Proprietal Sprint Figure 1 Spring Page 1 Spring Program 1 Spri	The Challed Files Programs of any Sec. CPAs, a planet on Segretary Branch agglobal. File 2 (1997)	Free COMpositions: Free C
Composite CMF in February Exemple 2 (1900) 1 (19	Composite OMF for \$4 lected Stripp Features Composite OMF (100 100	from CNF worksheet, assumes same values as opening year. From CNF worksheet, assumes same values as opening year.
Production Collabor Trajectory Januari og to Congo Fautures of Facility and C.A. Propriedite Production Collabor 1,000	Particular Collision Engagery Interesting For Strong Francisco of English and L. El agriculate. Policy Series (1988) 1,388 1,589 1,590 1,	Programs from Base CMA eith. E. Lefadorne et F. aghthalik s. Corqueita CMF (Programs from Base CMA eith. E. Lefadorne et F. aghthalik a Corqueita CMF



Collision Modification Factor Calculations

This sheet calculates a Composite CMF_{comm} and a Composite CMF_{pot} for each segment of the base and proposed cases, based on user input values for CMF_{comp} and F_{comp} for each of the selected design features. Use the upper table for CMF that apply equally to all seventies, and use the lower table for CMFs that have a different value for each severity (a.g. CMFs for median barrier)

User input Value If starting with a previous project ensure old input values are deleted Calculated Value

					Base Ca	se						
MFs that a	pply equally to all s	everities										
MF _{targets} P ₁	and CMF _{bid} for	each Design Feats	ire (see no	tes to the	right							
						Se	gment or I	ntersectio	n #			
Design	Design Feature		1	2	3	4	5	6	7		9	10
Feature #	Description	CMF _{taget1}	12.251	-	3	-		- 6			,	10
		UNT taget.	12.251									
1	Bridge Narrowing	Ptaquti	0.482									
		CMF _{seal1}	6.422	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{torpet2}		1.292								
2	Median Width	Ptowell.		1.000								
		CMF ₁₀₃ 0	1.000	1.292	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1,000
		CNF _{tugets}		1.005								
3	Lane Width (p.46	Ptrepoti		0.570								
	CMF for BC)	CMF _{seals}	1.000	1.003	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{toget6}										
4	4	Ptopost										
		CMF _{seals}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tripleS}										
5		Ptaques										
		CMF _{tetal5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{toque}										
6		Ptagosi										
		CMF _{total6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{toqut7}										
7		Ptaquer										
		CMF _{total7}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{toque0}										
8		Player										
		CMF _{total8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{toque}										
9		Ptagen										
		CMF _{101,05}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{taiget10}										
10		P _{terget00}										
		CMF _{trisi20}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1,000
		Composite CMF	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

				P	roposed	Case							
MFs that	apply equally to all	severities											
MF _{taget} , P	targets and CMFstat for	oreach Design Fe	ature (see	notes to th	he right	>)							
			Segment or Intersection #										
Design	Design Feature												
Feature #	Description		1	2	3	4	5	6	7	8	9	10	
	Bridge	CMF _{taquet}											
1	Narrowing [Not												
	applicable to 4 lane Hwy)	P _{tarpeti}											
	inne i myr	CMF _{tatalt}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{tempet2}		1.261									
2	Median Width	P _{terpet1}		1.000									
		CMF _{total}	1.000	1.261	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
	Lane Width (p.46	CMF _{target5}		0.994									
3	CMF for BC)	P _{tarpet3}		0.367									
		CMF _{tatalt}	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
	Passing Lane (4	CMF _{terpett}		0.750									
4	4 Lanes)	Ptargett		1.000									
		CMF _{tatals}	1.000	0.750	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{terpelS}											
5		Ptageti											
		CMF _{total} t	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{trapet6}											
6		Ptagesi											
		CMF _{totalk}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{target7}											
7		Ptarget											
		CMF _{total}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{tracet})	2.000	2010	2300	3.000	2010	2.110	2000	2000	2010		
8		P _{targett}											
		CMF _{totall}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{triple()}	2.000	2010	2.100	31000	2.000	2.000	27103	2.000	2010	2.400	
9		Payer											
_		CMF _{totall}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
		CMF _{trant(1)}	2.300	2.300	2.300	2.300	2.000	2.500	2,700	2.300	2.500	2.000	
10		P _{target00}											
2.0		CMF _{tota00}	1.000	1.000	1.000	1,000	1.000	1.000	1.000	1,000	1.000	1.000	
					-				1.000				
		Composite CMF	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	



Benefit Cost Calculations

This sheet calculates discounted agency costs, discounted user safety benefits, benefit cost ratio, and net present value. User safety benefits are calculated for each year of the benefit period based on collision frequency estimates from the "Coll Freq" worksheet and interpolation for inte

User Input Value	If starting with a previous project ensure old input values are deleted.
Calculated Value	
Looked-up Value	
or Default Value	

135,577

11,367

Defaults	
Fatal Unit Cost	5
Injury Unit Cost	\$
PDO Unit Cost	\$
Discount Rate	

Looked-up Values	
Current Year	2012
Construction Vocas	2012

Severity Distribution Inputs												
	Base Case			roposed								
				Case								
Fatal proportion		3.00%		2.12%								
Injury proportion		41.20%		44.83%								
PDO proportion		56.79%		56.79%		56.79%		56.79%		56.79%		53.05%
Severe (F+I) Unit Cost	\$	559,814	\$	418,283								

ngency	COSTS	(4)	

Benefit Period

	Base		Proposed		
	Case			Case	
Property	\$	-	\$	-	
Engineering	\$	-	\$	1,728,245	
Construction	\$		\$	26,196,754	
Total Capital Cost	\$		\$	27,924,999	
Annual Maintenance (\$/yr)	\$	25,360	\$	69,740	
Periodic Resurfacing (\$)	\$	480,000	\$	960,000	
Resurfacing Years:		2022		2028	
		2037		2043	
Salvage Value in Horizon Yr	\$	480,000	\$	21,053,403	
Discounted Capital Costs	\$	-	\$	26,344,339	
Discounted Maint. and Resurf.	\$	680,130	\$	1,203,619	
Discounted Salvage Value		-\$111,839		-\$4,905,414	
Total Discounted Agency Costs	\$	568,291	\$	22,642,544	

User Safety Costs and Benefits (\$)

		Discounted	Discounted			
		Safety Costs	Safety Costs			Discounted
Year	Base Case		Pro	posed Case	Safety Benefits	
2014	\$	843,303	\$	346,528	\$	496,776
2015	\$	804,081	\$	330,242	\$	473,838
2016	\$	766,596	\$	314,690	\$	451,906
2017	\$	730,779	\$	299,841	\$	430,938
2018	\$	696,560	\$	285,664	\$	410,897
2019	\$	663,874	\$	272,131	\$	391,743
2020	\$	632,657	\$	259,215	\$	373,441
2021	\$	602,846	\$	246,890	\$	355,956
2022	\$	574,383	\$	235,129	\$	339,254
2023	\$	547,211	\$	223,909	\$	323,302
2024	\$	521,275	\$	213,205	\$	308,069
2025	\$	496,521	\$	202,996	\$	293,525
2026	\$	472,723	\$	193,183	\$	279,540
2027	\$	450,029	\$	183,830	\$	266,198
2028	\$	428,389	\$	174,918	\$	253,471
2029	\$	407,756	\$	166,425	\$	241,332
2030	\$	388,088	\$	158,333	\$	229,754
2031	\$	369,339	\$	150,624	\$	218,715
2032	\$	351,469	\$	143,281	\$	208,189
2033	\$	334,439	\$	136,286	\$	198,153
2034	\$	318,211	\$	129,624	\$	188,587
2035	\$	302,748	\$	123,279	\$	179,469
2036	\$	288,017	\$	117,238	\$	170,779
2037	\$	273,983	\$	111,485	\$	162,498
Total:	\$	12,265,276	\$	5,018,946	\$	7,246,330

Summary of Results (Present Values, \$)

	Base		Proposed			
	Case Case		Case	Incremen		
Agency Costs	\$ 568,291	\$	22,642,544	\$	22,074,253	
User Safety Costs	\$ 12,265,276	\$	5,018,946	\$	7,246,330	
B/C Ratio	0.33					
Net Present Value	-\$14,827,923					

Notes:

6% for provincia	l projects	, 10% for federal cost shared projects	
------------------	------------	--	--

from 'Coll Freq' worksheet	
from 'Coll Freq' worksheet	
from 'Coll Freg' worksheet	`

input values used to calculate Severe Unit Cost

refer to "default coll proportns" worksheet
refer to "default coll proportns" worksheet
refer to "default coll proportns" worksheet

Property Purchased: Sunk Cost

7.075M Sunk Cost. 4,278,609 from properties, remainder subtracted from engineering

	_
Typically \$4,000/Ln-km for 2 Ln and \$5,500/Ln-km for 4-Ln	
Typically \$45,000 to \$80,000/Ln-km	
Typical pavement life is 15 yrs from the last resurfacing	
2nd resurfacing yr is ignored if > horizon yr (const. yr + benefit period	_
Typical is 100% of prpty + 80% of const.+ resurf. residual	

Present Value of Capital + Maintenance + Resurfacing - Salvage

All future costs are discounted to the end of the current year. First year of benefits assumed to occur 1 yr after the construction yr

Incremental Agency Costs = Proposed - Base	
Incremental User Benefits = Base - Proposed	
Incremental User Benefits/Incremental Agency Costs	
Incremental User Benefits - Incremental Agency Costs	



INTERSECTION SAFETYBENCOST



Collision Frequency Calculations

- 1. This sheet calculates collision frequency for base and proposed case (across the page) and for the opening year, letterin year, and horizon year (down the page).

 2. Inputs are required for both cases and all it time periods. Generally, inputs for the interin and horizon years will be the same as the opening year except for growth in AAD.
- The Empirical Bayes method of combining predicted and observed crash frequency can be included or combined for each segment in the base case or the proposed case

User imput Value If Starting with a previous project ensure old input values are delet Calculated Value

Current Year	2012
Construction Year	2013
Benefit Period Ivral	24

			80	ise Case	- Openk	ng Year					
nguts [see notes to th	e right	2)									
Amplysis Year	2014	1									
ieg or US#	1	2	3.	ı.	S.	- 6	- 7	8	9	10	Tetal
egment or US?			LI I								
ervice Class											
r I/S Type			Aire								
ADTner			6450.1								
ADT			349.175								1
rogth [km]		_	203/3	_							0.00
Ibserved PDO/yr			0.300								0.30
bserved Severe/yr		-	0.100	_	-			=			0.30
inpirical Bayes		_	0.100								2.20
Nethod Applicable 1											
A DESCRIPTION OF THE PROPERTY OF			yes								
redicted Callision Fre PDD	design nin	A serve co.	Ms, aquste	d using tr	reportar tia	yes Fappa	cakie				
PD0 30	295.06	29576	0.000004	mu/A	my/h	my/A	201/A	201/A	BN/A	BN/A	
	MILIA	etti (A	0.3473	etica.	ety/a	691/A	MIN/A	MN/A		MALA.	
al			0.5473						BN/A		
32	MVA.	MK/A		my/A	my/A	201/4	201/A	MN/A		BN/A	
Produted	MI/A	MK/A	263.2	#N/A	#N/A	MN/A	MN/A	MN/A	esya.	WV/A	_
PDO [coll/yr]	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.353
alpha	MI/A	SPE/A	0.997	IPU/A	SPE/A	SPE/A	SN/A	SN/A	BN/A	BN/A	_
E.B. Expected PDO											
[toll/yr]	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.253
[E.B.]/(Preclicted)	N/A	N/A.	1.003	M/A	M/A	N/A	N/A	N/A	N/A	N/A	
Severe			I was a second								
30	MI/A	MK/A	0.0000034	myA	MVA.	en/a	MN/A	MN/A	4N/A	MN/A	
				etti (A	ety/a:		MN/A	AN/A	#N/A		
01	AN/A	MN/A									
a2	MIN.	MK/A	0.6719	myA	#N/A	MN/A	MN/A	MN/A	4N/A	en/A	
a2 k							MY/A				L
a2 k Predicted	MV/A MV/A	MILIA MILIA	263.2	MIG/A	MVA MVA	MN/A MN/A	AN/A	MY/A	en/a en/a	en/A	
a2 k Predicted Severe (coll/yr)	#N/A #N/A 0.000	#N/A #N/A 0.000	0.6719 263.2 0.100	#N/A #N/A 0.000	#9/A #9/A 0.000	#9/A #9/A 0.000	#9/A 0.000	#9/A #9/A 0.000	85/A 85/A 0:000	65/A 65/A 0:000	0.301
a2 k Predicted Severe (coll/yr) alpha	MV/A MV/A	MILIA MILIA	263.2	MIG/A	MVA MVA	MN/A MN/A	AN/A	MY/A	en/a en/a	en/A	0.301
a2 h. Predicted Severe (colli/yri alpha C.B. Expected	MV/A MV/A 0.000	#N/A #N/A 0.000	0.6719 263.2 0.100 0.996	#5/A 0.000 #5/A	#N/A #N/A 0.000 #N/A	69/A 69/A 0.000 89/A	49/A 0.000 89/A	#9/A #9/A 0.000	65/A 65/A 6500 65/A	69/A 69/A 6:000 69/A	
a2 b. Predicted Severe (coll/yri alpha E.B. Expected Severe (coll/yri	90/A 90/A 0.000 90/A	#N/A 0.000 #N/A 0.000	0.6719 263.2 0.100 0.966 0.100	#N/A 0.000 #N/A 0.000	#N/A #N/A 0.000 #N/A 0.000	#9/A #9/A 0.000 #9/A 0.000	#9/A 0.000 #9/A 0.000	#9/A #9/A 0.000 #9/A 0.000	85/A 85/A 6:900 85/A 6:000	65/A 65/A 6500 65/A	
a2 h. Predicted Severe (colli/yri alpha C.B. Expected	MV/A MV/A 0.000	#N/A #N/A 0.000	0.6719 263.2 0.100 0.996	#5/A 0.000 #5/A	#N/A #N/A 0.000 #N/A	69/A 69/A 0.000 89/A	49/A 0.000 89/A	#9/A #9/A 0.000	65/A 65/A 6500 65/A	69/A 69/A 6:000 69/A	
a2 b. Predicted Severe (coll/yri alpha E.B. Expected Severe (coll/yri	90/A 90/A 0.000 90/A	#N/A 0.000 #N/A 0.000	0.6719 263.2 0.100 0.966 0.100	#N/A 0.000 #N/A 0.000	#N/A #N/A 0.000 #N/A 0.000	#9/A #9/A 0.000 #9/A 0.000	#9/A 0.000 #9/A 0.000	#9/A #9/A 0.000 #9/A 0.000	85/A 85/A 6:900 85/A 6:000	65/A 65/A 6500 65/A	
a2 b. Predicted Severe (coll/yr) alpha E.B. Capected Severe (coll/yr) [E.B.)/(Predicted)	90,00 0,000 30,00 0,000 M/A	89/A 0.000 89/A 0.000 N/A	0.6718 263.2 0.100 0.998 0.100 1.000	#N/A 0.000 #N/A 0.000	#N/A #N/A 0.000 #N/A 0.000	#9/A #9/A 0.000 #9/A 0.000	#9/A 0.000 #9/A 0.000	#9/A #9/A 0.000 #9/A 0.000	85/A 85/A 6:900 85/A 6:000	65/A 65/A 6500 65/A	
a2 By Predicted Severe (coll/yr) Alpha E.B. Capecia Severe (coll/yr) [E.B.///Predicted] orapos be CWF for Sev	MIVA MIVA 0.000 MIVA 0.000 N/A ected Desi	MN/A 0.000 MN/A 0.000 N/A	0.6719 263.2 0.100 0.998 0.100 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A	8%/A 0.000 8%/A 0.000 M/A	89/A 0.000 0.000 0.000 M/A	89/A 0.000 89/A 0.000 N/A	89/A 89/A 0.000 89/A 0.000 N/A	85/A 85/A 6:800 85/A 6:800 8/A	8N/A 8N/A 0:000 8N/A 0:000 N/A	
a2 b. Predicted Severe (coll/yr) alpha E.B. Capected Severe (coll/yr) [E.B.)/(Predicted)	90,00 0,000 30,00 0,000 M/A	89/A 0.000 89/A 0.000 N/A	0.6718 263.2 0.100 0.998 0.100 1.000	#N/A 0.000 #N/A 0.000	#N/A #N/A 0.000 #N/A 0.000	#9/A #9/A 0.000 #9/A 0.000	#9/A 0.000 #9/A 0.000	#9/A #9/A 0.000 #9/A 0.000	85/A 85/A 6:900 85/A 6:000	65/A 65/A 6500 65/A	
a2 Bracketed Severe (coll/yr) alpha E.S. Expected Severe (coll/yr) [E.B.///Precketed] composite CWF for Se- Composite CWF for Se-	MIVA MIVA 0.000 MIVA 0.000 N/A ected Desi	MN/A 0.000 MN/A 0.000 N/A	0.6719 263.2 0.100 0.998 0.100 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A	8%/A 0.000 8%/A 0.000 M/A	89/A 0.000 0.000 0.000 M/A	89/A 0.000 89/A 0.000 N/A	89/A 89/A 0.000 89/A 0.000 N/A	85/A 85/A 6:800 85/A 6:800 8/A	8N/A 8N/A 0:000 8N/A 0:000 N/A	
a2 By Predicted Severe (coll/yr) Alpha E.B. Capecia Severe (coll/yr) [E.B.///Predicted] orapos be CWF for Sev	MN/A MN/A 0.000 MN/A 0.000 N/A ected Designation	0.000 0.000 0.000 N/A 0.000 N/A	0.6719 263.2 0.100 0.998 0.100 1.000	95/A 0.000 35/A 0.000 N/A 1.000	#N/A 0.000 #N/A 0.000 M/A	#9/A #9/A 0.000 #9/A 0.000 M/A	89/A 0.000 89/A 0.000 N/A	89/A 89/A 0.000 89/A 0.000 N/A	8N/A 8N/A 0:800 8N/A 0:800 N/A	85/A 85/A 6,000 85/A 6,000 N/A	
a2 Produced Severe (coll)/y-l alpha E.B. Capected Severe (coll)/y-l (E.B.)/(Producted) ongoot be CWF for Sec Composite CWF (coll)/y-l Composite CWF (coll) composite CWF (coll)	#N/A #N/A 0.000 #N/A 0.000 N/A exted Designation 1.000	89(/A 89(/A 0.000 89(/A 0.000 N/A 1.000 1.000	0.6718 285.2 0.100 0.998 0.100 1.000	#N/A 0.000 #N/A 0.000 M/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.006 N/A 1.000	#9/A #9/A 0.000 #9/A 0.000 N/A 1.000	89/A 0.000 89/A 0.000 N/A 1.000	89/A 89/A 0.000 89/A 0.000 N/A	8N/A 8N/A 0:800 8N/A 0:800 N/A	85/A 85/A 6,000 85/A 6,000 N/A	
a2 b Predicted Severe (coll/yr) alpha C.B. Capected Severe (coll/yr) (E.B.//(Predicted) composite CAVE for Set Composite CAVE	#N/A #N/A 0.000 #N/A 0.000 N/A exted Designation 1.000	89(/A 89(/A 0.000 89(/A 0.000 N/A 1.000 1.000	0.6718 285.2 0.100 0.998 0.100 1.000	#N/A 0.000 #N/A 0.000 M/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.006 N/A 1.000	#9/A #9/A 0.000 #9/A 0.000 N/A 1.000	89/A 0.000 89/A 0.000 N/A 1.000	89/A 89/A 0.000 89/A 0.000 N/A	8N/A 8N/A 0:800 8N/A 0:800 N/A	85/A 85/A 6,000 85/A 6,000 N/A	
AZ Breater (colliste Severe (colliste Severe (colliste C.B. Especial Severe (colliste C.B. Capecial C.B. Capecial Composite CAF for Set Composite CAF Composite C	MN/A MN/A 0.000 MN/A 0.000 N/A exted Designation 1.000 1.000 quency Acc	MN/A MN/A 0.000 MN/A 0.000 N/A 1.000 1.000 0.445 rg fo	0.6718 263.2 0.100 0.998 0.100 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	89/A 0.000 89/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	8N/A 8N/A 6.800 8N/A 6.800 N/A	8N/A 8N/A 9000 8N/A 6000 N/A	0.301
aid By Predicted Sewer (colly) La Especies Sewer (colly) La Especies Sewer (colly) La Especies Composite CNF for See Composite CNF gas Composite CNF gas Predicted PRO (colly)	#N/A #N/A 0.000 #N/A 0.000 N/A exted Designation 1.000	89(/A 89(/A 0.000 89(/A 0.000 N/A 1.000 1.000	0.6718 285.2 0.100 0.998 0.100 1.000	#N/A 0.000 #N/A 0.000 M/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.006 N/A 1.000	#9/A #9/A 0.000 #9/A 0.000 N/A 1.000	89/A 0.000 89/A 0.000 N/A 1.000	89/A 89/A 0.000 89/A 0.000 N/A	8N/A 8N/A 0:800 8N/A 0:800 N/A	85/A 85/A 6,000 85/A 6,000 N/A	0.301
AD By Predicted Sewer (collis) E.S. Expected Sewer (collis) E.S. Expected Sewer (collis) [E.S.) (Predicted) Composite CAF for Se Composite CAF composi	MN/A MN/A 0.000 MN/A 0.000 N/A exted Designation 1.000 1.000 quency Acc	MN/A MN/A 0.000 MN/A 0.000 N/A 1.000 1.000 0.445 rg fo	0.6718 263.2 0.100 0.998 0.100 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	89/A 0.000 89/A 0.000 N/A 1.000 1.000	#N/A #N/A 0.000 #N/A 0.000 N/A 1.000 1.000	8N/A 8N/A 6.800 8N/A 6.800 N/A	8N/A 8N/A 9000 8N/A 6000 N/A	0.301

			Pro	oposed (Case - Op	ening Ye	ear				
nputs (see nates to t	des riche										
Analysis Year	2014	1 7									
ieg or US #	3	2	λ	å	5	6	7	8	9	10	Total
		_									- 10.00
Segment or 1/52			LII								
Service Class											
art/SType			4-Leg								
AOT _{map}			5450.1								
AACT			349.175								
Length (krs)											0.000
Observed POO/w			0.300								0.300
Observed Severo/yr			0.100								0.100
E.B. Applicable?			VED								
hedicted Collision F PDO	equency	using Basi	CPSEC 2013	asted asky	genginca	eaves if a	ggreatie				
PDO	295/6	89/6	0.000074	8978	#N/A	2007.0	BW/A	89/4	8507.6	850/A	
#1	MV/A	MN/A	0.3471	MN/A	MN/A	MY/A	WW/A	WVA	MN/A	WN/A	
22	294/A	#8/A	0.6719	MY/A	#9/A	201/A	BN/A	BN/A	EN/A	BN/A	
k	MN/A	MN/A	263.2	MN/A	MN/A	MS/A	WW/A	85/A	MN/A	MN/A	
Predicted			-								
PDD (call/wr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
alpha	IRK/A	SPE/A	0.997	SN/A	SFV/A	MV/A	EN/A	EN/A	254/A	214/A	
E.B. Expected PDO											
(csiUw)		0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.351
(E.B.[/[Fredicted)	N/A	N/A	1.003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Severe											
23	MK/A	MN/A	0.000074	MN/A	MN/A	MY/A	MN/A	#W/A	MAZA	MN/A	
#1	MN/A	AN/A	D.3471	AN/A	AN/A	AN/A	MV/A	AN/A	MM/A	MM/A	
									MN/A		
	MUA	ANY A	263.2	MS(A	ARY(A	MY/A	MV/A	RVA	856/A	MACA	
	0.000	0.000	0.100	0.000	2.000	2.000	2000	0.000	0.000	0.000	0.385
									814/A		DANK
	mon	aren.	0.994	mejie	APRIL TO	- major.	major	890	200	****	
	0.000	0.000	0.500	0.000	0.000	0.000	6.000	0.000	0.000	0.000	D.101
									N/A		
E.B. [/] Fredicted Severe (coll/pr) Alpha E.B. Dep cited Severe (coll/pr) (C.B. [/] Fredicted)	MN/A MN/A 0.000 MN/A 0.000 M/A	90/A 90/A 0.000 90/A 0.000 M/A	0.5719 203.2 0.100 0.998 0.100 1.000	89/A 89/A 0.000 89/A 0.000 N/A	89/A 89/A 0.000 89/A 0.000 N/A	89/A 89/A 0.000 89/A 0.000 N/A	8N/A 8N/A 0.000 8N/A 0.000 N/A	89/A 89/A 89/A 6:000 89/A 6:000 8/A	0.0 0.0	AV AV 000 AV 000	A\/A A\/A A\/A A\/A A\/A A\/A A\/A A\/A
amposite CMF for S	e lected (b)	ecian Feat	unes.								
Companie CVF	1.000	1.000	0.523	1,000	1,000	1,000	1,000	1,000	1.000	1.000	
Composite CMF	1.000	1.000	0.482	1,000	1,000	1,000	1000	1900	1.000	1.000	
composite CMP (pure)	1,000	1,000	0.462	1.000	1,000	1,000	1900	1900	1000	1000	
Predicted Collision F	requency	Accountin	g for Design	n Features	of Facility	and E.B. if	applicable				
Fredicted											
PDO (cell/w)	0.000	0.000	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.009
Fredicted											

asing base O	3 44-eg 7514-367 175,7689	4		es l'appl	7 able	8	9	10	Tet
asing Base O	18 44.eg 7514.367 175.7689	ed using to	vpirical Ba			8	9	15	
asing Base O	18 44.eg 7514.367 175.7689	ed using to	vpirical Ba			8	9	10	
asing Base O	18 44.eg 7514.367 175.7689	ed using to	vpirical Ba			8	9	10	
AN/A AN/A	84.8g 7514.387 175.7889	-		pes if appli	cable				0.0
AN/A AN/A	84.8g 7514.387 175.7889	-		pes if appli	citle				0.0
AN/A AN/A	7514.587 175.7889 Ws. adjusto 0.002004	-		yes if appli	cette				0.0
AN/A AN/A	173,7689 Ws. adjusts	-		yes if appl	cable				0.0
AN/A AN/A	Ws. adjust	-		yes if appli	sakle				0.0
AN/A AN/A	0.002074	-		yes if appl	cable				0.0
AN/A AN/A	0.002074	-		yes if appl	cable				_
MIN.				and the					
			PN/A	AN/A	AN/A	AN/A	en/a	an/A	
		MN/A	MV/A	MN/A	MN/A	MN/A	en/A	MN/A	
PR//A	263.2	MN/A	#N/A	ety/A	MN/A	MN/A	en/a	WW/A	
mun	204.2	mun	mun	my	mayor	myra	engve.	BOOK.	-
0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	6.000	0.3
00000	00174	0.000	0.000	00000	0.000	0.000	6:600	2.000	
0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.1
									П
294/A	0.0000074	my/h	my/h	201/A	201/6	MN/A	BN/A	BN/A	
AN/A	0.3473	MV/A	AN/A	AN/A	AN/A	AN/A	#N/A	WV/A	
201/6	0.6719	my/h	my/a	299/A	201/A	201/A	BN/A	BN/A	
MN/A	263.2	#N/A	#N/A	ets/A	MN/A	MN/A	#N/A	#N/A	_
0.000	0.118	0.000	0.000	0.000	0.000	0.000	11100	0.000	0.3
0.000	0118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.3
	#N/A #N/A #N/A #N/A 0.000	90,000 0,177 90,00 0,000,000 90,00 0,573 90,00 0,118	0.000 0.177 0.000	0.006 0.177 0.000	0.000 0.177 0.000	0.000 0.177 0.000 0.00	0.000 0.137 0.000 0.0	0.000 0.127 0.096 0.000 0.0	0.000 0.177 0.000 0.00

	Proposed Case - Interim Year										
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	- 2	1	4	6	- 6	7		9	10	Total	
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		l u									
		6-Leg									
		7514.367									
		173,7889									
		-								0.00	
	-										
mun	With a	201.2	mayor	Maryon	Mary N.	BOUGH.	BN/X	BN/A	BN/A		
0.000	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.17	
U.U.E.	0.000	0.176	0.000	0.000	0.000	2000	2000	2.000	2.00	50,40	
0.000	0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.17	
201/4	MW/A	0.002071	201/A	201/A	201/A	BN/A	BN/A	EN/A.	8%/A		
AN/A	AN/A	0.3471	AN/A	AN/A	AN/A	#W/A	WV/A	854/A	#14/A		
205/A	MW/A	0.6019	MN/A	MN/A	201/A	BN/A	BN/A	EN/A	8%/A		
MN/A	AN/A	263.2	AN/A	AN/A	MY/A	#W/A	WV/A	MN/A	MN/A	_	
0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.11	
										0.11	
mae	0.000	0.418	4.500	4.000	4.500	2-300	9500			-641	
lected by	sign Feat	unes.									
1.000	1.000	0.523	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
1.000	1.000	0.482	1.000	1.000	1.000	1.000	1.000	1.000	1.000		
equency.	kecountin	g for Design	Features	of fectivy	and E.B. if	applicable	_	_	_	_	
0.000	0.000	0.092	0.500	0.900	0.900	0:000	0:000	0.000	9.000	0.05	
										0.05	
	2025 3 2025 3 2025 2025 2025 2025 2025 2025 2025 2025	3000 3000 0,0000	1 2 3 1 1 1 1 1 1 1 1 1	2 3 4	2	1	1	2 3 4 6 6 7 8	2 3 4 5 6 7 8 9	2 3 4 5 6 7 8 9 13	

			Bi	ase Case	- Horizo	n Year					
quits (see notes to the		2)									
rsolysis Year	2057	⊢		4	5.	6	-	8	9	10	Tet
eg or US #	1	2	1	ı.	-	-	7	- 8	9	10	Tet
egweet or US?			u								
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r US Type		-	4-teg	_	_		_	_	_	_	
ADTmer		_	8675.385								
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redicted Cell bilan Fred PDD	MN/A	#N/A	D.OEGON	#N/A	epercal De	PET F (SS)	#N/A	#5/A	#W/A	#N/A	
60											
31	MIL/A	201/6	0.3471	MN/A	my/A	200/A	201/A	MN/A	BN/A	BN/A	
9.2 h	#8/A	#N/A	263.2	MN/A	MN/A	MN/A	MN/A	MN/A	BN/A	BN/A	
Predicted	mun	mun	269.2	mun	mun	majo	major	-major	Brigge.	Brigge	_
PDD (soli/yr)	0.000	0.000	0.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.2
E.S. Expected			0000	0.000	0.00	0.000	0.000	0.000	E-800	2.000	-
PDO (coli/yr)	0.000	0.000	0.205	0.000	0.000	0.000	0.000	0,000	0.000	0.000	0.2
Seveno		-									
30	20U/A	205/6	0.000004	my/h	my/A	299/A	201/0	295/A	BN/A	BN/A	ı
a1	MICA.	MN/A	0.3473	#N/A	#W/A	es/a	MN/A	MN/A	45/A	WW/A	
až	29K/A	MK/A	0.6719	my/h	my/h	201/A	201/0	MV/A	EN/A	BN/A	
k	MICA.	MK/A	263.2	#N/A	#RUA	MN/A	MN/A	AN/A	#N/A	MN/A	_
Predicted											
Severe [coll/yr]	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.1
E.B. Expected Severe (coll/yr)	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.1
	uude	0.000	0.136	0.000							

			Pri	oposed	Case - Ho	rizon Ye	sar				
		- 5									
rputs (see notes to t Inglissis Year	2037	1									
ieg or US #	3	2	lλ	å	5	6	7	8	9	10	Tat
eg to to a		-	-	-	-	-		-		- 10	191
legment or 1/5?			u l								
iervice Class		-									
r VS Type			4111								
AOT _{mon}			8675,385								
AOF _{mont} 20A			200,6404								
angth (km)		-	200.0-0-1	_	_	_	_	_	_	_	0.00
Predicted Collision Fr PDO											
63	MN/A	AN/A	0.002034	AN/A	AN/A	AN/A	#W/A	WV/A	MW/A	854/A	
at	MK/A	MV/A	0.3471	201/0	201/A	201/A	BN/A	BN/A	EN/A	25UA	
12	MN/A	AN/A	0.6719	AN/A	AN/A	AN/A	MV/A	MV/A	MA/A	#M/A	
- 8	794/A	MN/A	263.2	201/A	201/A	209/A	EN/A	BN/A	EN/A.	25/A	_
Fredicted											
PDO (cult/yr)	0.000	0.000	0.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.30
E.B. Expected PDO (call/yr)	0.000	0.000	0.206	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.31
Severe	LILLERY	U.U.S.	0.209	0.00	0.00	0.00	00.0	200	£ 100	0.000	0.21
23	29576	89/6	0.000074	89/6	89/6	200/30	BN/A	BN/A	EN/A	850 A	
41	esca.	MN/A	0.3471	MN/A	MN/A	MY/A	WW/A	WV/A	MN/A	MN/A	
22	205/6	MN/A	0.6719	201/0	#9/A	200/A	BN/A	BN/A	85/A	85UA	
k	MN/A	AN/A	263.2	MN/A	MN/A	MN/A	WW/A	WW/A	MM/A	MM/A	
Predicted											
Savere (call/yr)	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.13
E.B. Expected											
Severe (call/yr)	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.13

A-viii



Collision Modification Factor Calculations

This sheet circulates a Composite CMF_{trates} and a Composite CMF_{pit} for each segment of the base and proposed cases, based on user input values for CME_{trape} and P_{trape} for each of the selected design features.

The the upper table for CME that and upper the properties and upper table for CMEs that have a different value for each exceptible. A CMEs for median beginning.

User Input Yalue If starting with a previous project ensure old input values are deleted.
Calculated Yalue
Laoked-up Value

					Base Ca	se						
	pply equally to all s											
MF _{terpris} P _{te}	_{reget} , and CMF _{total} for	each Design Feats	re (see no	tes to the	right>							
			_			5e	gment or I	ntersectio	n#			
Design	Design Feature		1	2	3	4	5	6	7	8	9	10
Feature #	Description	C1 ==	1	Z	3	4	- 5	- 6	7	- 8	9	10
		CMF _{trept1}										
1		Paget										
		CMF _{btel}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{totat2}	1.000	2.000	1.007	1.000	1.000	1,000	1.000	1.000	2.000	2.000
2		Paget										
٤.		CMF _{beaC}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{togat})	1.000	2.000	2.000	1.000	1.000	2.000	1.000	1.000	2.000	2.000
3		Paget										
,		CMF ₁₀₁₀	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tagett}	1.000	2.000	2.000	1.000	1000	2700	2.000	1.000	2.000	37000
4		Paget										
		CMF _{totald}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tagati}	2.010	2.000	27000	2.000	2.000	4700	2.000	2.000	2.000	37000
5		P _{topet} .										
		CMF ₁₀₃ G	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1,000
		CMF _{togeti}	2.010	2.700	21000	2.000	2.000	27700	2.000	2.010	2.000	21000
6		Piergetti										
		CMF _{stratic}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{theat?}	2.010	2.000	2.000	2.010	2.010	2.100	2.000	2.010	2.000	2.000
7		Player										
		CMF ₁₀₃ (7	1.000	1.000	1.000	1.000	1.000	1,000	1.000	1.000	1.000	1,000
		CMF _{tagett}										
8		Pargett										
		CMF _{stull}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tagett}										
9		Paget										
		CMF _{NORE}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{terpetC0}										
10		P _{terpet(0)}										
		CMF _{NOREO}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Composite CMF	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

				Р	roposed	Case						
MFs that a	pply equally to all	severities										
MF _{target} , P _c	pepts and CMF _{total} fo	oreach Design Fe	sture (see	notes to th	e right	->)						
						Se	gment or I	ntersection	n#			
Design	Design Feature											
Feature #	Description		1	2	3	4	5	- 6	7	8	9	10
	Add Right Turn	CMF _{temprij}			0.860							_
1	Lanes at Rural Unsig				1.000							
	Intersections	P _{tarpeti} CMF _{totali}	1.000	1.000	0.860	1.000	1.000	4.000	4.000	4.000	1.000	4 400
	Add left-turn		1.000	1.000		1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	lane at Bural	CMF _{triple2}			0.560			_				
2	Stop Controlled	Paget	4 000	4 040	1.000	4 000	4 000	4 000	4 400	4 000	4 040	
	leto mostions	CMF _{total2}	1.000	1.000	0.560	1.000	1.000	1.000	1.000	1.000	1.000	1.000
_		CMF _{trip(d)}						_			_	
3		Ptagett	4 000					4 000			4 040	
		CMF _{total5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMFsuport						_				
4		Ptagett										
		CMF _{totoN}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tage6}										
5		P _{targett}										
		CMF _{tata6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{taquei}										
6		P _{targett}										
		CMF _{totol6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{taque?}										
7		P _{target7}										
		CMF _{tatal}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{targett}										
8		P _{targett}										
		CMF _{total}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{tager0}										
9		Pterpoti										
		CMF _{tatal8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		CMF _{target(3)}										
10		Pesquetió										
		CMF _{tatable}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
		Composite CMF	1.000	1.000	0.482	1.000	1.000	1.000	1.000	1.000	1.000	1.000



Benefit Cost Calculations

This sheet calculates discounted agency costs, discounted user safety benefits, benefit cost ratio, and net present value.

User safety benefits are calculated for each year of the benefit period based on collision frequency estimates from the "Coll Freq" worksheet and interpolation for inte

User Input Value
Calculated Value
Looked-up Value
or Default Value

If starting with a previous project ensure old input values are deleted.

Defaults

Delauits		
Fatal Unit Cost	\$ 6,385,999	9
Injury Unit Cost	\$ 135,577	7
PDO Unit Cost	\$ 11,367	7
Discount Rate	6%	

Looked-up Values

Current Year	2012
Construction Year	2013
Benefit Period	24

Severity Distribution Inputs

	Base Case	F	Proposed Case
Fatal proportion	1.01%		1.01%
Injury proportion	43.22%		43.22%
PDO proportion	55.77%		55.77%
Severe (F+I) Unit Cost	\$ 278,179	\$	278,179

Agency Costs (\$)

Agency Costs (5)	-	_	
	Base	P	roposed
	Case		Case
Property	\$ -		
Engineering	\$ -	\$	
Construction	\$ 	\$	
Total Capital Cost	\$ -	\$	
Annual Maintenance (\$/yr)	\$	\$	
Periodic Resurfacing (\$)	\$	\$	
Resurfacing Years:	2011		2028
	2026		2043
Salvage Value in Horizon Yr	\$	\$	
Discounted Capital Costs	\$	\$	
Discounted Maint. and Resurf.	\$ -	\$	-
Discounted Salvage Value	\$0		\$0
Total Discounted Agency Costs	\$	\$	

User Safety Costs and Benefits (\$)

	Discounted			Discounted		
	Safety Costs			afety Costs	C	Discounted
Year	Base Case			oposed Case	Saf	ety Benefits
2014	\$	26,444	\$	12,798	\$	13,646
2015	\$	25,329	\$	12,258	\$	13,070
2016	\$	24,255	\$	11,739	\$	12,516
2017	\$	23,222	\$	11,239	\$	11,983
2018	\$	22,228	\$	10,758	\$	11,470
2019	\$	21,273	\$	10,295	\$	10,977
2020	\$	20,354	\$	9,851	\$	10,503
2021	\$	19,471	\$	9,423	\$	10,048
2022	\$	18,623	\$	9,013	\$	9,610
2023	\$	17,808	\$	8,619	\$	9,190
2024	\$	17,026	\$	8,240	\$	8,786
2025	\$	16,276	\$	7,877	\$	8,399
2026	\$	15,556	\$	7,529	\$	8,027
2027	\$	14,866	\$	7,195	\$	7,671
2028	\$	14,204	\$	6,874	\$	7,330
2029	\$	13,569	\$	6,567	\$	7,002
2030	\$	12,961	\$	6,273	\$	6,688
2031	\$	12,378	\$	5,991	\$	6,388
2032	\$	11,820	\$	5,720	\$	6,099
2033	\$	11,285	\$	5,462	\$	5,823
2034	\$	10,773	\$	5,214	\$	5,559
2035	\$	10,282	\$	4,976	\$	5,306
2036	\$	9,813	\$	4,749	\$	5,064
2037	\$	9,364	\$	4,532	\$	4,832
Total:	\$	399,180	\$	193,193	\$	205,987

Summary of Results (Present Values, \$)

	Base		Proposed			
	Case		Case	Incremental		
Agency Costs	\$ -	\$	-	\$	-	
User Safety Costs	\$ 399,180	\$	193,193	\$	205,987	
B/C Ratio	#DIV/0!					
Net Present Value	\$205,987					

Notes:

6% for provincial projects, 10% for federal cost shared projects

from 'Coll Freq' worksheet	
from 'Coll Freq' worksheet	
from 'Coll Freq' worksheet	`

input values used to calculate Severe Unit Cost

refer to "default coll proportns" works	neet
refer to "default coll proportns" works	neet
refer to "default coll proportns" works	neet

Typically	10% to 20% of construction
Typically	\$4,000/Ln-km for 2 Ln and \$5,500/Ln-km for 4-Ln
Typically	\$45,000 to \$80,000/Ln-km
Typical pa	evement life is 15 yrs from the last resurfacing
2nd resur	facing yr is ignored if > horizon yr (const. yr + benefit period)
Typical is	100% of prpty + 80% of const.+ resurf. residual

Present Value of Capital + Maintenance + Resurfacing - Salvage

All future costs are discounted to the end of the current year.

First year of benefits assumed to occur 1 yr after the construction yr

Incremental Agency Costs = Proposed - Base
Incremental User Benefits = Base - Proposed
Incremental User Benefits/Incremental Agency Costs
Incremental User Benefits - Incremental Agency Costs



SHORTBEN - TRAVEL TIME AND VEHICLE OPERATING COSTS



nded for use as a screening tool prior to more be an original copy before using.				
TREATED SECTION neral Information	Base	Proposed 3		Notes
Segment Length (km)	2.80	2.80		Important to show any differences between base & prop.
AADŤ	6,450	6,450		Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%) % Trucks	1.50%	1.50%		Compound growth
Base Year	2014	2014	Construction in 2013-Benefits start 2014	Should be same for base and proposed.
Benefit Period (yrs) Discount Rate	24 6%	24 6%		Assumes 1 yr of construction prior to benefits starting.
ancial Account	0,0	0,1		
Property (S)	\$0	\$0	All costs in SafetyBencost	,
Engineering (S)	\$0 \$0	\$0	All costs in SafetyBencost	Typical 10% to 20% of Construction
Construction (S) Total (S)	\$0 \$0	\$0 \$0	All costs in SafetyBencost	
Maintenance (\$/km/yr)	\$8,000	\$22,000		Typical \$4,000/Ln-km for 2 Ln and \$5,500/Ln-km for 4-Ln
Resurfacing Cost (\$/km)	\$250,000	\$500,000		Typical \$45,000 to \$80,000/Ln-km
Resurfacing Years	2022	2029		Typical Pavement He is 15 yrs from the last resurfacing
Salvage Value (5) in Horizon Yr	2037 \$630,000	2044 \$140,000		2nd resurf yr is ignored if 0 or >(base yr + benefit period) Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value	\$756,786	\$1,324,653		Present Value of capital + maint.+ resurf salvage
stomer Service Account	\$150,100	311124100		recent time of commit manner revent. Further
Time Costs % of AADT				% of AADT occurring in each period. For example
Peak	13.1%	13.1%	Source: HCS Summary	a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	55.9%	55.9%	Source: HCS Summary	These splits are used to differentiate speed, delay and
Low Total	31.1%	31.1%	Source: HCS Summary	veh. Op. costs during different periods of the day. Total must equal 100%
Auto Speed (km/hr)				
Peak Shoulder	82.3 87.1	96.7	Source: HCS Summary Source: HCS Summary	Representative average speeds in peak and shoulder
Shoulder Low	92.4	96.7	Source: HCS Summary Source: HCS Summary	periods are usually not much lower than speeds in the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				
Peak Shoulder	82.3 87.1	96.7 96.7	Source: HCS Summary Source: HCS Summary	
Low	92.4	96.7	Source: HCS Summary	
Avg, Control Delay (sec/veh) Peak	0	0		LOS for Signalized US (sec/veh) LOS A B C D E
Shoulder	0	0		LOS A B C D E Max Delay 10 20 35 55 80
Low	0	0		
% of Vehicles Stopping Peak				% Vehicles Stopping during each period should be 0 if control delay is 0. Values are used for fuel calculations only.
Shoulder				They do not impact delay calculations.
Low Value of Town Library				
Value of Travel Time Passenger Veh Occupancy	1.3	1.3		Use the same for base and proposed.
Value of Time (\$/occupant) Car (\$/yeh)	\$15.94	\$15.94		
Car (S/veh) Truck Driver (S/veh)	\$20.72 \$29.16	\$20.72 \$29.16		Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1				Excludes cross street delay.
Car Truck	52,438 22,473	47,719 20,451		
Present Value of Time Costs (Smill)	22,473	20,401		
for Benefit Period				
Car Truck	\$15.751 \$0.400	\$14.334 \$8.644		
Tetal	\$25.250	\$22.978		
Accident Costs				Typical acc. rates and severities by service class (2001 - 2005 data) Service Class UAU2 UAU4 UAD4 UED4 UFD4 B
Rate (coll/mvk)	0.00	0.00	Reference Safety Bencost instead	Rate (coll/mvk 0.75 0.77 1.37 0.51 0.35
Severity % Fatal	0.0%	0.0%	Defense Fefer Bernetten 4	Fatal 0.93% 0.93% 0.21% 0.63% 0.91% 2
% Injury	0.0%	0.0%	Reference Safety Bencost instead Reference Safety Bencost instead	Injury 41.5% 45.5% 44.5% 39.2% 38.7% 4
% PDO	0.0%	0.0%	Reference Safety Bencost instead	PDO 57.5% 53.6% 55.3% 60.2% 60.4% 5
Cost/Collision Fatal	\$6,063,419	\$6,063,419		This is per fatal collision. Not per fatality (typical is 1.2 fatalities/fat acc.)
Injury	\$134,824	\$134,824		This is per interest and its rest in the control of
PDO	\$7,759 \$0	\$7,759 \$0		
Weighted Average Present Value Coll. Costs (\$ mill)	\$0.000	\$0.000		
Vehicle Operating Costs (VOC)				
Running Fuel (L/km) Car	0.101	0.111		Fuel consumed at running speed, no control delay
Composite Truck	0.442	0.486		35%SU, semi - 20%empty 30% full, Btrain- 7%empty 8%full
Control Delay Fuel (L/veh) Car	0.000	0.000		Additional fuel consumed due to control delay.
Composite Truck	0.000	0.000		includes deceleration, stop time and acceleration
Fuel (Litres/yr)				Annual Fact Consumption (L)
Cars Composite Truck	465,889 873,931	512,005 960,950		
Fuel Price (\$/L)				Price net of taxes is about 55% of pump price
Car Composite Truck	50.90 50.98	\$0.90 \$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost (S/yr)				and a section of the
Car	\$418,369	\$459,781		Includes excess fuel consumption due to control delay, if any.
Composite Truck Other Vehicle Costs	\$854,704	5939,809		
Car (S/lan)	\$0.106	\$0.106		Use-related costs (other than fuel)
Truck Time (\$/hr) Truck Distance (\$/km)	\$20.64 \$0.358	\$20.64 \$0.358		5 axle dry freight 80000km/yr, year 2007
				Composite values based on peak, shoulder and
Annual Cost (\$/yr)	\$905,188	\$946,600 \$422,106		low period speeds. Assumes 0% grade.
Car	0.443.000			
Car Truck Time Truck Distance	\$463,208 \$1,562,144	\$1,647,248		
Car Truck Time Truck Distance Present Value of VOC (Smillions)	\$1,562,144			
Car Truck Time Truck Distance Present Value of VOC (Smillions) Car	\$1,562,144 \$13.121	\$13.721		
Car Truck Time Truck Distance Present Value of VOC (Smillions) Car Truck Total	\$1,562,144			
Car Truck Time Truck Distance Present Value of VOC (Smillions) Car Truck Total unany of Discounted Costs (Smillions)	\$1,562,144 \$13,121 \$29,358 \$42,480	\$13.721 \$29.996 \$43.718		
Car Truck Time Truck Distance Present Value of VOC (Smillions) Car Truck Total many of Discounted Costs (Smillions) Capital Maistenance & Resurf	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904	\$13,721 \$29,996 \$43,718 \$0,000 \$1,357		
Car Track Time Track Distance Track Distance Present Value of VOC (Smillions) Car Track Track Of Smillions) Capital Maintenance & Resurf Salvage	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147)	\$13,721 \$29,996 \$43,718 \$0,000 \$1,357 (\$0,033)		
Car Track Time Track Detance Track Detance Present Value of VOC (smillons) Car Track Total many of Discounted Costs (Smillons) Copital Maistenance & Resurf Salvage Total	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904	\$13,721 \$29,996 \$43,718 \$0,000 \$1,357		Sum of discounted Clasts
Car Track Time Track Detance Present Value of VOC (smillons) Car Track Total many of Discounted Costs (Smillons) Capital Maisteanace & Resurf Salvage Total many of Discounted Benefits True Savings	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147)	\$13,721 \$29,996 \$43,718 \$0,000 \$1,357 (\$0,033)		Savings due to higher speeds or shorter distance
Car Track Time Track Datance Track Datance Track Datance Car Track Total Track Total Track Total Track Total Track Total Tracy Total Track Total Track Total Track Track Total Track	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147)	\$13.721 \$29.996 \$43.718 \$0000 \$1.357 (\$0.033) \$1.325		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity
Car Truck Time Truck Distance Truck Distance Present Value of VDC (Smillions) Car Truck Total Truck Truck Total Truck Tr	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.033) \$1.325 \$2.272 (\$1.238)		Savings due to higher speeds or shorter distance
Car Track Time Track Detance Track Detance Present Value of VOC (smillons) Car Track Total many of Decounted Costs (smillons) Ceptal Maistenance & Resurf Salvage Total many of Becounted Benefits Time Swings Accident Swings Vehick Operating Swings Total Benefits Total Swings Total Benefits Total Swings Total Benefits	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.033) \$1.325 \$2.272 (\$1.238) \$1.034		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity
Car Truck Time Truck Distance Truck Distance Present Value of VDC (Smillions) Car Truck Total Truck Total Manatemance & Resurf Salvage Manatemance & Resurf Salvage Arcident Savings Arcident Savings Arcident Savings Vehick Operating Savings Total Benefits many of Result Values in Smillions) many of Results Values in Smillions) Fanatical Account	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.033) \$1.325 \$2.272 (\$1.238) \$1.034		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with nicreasing fuel at higher speed
Car Track Time Track Detance Track Detance Present Value of VOC (smillons) Car Track Total many of Decounted Costs (smillons) Ceptal Maistenance & Resurf Salvage Total many of Becounted Benefits Time Swings Accident Swings Vehick Operating Swings Total Benefits Total Swings Total Benefits Total Swings Total Benefits	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 (\$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.033) \$1.325 \$2.272 (\$1.238) \$1.034		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fuel at higher speed = Ptoposed - Base
Car Track Time Track Detance Track Detance Present Value of VOC (smillons) Car Track Total many of Decounted Costs (smillons) Ceptal Maistenance & Resurf Salvage Total many of Boscounted Benefits Time Swings Accident Swings Vehick Operating Swings Total Benefits Total many of Results (Pesent Values in Smillons) Flancial Account Incremental Cost Customer Service Account	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 \$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.03) \$1.325 \$2.272 (\$1.238) \$1.034 \$1.325 \$0.568 \$66.696		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fuel at higher speed - Proposed - Base - Base - Proposed
Car Track Time Track Datance Track Datance Present Value of VDC (Smillons) Car Track Total many of Daccounted Costs (Smillons) Capital many of Daccounted Costs (Smillons) Capital many of Daccounted Costs (Smillons) Track T	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 \$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.03) \$1.325 \$2.272 (\$1.238) \$1.034 \$1.325 \$0.568 \$66.696		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fixed at higher speed = Phoposed - Base ablese -Proposed = brommerstrad benefits/incremental coats
Car Track Time Track Datance Track Datance Track Datance Track Tra	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 \$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.03) \$1.325 \$2.272 (\$1.238) \$1.034 \$1.325 \$0.568 \$66.696		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fuel at higher speed - Proposed - Base - Base - Proposed
Car Track Time Track Datance Track Datance Track Datance Track Tra	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 \$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.03) \$1.325 \$2.272 (\$1.238) \$1.034 \$1.325 \$0.568 \$66.696		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fixed at higher speed = Phoposed - Base ablese -Proposed = brommerstrad benefits/incremental coats
Car Track Time Track Datance Track Datance Track Datance Track Tra	\$1,562,144 \$13,121 \$29,358 \$42,480 \$0,000 \$0,904 \$0,147) \$0,757	\$13.721 \$29.996 \$43.718 \$0.000 \$1.357 (\$0.03) \$1.325 \$2.272 (\$1.238) \$1.034 \$1.325 \$0.568 \$66.696		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity Often negative with increasing fixed at higher speed = Phoposed - Base ablese -Proposed = brommerstrad benefits/incremental coats

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sion 21 September 2008 inded for use as a screening tool prior to mor ke an original copy before using.	Optional Inputs e complete benefit		Note: TTS apply to the Treated & Treated, Upstream & Downstrea	m sections						
TREATED SECTION	Base	Proposed				Notes				_
neral Information Segment Length (km)	5.70	5.70	Effective Length = 10 - A ADT/1500	Important to she	ow any diffr	erences be	tween ba	se & prop.		_
AADŤ Annual Traffic Growth (%)	6,450 1.50%	6,450 1.50%		Base & Propose Compound grov	ed AADT sl	hould nom	mally be t	ne same.		
% Trucks	30.0%	30.0%								
Base Year Benefit Period (yrs)	2014 24	2014		Should be same Assumes 1 yr o	: for base an of constructi	ad propose ion prior to	ed. o benefits	starting.		
Discount Rate	6%	6%		7,70	T COMPANIES.	Kon priko to	, Delicera			
Property (5)	\$0	\$n	All costs in SafetyBencost	_						
Engineering (8)	\$0		All costs in SafetyBencost	Typical 10% to	20% of Con	astruction				
Construction (\$)	80		All costs in SafetyBencost							
Total (\$) Maintenance (\$/km/yr)	\$0 \$0	\$0 \$0		Typical \$4,000/I	I n. lon for ?	In and \$5	SOUT a Jorg	m for 4.1 n		
Resurfacing Cost (\$/km)	\$0		All costs in SafetyBencost	Typical \$45,000			.500 Lii-ki	nior+La		
Resurfacing Years	2022	2029		Typical Paveme	ent life is 15	yrs from th	he last res	aufacing		
	2037	2044		2nd resurf yr is						
Salvage Value (\$) in Horizon Yr Present Value	\$0 \$0	90 90		Typical is 100% Present Value of						
stomer Service Account			1	THE STATE OF	· capital · c					_
Time Costs % of AADT			1	% of AADT occ	curring in ea	ach period	. For exa	mple		_
Peak	13.1%	13.1%		a 3 hr peak perio	od with 10%	6 of AADT	f per hr=	30% of AAI	ж	
Shoulder Low	31.1%	31.1%		These splits are veh. Op. costs d	during differ	nent period	speed, de is of the c	lay and lay.		
Total	100.0%	100.0%		Total must equa	al 100%					
Auto Speed (km/hr) Peak	82.3	82.9	Downstream TTS from HCS Summery 0.6	Representative	average spo	eeds in per	ak and sh	oulder		
Shoulder	87.1	89.0	Downstream TTS from HCS Summary 1.9	periods are usua	ally not mad	ch lower th	ian speci	ds in		
Low Truck Speed (km/hr)	92.4	96.2	Downstream TTS from HCS Summary 3.8	the low period	unless dem	and is exce	eding 80	n of capacit	у.	
Peak	82.3	82.9	Downstream TTS from HCS Summary							
Shoulder Low	87.1 92.4	89.0 96.2	Downstream TTS from HCS Summary Downstream TTS from HCS Summary							
Avg,"Control Delay (sec/veh)					OS for Signa					1
Peak Shoulder	0	0		LOS Max Delay	A 10	B 20	C 35	D 55	E 80	1
Low	0	0	1						- 00	
% of Vehicles Stopping Peak				% Vehicles Stop if control delay					ılv.	
Shoulder				They do not in					01	
Low Value of Travel Time										
Passenger Veh Occupancy	1.3	1.3		Use the same fo	or base and	proposed.				
Value of Time (\$/occupant) Car (\$/yeh)	\$15.94 \$20.72	\$15.94 \$20.72								
Truck Driver (\$/veh)	\$29.16	\$29.16		Assumes occup	pancy 1.0					
Travel Time (veh-hrs) in Year 1				Excludes cross s	street delay	r.				
Car Truck	106,747 45,749	104,098 44,613								
Present Value of Time Costs (Smill) for Benefit Period										
Car	\$32,064	\$31.268								
Truck	\$19.337	\$18.858								
Total	\$51,402	\$50.126		Typical acc, rate	es and seve	critics by s	ervice cla	ss (2001 - 20	(05 data)	
Accident Costs Rate (coll/mvk)	0.00	0.00	Up & Downstream Safety Benefits in Safety Bencost	Service Class	UAU2 I	UAU4 0.77	UAD4 1.37	UED4 0.51	UFD4 0.35	R.
Severity										
% Patal % Injury	0.0%	0.0%	Up & Downstream Safety Benefits in SafetyBencost Up & Downstream Safety Benefits in SafetyBencost			0.93% 45.5%	0.21%	0.63% 39.2%	0.91% 38.7%	41
% PDO	0.0%	0.0%	Up & Downstream Safety Benefits in SafetyBencost			53.6%	55.3%	60.2%	60.4%	55
Cost/Collision Fatal	\$6,063,419	\$6,063,419		This is per fatal	Collision N	Not ner fata	dity (tynis	ralis 1.2 fata	lities/fat ac	e)
Injury	\$134,824	\$134,824		THE D PHI INIT		per iiii				
PDO Weighted Average	\$7,759 \$0	\$7,799 \$0								
Present Value Coll. Costs (\$ mill)	\$0.000	\$0.000								
Vehicle Operating Costs (VOC) Running Fuel (L/km)	T 1		1	Fuel consumed	at running	speed, no	control d	elay		_
Car	0.101	0.104								
Composite Truck Control Delay Fuel (L/veh)	0.442	0.454		35% SU, semi - 2 Additional fuel	20% empty 3 consumed c	30% full, Bt	train- 7% c trol delay	mpty 8%full	1	_
Car	0.000	0.000		includes deceler						
Composite Truck Fael (Litres/yr)	0.000	0.000	1	Annual Fuel Co	ensumetion	(L)				_
Cars	948,407	973,267	1							
Composite Truck Fuel Price (S/L)	1,779,052	1,826,215	1	Price net of taxe	ns is about 4	55% of nov	on price			
Car	\$0.90	\$0.90								
Composite Truck Fuel Cost (\$/yr)	\$0.98	\$0.98	1	Truck fuel is us	ually diesel	which is le	ess costly	than gasoù	DC.	_
Car	\$851,669	\$873,993		Includes excess	fuel consu	mption du	e to conti	tol delay, if a	ny.	
Composite Truck Other Vehicle Costs	\$1,739,913	\$1,786,038	1							_
Car (\$/km)	\$0.106	50,106		Use-related cost	ts (other th:	an fuel)				
Truck Time (\$/hr)	\$20.64 \$0.358	\$20.64 \$0.358		5 axle dry freigh	st 80000km/y	yr, year 200	07			
Truck Distance (\$/km) Annual Cost (\$/yr)				Composite valu	ies based or	n peak, sho	oulder and	1		_
Car Truck Time	\$1,842,683 \$942,948	\$1,865,007 \$918,705	1	low period spee	eds. Assume	es 0% grad	ie.			
Truck Distance	\$942,948 \$3,180,041	\$918,705 \$3,226,166								
Present Value of VOC (Smillions)	\$26.711	\$27.034								
Truck	\$59.765	\$60.082								
Total	\$86,475	\$87.116	1							
nmary of Discounted Costs (Smillions) Capital	\$0.000	\$0.000	1							_
Maintenance & Resurf Salvage	\$0.000 \$0.000	\$0.000 \$0.000								
Total	\$0.000	\$0.000]	Sum of discoun	ited Costs					
nnary of Discounted Benefits						ade ac -t	des Co			_
Time Savings Accident Savings		\$1.276		Savings due to Savings due to	reduced acc	cident rate	or severi	ty		
Vehicle Operating Savings		(\$0.641)	1	Often negative						
Total Benefits mary of Results (Present Values in Smillions	, I	\$0.635	1							_
Financial Account	\$0.000	\$0,000]							
Incremental Cost Customer Service Account	\$137.877	\$0.000 \$137.242		= Proposed - Ba	isc					
Incremental Benefit	3157.077			=Base -Propose	bd					
B/C Ratio Net Present Value		#DIV/0! \$0.000		 Incremental Incremental 						
DATE OF STREET		\$0.000	1	2 Ficremental	periodits - I	croment	O05(S			_
enhouse Gas Reduction										
enhouse Gas Reduction Gas Dies										
enhouse Gas Reduction	ı	-187	1							
enhouse Gas Reduction Gas Dies Kg/Litre		-187 -10								



SHORTBEN - RELIABILITY



ided for use as a screening tool prior to more e an original copy before using.	Optional Inputs complete benefit	oost analysis	Used avg control delay to r	replicate the seconds of delay per day on average
	Base	Proposed *		Notes
eral Information Segment Length (km)	0.00	0.00	6000	Important to show any differences between base & prop.
AADŤ	1,091.7 1.50%	1,092	0.1819	Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%) § Trucks	30.0%	1.50%		Campound growth
Base Year Benefit Period (vrs)	2012	2012 24		Should be same for base and proposed.
Discount Rate	6%	6%		Assumes 1 or of construction prior to benefits starting.
incial Account	1 401	40		
roperty (S) Engineering (S)	\$0 \$0	\$0 \$0		Typical 10% to 20% of Construction
Construction (S)	\$0			Typina to to 200 of Community
Total (S)	\$0	\$0		
Maintenance (S/km/yr) Resurfacing Cost (S/km)	\$0 \$0	\$0 \$0		Typical \$4,900/Ln-km for 2 Ln and \$5,500/Ln-km for 4-Ln Typical \$45,000 to \$80,000/Ln-km
Resurfacing Years	2021	2027		Typical Pavement life is 15 yrs from the last resurfacing
2	2036	2042		2nd resurf yr is ignored if 0 or >(base yr + benefit period)
Salvage Value (S) in Horizon Yr	50	50		Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value Iomer Service Account	90	50		Present Value of capital + maint. + resurf salvage
ime Costs % of AADT			l	% of AADT occurring in each period. For example
% of AAD1 Peak	40.0%	40.0%		a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%		These splits are used to differentiate speed, delay and
Low Total	30.0% 100.0%	30.0% 100.0%		veh. Op. costs during different periods of the day. Total must equal 100%
Auto Speed (km/hr)				
Peak Shoulder	100.0 100.0	100.0 100.0		Representative average speeds in peak and shoulder periods are usually not much lower than speeds in
Low	100.0	100.0		the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr) Peak	100	100		
Shoulder	100	100		
Low Avg, Control Delay (sec/veh)	100	100		LOS for Signalized VS (sec/veh)
Peak	43	0	262 Ave. Minutes/Year	LOS A B C D E
Shoulder	43	0		Max Delay 10 20 35 55 80
Low % of Vehicles Stopping		0		% Vehicles Stopping during each period should be 0
Peak	100%			if control delay is 0. Values are used for fuel calculatons only.
Shoulder Low	100% 100%			They do not impact delay calculations.
Value of Travel Time				
Passenger Veh Occupancy Value of Time (\$/occupant)	1.3 \$15.94	1.3 \$15.94		Use the same for base and proposed.
Car (S/veh)	\$41.44	\$20.72	x2=non-work VTTS adjustment factor (UBCS	Guidebook P. B37)
Truck Driver (S/veh) Travel Time (veh-hrs) in Year I	\$64.70	\$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjustr	Assumes occupancy 1.0 Excludes cross street delay.
Car	3,337	0	\$138,293 Year 1	Daniel closs street deay.
Truck Present Value of Time Costs (Smill)	1,430	0	\$92,524 Year 1	
for Benefit Period			\$230,816 Year 1 sum	
Car	\$2.005	\$0.000		
Truck Total	\$1.341 \$3.346	\$0.000		
	555.44	90.000		
Rate (coll/mvk)	0.00	0.00		
Severity				
% Fatal % Injury	2.6% 41.0%	2.1% 44.8%		
% PDO	56.5%	53.1%		
Cost/Collision Fatal	\$6,063,419	\$6,063,419		This is per fatal collision. Not per fatality (typical is 1.2 fatalities/fat acc.)
Injury	\$134,824	\$134,824		, , , , , , , , , , , , , , , , , , , ,
PDO Weighted Average	\$7,759 \$214,436	\$7,759 \$193,307		
Present Value Coll. Costs (\$ mill)	\$0.000	\$0.000		
Pehicle Operating Costs (VOC) Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.116	0.116		ruet consumed at tunning speed, no control deady
Composite Truck Control Delay Fuel (L/veh)	0.505	0.505		35%SU, semi - 20%empty 30% full, Btrain-7%empty 8% full
Car	0.116	0.000		Additional fuel consumed due to control delay. includes deceleration, stop time and acceleration
Composite Truck Fuel (Litres/yr)	0.545	0.000		Annual Fuel Consumption (L)
Fuel (Litres/yr) Cars	32,220	0		Printing Part Consumption (L)
Composite Truck	65,143	0		ni a come de la come d
Fuel Price (S/L) Car	\$0.90	\$0.90		Price net of taxes is about 55% of pump price
Composite Truck	\$0.98	\$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost (\$/yr) Car	\$28,933	50		Includes excess fuel consumption due to control delay, if any.
Composite Truck	\$63,710	50		, , , , , , , , , , , , , , , , , , , ,
Other Vehicle Costs Car (S/km)	\$0.106	\$0.106		Use-related costs (other than fuel)
Truck Time (\$/hr)	\$20.64	\$20.64		5 axle dry freight 80000km/yr, year 2007
Truck Distance (\$/km) Annual Cost (\$/vr)	\$0.358	\$0.358		Composite values based on peak, shoulder and
Car	\$28,933	50		low period speeds. Assumes 0% grade.
Truck Time Truck Distance	\$29,517 \$63,710	50 50		
Present Value of VOC (\$millions)				
Car	\$0.419	\$0.000		
Truck Total	\$1.351 \$1.771	\$0.000 \$0.000		
mary of Discounted Costs (Smillions)			I	
Capital Maintenance & Resurf	\$0.000 \$0.000	\$0.000 \$0.000		
ialvage	\$0.000	\$0.000		
Total mary of Discounted Benefits	\$0.000	\$0.000		Sum of discounted Costs
lime Savings		\$3.346		Savings due to higher speeds or shorter distance
Accident Savings		\$0.000 \$1.771		Savings due to reduced accident rate or severity Often negative with increasing fuel at higher speed
Vehicle Operating Savings Total Benefits		\$1.771 \$5.117		ones seguite was increasing mer at figher speed
mary of Results (Present Values in Smillions)			I	
inancial Account Incremental Cost	\$0.000	\$0,000		= Proposed - Base
Oustomer Service Account	\$5.117	\$0.000		
Incremental Benefit 3/C Ratio		\$5.117 #DEV/0!		=Base -Proposed = Incremental benefits/incremental costs
Net Present Value		\$5.117		= Incremental Benefits - Incremental Costs
nhouse Gas Reduction				
No. Disc.				
las Dies G/Litre				
as Dies		254 14		

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SHORTBEN — CATASTROPHIC FAILURE AVOIDANCE



ended for use as a screening tool prior to more			Disbenefits due to	
ke an original copy before using.		Proposed *		Notes
neral Information				
Segment Length (km) AADT	6,000.0	0.00 6,000		Important to show any differences between base & peop. Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%		Compound growth
% Trucks Base Year	30.0% 2012	30.0% 2012		Should be same for base and proposed.
Benefit Period (yrs)	0.08333333	0.08333333	1 Month duration	Assumes I yr of construction prior to benefits starting.
Discount Rate	6%	6%		, , ,
Property (S)	\$0	\$0		_
Engineering (S)	\$0	\$0		Typical 10% to 20% of Construction
Construction (\$)	80			
Total (\$) Maintenance (\$/km/yr)	\$0 \$0	\$0 \$0		Torin 184 0000 - In Co-21 - and 64 6000 - In Co-41 -
Resurfacing Cost (\$/km)	50	\$0		Typical \$4,000/Ln-km for 2 Ln and \$5,500/Ln-km for 4-Ln Typical \$45,000 to \$80,000/Ln-km
Resurfacing Years	2021	2027		Typical Pavement life is 15 yrs from the last resurfacing
	2036	2042		2nd resurf yr is ignored if 0 or >(base yr + benefit period)
Salvage Value (\$) in Horizon Yr	50	\$0		Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value tomer Service Account	\$0	50		Present Value of capital + maint.+ resurf salvage
Time Costs				
% of AADT	40.0%	40.0%		% of AADT occurring in each period. For example a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Peak Shoulder	30.0%	30.0%		a 3 hr peak period with 10% of AADT per hr = 30% of AADT. These splits are used to differentiate speed, delay and
Low	30.0%	30.0%		veh. Op. costs during different periods of the day.
Total	100.0%	100.0%		Total must equal 100%
Auto Speed (km/hr) Peak	100.0	100.0		Representative average speeds in peak and shoulder
Shoulder	100.0	100.0		periods are usually not much lower than speeds in
Low Truck Speed (km/hr)	100.0	100.0		the low period unless demand is exceeding 80% of capacity.
Peak	100	100		
Shoulder Low	100 100	100 100		
Avg, Control Delay (sec/veh)				LOS for Signalized I/S (sec/veh)
Peak	0	13500	3.75 hours delay	LOS A B C D E
Shoulder Low	0	13500 13500		Max Delay 10 20 35 55 80
% of Vehicles Stopping		. 3000		% Vehicles Stopping during each period should be 0
Peak Shoulder	100% 100%			if control delay is 0. Values are used for fuel calculatons only. They do not impact delay calculations.
Shoulder Low	100%			ting so not inputs octay calculations.
Value of Travel Time				
Passenger Veh Occupancy Value of Time (\$/occupant)	1.3 \$15.94	1.3 \$15.94		Use the same for base and proposed.
Car (S/veh)	\$41.44	\$41.44	x2=non-work VTTS adjustment factor (UBC	S Guidebook P. B37)
Truck Driver (S/veh)	\$64.70	\$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjust	Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1 Car		5,748,750	50 Year I	Excludes cross street delay.
Truck	ő	2,463,750	S0 Year 1	
Present Value of Time Costs (Smill)			S0 Year 1 sum	
for Benefit Period Car	\$0,000	\$19,385		
Truck	\$0,000	\$12.969		
Total	\$0,000	\$32,354		
Accident Costs				
Rate (coll/mvk)	0.00	0.00		
Severity % Fatal	2.6%	2.1%		
% Injury	41.0%	44.8%		
% PDO Cost/Collision	56.5%	53.1%		
Fatal	\$6,063,419	\$6,063,419		This is per fatal collision. Not per fatality (typical is 1.2 fatalities/fat acc.)
Injury PDO	\$134,824	\$134,824 \$7,759		
Weighted Average	\$7,759 \$214,436	\$193,307		
Present Value Coll. Costs (\$ mill)	\$0.000	\$0.000		
Vehicle Operating Costs (VOC) Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.116	0.116		Twittonsume at faming speed, no contordenty
Composite Truck	0.505	0.505		35%SU, semi - 20%empty 30% full, Btrain-7%empty 8%full
Control Delay Fuel (L/veh) Car	0.095	6.494		Additional fuel consumed due to control delay. includes deceleration, stop time and acceleration
Composite Truck	0.132	129.600		
Fuel (Litres/yr) Cars	145,328	9 954 536		Annual Fuel Consumption (L)
Cars Composite Truck	145,328 86,396	9,954,536 85,147,200		
Fuel Price (S/L)				Price net of taxes is about 55% of pump price
Car Composite Truck	\$0.90 \$0.98	\$0.90 \$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost (\$/yr)				
Car Composite Truck	\$130,505	\$8,939,173 \$83,273,962		Includes excess fuel consumption due to control delay, if any.
Composite Truck Other Vehicle Costs	\$84,495	883,273,962		
Car (\$/km)	\$0.106	\$0.106		Use-related costs (other than fuel)
Truck Time (\$/hr) Truck Distance (\$/km)	\$20.64 \$0.358	\$20.64 \$0.358		5 axle dry freight 80000km/yr, year 2007
Annual Cost (S/yr)				Composite values based on peak, shoulder and
Car	\$130,505	\$8,939,173		low period speeds. Assumes 0% grade.
Truck Time Truck Distance	\$0 \$84,495	\$50,851,800 \$83,273,962		
Present Value of VOC (Smillions)				
Car	\$0.011 \$0.007	\$0.727 \$10.913		
Truck Total	\$0.007 \$0.017	\$10.913 \$11.640		
mary of Discounted Costs (Smillions)				
Capital	\$0.000 \$0.000	\$0.000 \$0.000		
Maintenance & Resurf Salvage	\$0.000	\$0.000		
Total	\$0.000	\$0.000		Sum of discounted Costs
mary of Discounted Benefits Time Savings	1	(\$32.354)		Savings due to higher speeds or shorter distance
Accident Savings		\$0.000		Savings due to reduced accident rate or severity
Vehicle Operating Savings		(\$11.623)		Often negative with increasing fuel at higher speed
Total Benefits mary of Results (Present Values in Smillions)		(\$43.977)		
Financial Account	\$0,000	\$0.000		
Incremental Cost Customer Service Account	\$0.017	\$0.000		= Proposed - Base
Customer Service Account Incremental Benefit	\$0.017	\$43.994 -\$43.977		=Base -Proposed
B/C Ratio	1	#DIV/05		= Incremental benefits/incremental costs
Net Present Value enhance Gas Reduction		-\$43.977		= Incremental Benefits - Incremental Costs
nhouse Gas Reduction				
Gas Dies				
Kg/Litre				
Kg/Litre 2.36 2.73 Carbon Dioxide		-255375 -9545		
Gs Dies kg/Litre 2.73 2.75 2.73 0.262 0.08 Nitrogen Oxide Nitrogen Oxide 4.122 0.12 Annual Saving (tonnes/y		-255375 -9545 -11574 -276494		



SHORTBEN.XLS Version 21 September 2008	Required Inputs Optional Inputs	in Green	D' L C	
Intended for use as a screening tool prior to more Make an original copy before using.	complete benefit	Proposed	Disbenefits of	due to detour bridge during repairs
General Information				
Segment Length (km) AADT Annual Traffic Growth (%)	1.50 6,000.0 1.50%	1.50 6,000 1.50%		Important to show any differences between base & prop. Base & Proposed AADT should normally be the same. Compound growth
% Trucks Base Year	30.0% 2012	30.0% 2012		Should be same for base and proposed.
Benefit Period (yrs) Discount Rate	1.5 6%	1.5 6%	18 months	Assumes 1 yr of construction prior to benefits starting.
Property (S)	\$0	\$0		•
Engineering (S) Construction (S)	\$0 \$0	\$0		Typical 10% to 20% of Construction
Total (5)	\$0	\$0		
Maintenance (\$/km/yr)	\$0 \$0	\$0 \$0		Typical \$4,000°Ln-km for 2 Ln and \$5,500°Ln-km for 4-Ln Typical \$45,000 to \$80,000°Ln-km
Resurfacing Cost (\$/km) Resurfacing Years	2021	2027		Typical Pavement life is 15 yrs from the last resurfacing
Salvage Value (S) in Horizon Yr	2036	2042 50		2nd resurf yr is ignored if 0 or >(base yr + benefit period) Typical is 100% of pepty + 80% of Const.+ resurf. Residual
Present Value	\$0 \$0	50		Present Value of capital + maint.+ resurf salvage
Customer Service Account Time Costs				
% of AADT Peak	40.0%	40.0%		% of AADT occurring in each period. For example a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%		These splits are used to differentiate speed, delay and
Low Total	30.0%	30.0% 100.0%		veh. Op. costs during different periods of the day. Total must equal 100%
Auto Speed (km/hr) Peak	100.0	50.0	reduced speed to 50km	Representative average speeds in peak and shoulder
Shoulder Low	100.0 100.0	50.0 50.0	,	periods are usually not much lower than speeds in the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				the low period united sections is calcoloung over or expensive
Peak Shoulder	100 100	50 50		
Low Avg, Control Delay (sec/veh)	100	50		LOS for Signalized I/S (sec/veh)
Peak Shoulder	0	0		LOS A B C D E MaxDelay 10 20 35 55 80
Low	0	0		
% of Vehicles Stopping Peak	100%			% Vehicles Stopping during each period should be 0 if control delay is 0. Values are used for fuel calculations only.
Shoulder Low	100% 100%			They do not impact delay calculations.
Value of Travel Time Passenger Veh Occupancy	1,3	1.3		Use the same for base and proposed.
Value of Time (S/occupant)	\$15.94	\$15.94	x2=non-work VTTS adjustment factor (UBC	
Car (\$/veh) Truck Driver (\$/veh)	\$41.44 \$64.70	\$41.44 \$64.70	x2=non-work VITS adjustment factor (UBC) x2 = value of cargo, TTI 1997; x1.23 = adjust	Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1 Car	22,995	45,990	\$953,005 Year I	Excludes cross street delay.
Truck Present Value of Time Costs (Smill)	9,855	19,710	\$637,599 Year 1 \$1,590,604 Year 1 sum	
for Benefit Period				
Car Truck	\$1.353 \$0.905	\$2.706 \$1.811		
Total	\$2.258	\$4.517		
Accident Costs Rate (coll/mvk)	0.00	0.00		
Severity % Fatal	2.6%	2.1%		
% Injury	41.0%	44.8%		
% PDO Cost/Collision	56.5%	53.1%		
Fatal Injury	\$6,063,419 \$134,824	\$6,063,419 \$134,824		This is per fatal collision. Not per fatality (typical is 1.2 fatalities/fat acc.)
PDO Weighted Average	\$7,759 \$214,436	\$7,759 \$193,307		
Present Value Coll. Costs (\$ mill) Vehicle Operating Costs (VOC)	\$0.000	\$0.000		
Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car Composite Truck	0.116 0.505	0.091 0.354		35%SU, semi - 20%empty 30% full, Btrain- 7%empty 8%full
Control Delay Fuel (L/veh) Car	0.095	0.000		Additional fuel consumed due to control delay, includes deceleration, stop time and acceleration
Composite Truck Fuel (Litres/yr)	0.132	0.000		Annual Fuel Consumption (L)
Cars Composite Truck	410,944	208,990		
Fuel Price (S/L)	584,379	348,433		Price net of taxes is about 55% of pump price
Car Composite Truck	\$0.90 \$0.98	\$0.90 \$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost (S/yr) Car	\$369,027	\$187,673		Includes excess fuel consumption due to control delay, if any.
Composite Truck Other Vehicle Costs	\$571,522	\$340,768		
Car (8/km) Truck Time (8/hr)	\$0.106 \$20.64	\$0.106 \$20.64		Use-related costs (other than fuel) 5 ade dry freight 80000km/yr, year 2007
Truck Distance (S/km)	\$20.64 \$0.358	\$20.64 \$0.358		
Annual Cost (S/yr) Car	\$611,625	\$430,270		Composite values based on peak, shoulder and low period speeds. Assumes 0% grade.
Truck Time Truck Distance	\$203,407 \$924,061	\$406,814 \$693,307		
Present Value of VOC (Smillions) Car	90.868	90.611		
Truck	\$1.601	\$1.562		
Total Summary of Discounted Costs (Smillions)	\$2,469	\$2.173		
Capital Maintenance & Resurf	\$0.000 \$0.000	\$0.000 \$0.000		
Salvage Total	\$0.000 \$0.000	\$0.000 \$0.000		Sum of discounted Costs
Summary of Discounted Benefits	- posterior	(\$2.258)		
Time Savings Accident Savings		\$0.000		Savings due to higher speeds or shorter distance Savings due to reduced accident rate or severity
Vehicle Operating Savings Total Benefits		\$0.296 (\$1.962)		Often negative with increasing fuel at higher speed.
Summary of Results (Present Values in Smillions) Financial Account	S0.000	\$8,000		
Incremental Cost Customer Service Account	\$4,728	\$0.000 \$6.690		= Proposed - Base
Incremental Benefit	54.728	-\$1.962		=Base -Proposed
B/C Ratio Net Present Value		#DIV/05 -\$1.962		= Incremental benefits/incremental costs = Incremental Benefits - Incremental Costs
Greenhouse Gas Reduction Gas Dies				
Kg/Litre 2.36 2.73 Carbon Dioxide	,	1121		
naca our Mitmore Conta	-	72		
0.262 0.08 Nitrogen Oxide 0.122 0.12 Hydrcarbons		53		

A-xviii



AAAT AAAT AARIAGO AMARIAGO A	225.00 (0.50%)	90.00 90.00	Average distance hwy 3.& hwy 5 Ahemate mute traffic I month Idom speed reduction s2=non-week VTT 8 adjustment factor (UB s2=-wike of cupp. TTI 1997; s1.25=-adju s231,633,106 Year 1 s386,605,034 Year 1 sum	Important to show Bace & Prophored. Compound growth Should be same fo Assumes 1 ½ of compound growth Should be same for Assumes 1 ½ of compound growth Should be same for Assumes 1 ½ of compound growth Should be same for Assumes 1 ½ of compound growth Should be same for the same for the same for the Should growth Should gro	rbase and proposed. nostruction prior to benefits \$ of Construction In for 2 Ln and \$5,500 Ln-\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	use & grop, he same. starting.	DT sy	
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Annual Tariffs Gowth (%) 5 Texels Base Year 7 Texels Base Year 7 Texels Base Year 8 Texels Base Year 9 To 0.0833 Base Hard 1 To 1.0833 Base Hard	50% 0.09% 500% 500 500 500 500 500 500 500 500 5	1.50% 20 12	10km speed reduction 22-non-work VTTS adjustment factor (UB 22 = who of cupo, TTI 1997; xl. 23 = adju 521,633,06; Year 1 5336,005,034 Year 1 sum	Compound growth Should be same for Assumes 1 ½ of or Assumes 1 ½ of or Assumes 1 ½ of or Typical 10% to 207 Typical 545,000 to	r base and proposed. nostruction proof to benefits of Construction lam for 2 Ln and \$5,509 Ln. & \$84,000 Ln	um for 4La	DT sy	
## Tracks Base Year Benefit Period (yes) Common	0.0% S0	30.0% 30.0% 0.08333333 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0 \$0	tidem speed reduction **Zenon-work VTT's adjustment factor (UB s2 = white of cupp. TTI 1997; x1.25 = adjustment (S1, S1, S1, S1, S1, S1, S1, S1, S1, S1,	Should be same for Assumes 1 37 of or Assumes 1 37 of or Or Assumes 1 37 of or Or Assumes 1 37 of or	rbase and proposed. nostruction prior to benefits \$ of Construction In for 2 Ln and \$5,500 Ln-\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	om for 4-Ln surfacing efit period) urf. Residual age mple 30% of AAI chay and day. conlider ds in % of capacit D 55 M be 0	DT sy	
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Se of AADT Peak Shoulder 1 or 1 Shoulder 1 or	0.0% 0.0% 0.0% 100.0 100.0 100.0 100 0 0 0 0 0 100% 100%	30.0% 30.0%	Canon-work VTTS adjustment factor (UB) 32 = value of carpo, TTI 1997; xl.23 = adju \$231,633,06 Year 1 \$336,605,034 Year 1 sum	a 3 hr peak periad These splits are us veh. Op. costs duf Total must east Representative av periods are usually the low period unl LOS LOS Max Delay if control delay is They do not anpa Use the same for b CS Gaidebook P. B37) CS Gaidebook P. B37)	sain 10% of AADT per live and GADT per live and GADT per live 20% of differentiates speed, dig different periods of the 20% of the 2	30% of AAI clay and day. coulder ds in 6% of capacit D 55 M be 0	E 80	
Peak Shoulder Low Shoulder Shoulder Low Shoulder Shoulder Shoulder Shoulder Low Shoulder Shoulde	0.0% 0.0% 0.0% 100.0 100.0 100.0 100 0 0 0 0 0 100% 100%	30.0% 30.0%	Canon-work VTTS adjustment factor (UB) 32 = value of carpo, TTI 1997; xl.23 = adju \$231,633,06 Year 1 \$336,605,034 Year 1 sum	a 3 hr peak periad These splits are us veh. Op. costs duf Total must east Representative av periods are usually the low period unl LOS LOS Max Delay if control delay is They do not anpa Use the same for b CS Gaidebook P. B37) CS Gaidebook P. B37)	sain 10% of AADT per live and GADT per live and GADT per live 20% of differentiates speed, dig different periods of the 20% of the 2	30% of AAI clay and day. coulder ds in 6% of capacit D 55 M be 0	E 80	
Shoulder Low 3 Total Auto Speed durhar) Peck Shoulder Low Trusk Speed durhar) Peck Shoulder Low Arge Guntral Edely (see'veh) Peck Shoulder Low 4 Control Edely (see'veh) Peck Shoulder Low 4 Shoulder Low 4 Control Edely (see'veh) Peck Shoulder Low 5 of Vichick's Stopping Peck Shoulder Low 4 Shoulder Low 4 Shoulder Low 5 of Vichick's Stopping Peck 5 Shoulder Low 4 Shoulder Low 5 Frac (Soccupant) Trusk Diver (O'veh) Travel Time Passeager Vish Occupanty Value of True' Time Passeager Vish Occupanty Value of True Control Trusk Diver (O'veh) Travel Time Cocks (Smill) for Benefit Petiod Cur Truck Shoulder Truck Shoulder Truck Shoulder Cur Truck Shoulder Shoulde	0.0% 0.0% 0.0% 100.0 100.0 100.0 100 0 0 0 0 0 100% 100%	30.0% 30.0%	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,5719.85. Year 1 5386,605.035.	These splits are such Op. costs of the Costs	ed to differentiate speed, dis gifferent periods of the 2005. gifferent periods of the 2005. for Signallard IS (sect/reb). for Signallard IS (sect/reb). \$\frac{1}{2}\$	elay and day. conlder ds in PS of capacit D 55	E 80	
Total Auto Speed (amhr) Peak Shoulder Low Truck Speed (awhr) Peak Shoulder Low Avg Control Delay (see/veh) Shoulder Low Gerythickes Stepping Feak Shoulder Low Value of Tavel Time Passeager (with Occupancy Value of Tavel	100.076 100.0 100.0 100.0 100.0 100.0 0 0 0 0 0	90.0 99.0 99.0 99.0 99.0 99.0 99.0 99.0	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,5719.85. Year 1 5386,605.035.	Total must equal 1 Representative ava wasally the low period unl LOS LOS What Deby Whieles Stoppi if control deby is if They do not impa- Use the same for to Use the same for to Stoppide St	2005 mage speeds in peik and sh not much lower than spee se demand is exceeding 80 to 50	ounder ds in % of capacit D 55	E 80	
Auto Speed family Peak Shoulder Low Truck Speed dearlur Peak Shoulder Low Avg*Control Delay (sec/veh) Peak Shoulder Low Avg*Control Delay (sec/veh) Peak Shoulder Low Gericher Stopping Peak Shoulder Low Unles of Travel Time Passenger Wh Occupancy Value of Time (Soccupant) Car (Sv'och) Travel Time (sch shot in Vene 1 Car Truck Truck Diversifyer) Travel Time (sch shot in Vene 1 Car Truck Truck Diversifyer) Speed Truck Composite Truck Truck Time (Shot) Truck Time	100.0 100.0 100.0 100.0 100 0 0 0 100% 100%	90.0 90.0 90.0 90.0 90.0 90 90 90 90 90 90 90 90 90 90 90 90 90	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,5719.85. Year 1 5386,605.035.	Representative avperieds are usually the low period unlike the low	rage speeds in peak and sh not much lower than spee ses a demand in exceeding 80 does Signatured IFS (see/veh)	ds in % of capacit D 55	E 80	
Peak Showlder Low Truck Speed dowln's Peak Showlder Low Showlder Low Truck Speed dowln's Peak Showlder Low % of Vehicks Stopping Peak Showlder Low % of Vehicks Stopping Peak Showlder Low Value of Trave Vehicks Stopping Peak Showlder Travel Time Corbeth of Vehick Travel Time Corbeth of Vehick Travel Time Coats (foull) for Beacta Period Car Travel T	100.0 100.0 100.0 100 0 0 0 0 0 0 0 0 0	90.0 90.0 90.0 90 90 90 90 90 90 90 90 90 90 90 90 90	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,5719.85. Year 1 5386,605.035.	periods are usually the low period unlike low	not much lower than specess demand in exceeding 80 for Signalized 1/8 (see/web) x B C C Signalized 1/8 (see/web) x B C	ds in % of capacit D 55	E 80	
Low Trusk Speed dawhr) Peak Shoulder Low Avg*Control Delay (see/veh) Peak Shoulder Low Value of Trave Time Passenger Vah Occupancy Value of Trave Time Passenger Vah Occupancy Value of Trave Shoulder Low Trave Time (solven) Travel Travel Time (solven) Travel Travel Time (solven) Travel Travel Travel Time (solven) Travel Trav	100.0 100 100 0 0 0 0 100% 1.33 815.94 441.44 664.70 89,063 395,313	90.0 90.0	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,5719.85. Year 1 5386,605.035.	LOS LOS LOS MaxDelay § Vehicles Suppil foonted delay is They do not impa Use the same for b	ses demand is exceeding 80 for Signalized US (sec/veb) X. B C 0 29 35 ng during each period shou X Values are used for fuel ear t delay calcularions. ase and proposed.	D 55	E 80	
Truck Speed doubth Peak Shoulder Low Avg.Control Delay (sec/veh) Peak Shoulder Low 4vg.Control Delay Fus.Assert Low Plassenger Wh Occupancy Plassenger Wh Occupancy Car (Svveh) Truck Direct (Sveh) Truck Direct (Sveh) Truck Truck (sec) Truck Truck Truck (sec)	100 100 0 0 0 0 100% 100% 1.3 \$15.94 \$41.44 664.70 89,063 15,313 18.846 9,165 11,456	1.3 1.3 1.3 1.3 1.3 1.3 1.3 1.3	s2-non-work VTTS adjustment factor (UB s2 = value of cape, TTI 1997; xl 23 = adju 523 (463),06. Year 1 5336,6785,034 Year 1 sum	LOS Max Deby I % Vehicles Stoppi delay is of control deby is of They do not impa Use the same for b US Guidebook P. B37) strf Assumes occupant	for Sunalized US (sec/veh) A B C O 20 35 and guring each period show Whites are used for fuel cort of the cort o	D 55	E 80	
Peak Shoulder Low Avg Counted Delay (sec/veh) Peak Shoulder Low Avg Counted Delay (sec/veh) Peak Shoulder Low Shoulder Low Shoulder Low Walson of Travel Time Shoulder Low Walson of Travel Time Travel Time (secupant) Car (Sveh) Travel Time (velo-than in Near Car (Sveh) Travel Time (velo-than in Near Shoulder Sh	100 0 0 0 0 100% 100% 100% 13.3 15.94 141.44 664.70 89,063 15.313 18.846 12.609 9	1.3 1.3 1.5 1.5 1.5 1.5 1.5 1.5 1.5 1.5	s2-mon-work VTTS adjustment factor (UB s2 = value of carpo, TTT 1997; x1.23 = adju \$231,633,06 Year 1 \$336,605,034 Year 1 sum	LOS MaxDelay 1 % Vehicles Stoppi if control delay is 6 They do not impa Use the same for b CCS Guidebook P. B37) strt Assumes occupan	A B C 0 20 35 ng during each period shou t. Values are used for fuel ear et delay calculations. ase and proposed.	55 ld be 0	80	
Low	100 0 0 0 100% 100% 13.3 515.94 541.44 664.70 89,063 18,846 12.609 9	1.3.3 \$15.94 \$10.069 \$2.661,458 \$20.941 \$1.010 \$34.951	s2mon-work VTTS adjustment factor (UB s2 = value of curpo, TII 1997; s1.23 = adju s231,633.06 Year 1 s154,971,925 Year 1 s386,605.034 Year 1 sum	LOS MaxDelay 1 % Vehicles Stoppi if control delay is 6 They do not impa Use the same for b CCS Guidebook P. B37) strt Assumes occupan	A B C 0 20 35 ng during each period shou t. Values are used for fuel ear et delay calculations. ase and proposed.	55 ld be 0	80	
Avg. Control Delay (see/veh) Peak Shoulder Low Solvithieles Stopping Peak Shoulder Low Viline of Tree! Time William of Tree! Time Viline of Tree! One Viline Vilin	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.3. 1.5.94 541.44 554.70 6.210.009 52,661.458 530.941 514.010 534.951	s2-mon-work VTTS adjustment factor (UB s2 = value of carpo, TTT 1997; x1.23 = adju \$231,633,06 Year 1 \$336,605,034 Year 1 sum	LOS MaxDelay 1 % Vehicles Stoppi if control delay is 6 They do not impa Use the same for b CCS Guidebook P. B37) strt Assumes occupan	A B C 0 20 35 ng during each period shou t. Values are used for fuel ear et delay calculations. ase and proposed.	55 ld be 0	80	
Peak Shoulder Low Shoulder	0 0 0 100% 100% 100% 100% 100% 100% 100	1.3 \$15.94 \$15.94 \$41.44 \$64.70 6.210,069 2.661,458 \$20,941 \$14.010 \$34,951	s2-mon-work VTTS adjustment factor (UB) s2 = value of carpo, TTI 1997; xl.23 = adju \$231,633,160 Year 1 \$336,605,034 Year 1 sum	LOS MaxDelay 1 % Vehicles Stoppi if control delay is 6 They do not impa Use the same for b CCS Guidebook P. B37) strt Assumes occupan	A B C 0 20 35 ng during each period shou t. Values are used for fuel ear et delay calculations. ase and proposed.	55 ld be 0	80	
Low Composite Track Comp	0 100% 100% 1.3 \$15.94 \$41.44 \$64.70 \$9,063 \$15,313 \$18.846 \$12.609 \$9	1.3.3 \$15.94 \$41.44 \$64.70 6.210.069 2.661.458 \$30.941 \$14.010 \$34.951	x2=non-work VTTS adjustment factor (UB x2 = white of cupp. TTI 1997; x1.25 = adju 5231,633.106. Year 1 5314,571.938. Year 1 5386,605.038.	% Vehicles Stoppi if control delay is 6 They do not impa Use the same for b CS Guidebook P. B37) stri Assumes occupan	ng during each period shou t. Values are used for fuel eact delay calculations. ase and proposed.	ld be 0	- 00	
% of Vehicles Stopping Peak Shoulder Low Value of Trave Vehic Coupancy Value of Trave Vehic Coupancy Value of Trave Vehic Coupancy Value of Trave Vehic Vehi	100% 100% 1.3 1.5 15.94 441.44 664.70 89,063 15,313 18,846 12,609 9	1.3. \$15.94 \$41.44 \$64.70 6.210,069 2,661,458 \$30,941 \$14,010 \$34,951	s2-mon-work VTTS adjustment factor (UB) s2 = value of cargo, TTI 1997; xl.23 = adju S231,613,160 Year 1 S336,605,034 Year 1 sum	if control delay is 6 They do not impa Use the same for b CS Guidebook P. B37) str Assumes occupan	Values are used for fuel cated lay calculations. ase and proposed. cy 1.0	ld be 0	aly-	_
Peak Shoulder Low	100% 1.3 815.94 841.44 841.44 89,063 15,313 18,846 12,609 91,456	\$15.94 \$41.44 \$64.70 6.210,069 2.661,458 \$20,941 \$14,010 \$34,951	x2mon-work VTTS adjustment factor (UB) x2 = value of cango, TTI 1997; x1.23 = adju \$231,633,106 Year 1 \$134,971,928 Year 1 \$386,605,034 Year 1 sum	if control delay is 6 They do not impa Use the same for b CS Guidebook P. B37) str Assumes occupan	Values are used for fuel cated lay calculations. ase and proposed. cy 1.0	akulintens on	aly.	_
Low	1.3 315.94 441.44 441.44 664.70 89,063 15,313 38.846 9,063 15,313	\$15.94 \$41.44 \$64.70 6.210,069 2.661,458 \$20,941 \$14,010 \$34,951	x2mon-work VTTS adjustment factor (UB) x2 = value of cango, TTI 1997; x1.23 = adju \$231,633,106 Year 1 \$134,971,928 Year 1 \$386,605,034 Year 1 sum	Use the same for b	ase and proposed.			
Value of Travel Time	1.3 515.94 641.44 664.70 89,063 15,313 88.846 9.2.609 9	\$15.94 \$41.44 \$64.70 6.210,069 2.661,458 \$20,941 \$14,010 \$34,951	x2mon-work VTTS adjustment factor (UB) x2 = value of cango, TTI 1997; x1.23 = adju \$231,633,106 Year 1 \$134,971,928 Year 1 \$386,605,034 Year 1 sum	CS Guidebook P. B37) stn Assumes occupan	cy 1.0			
Value of Time (Sociation) Value of Time (Sociation) Tired Direct (Soviet) Tired Direct (Soviet) Tired Time (Soviet) Cir Cir Cir Cir Cir Cir Cir Ci	815.94 841.44 864.70 89,063 85,313 18.846 12.609 81.456	\$15.94 \$41.44 \$64.70 6.210,069 2.661,458 \$20,941 \$14,010 \$34,951	x2mon-work VTTS adjustment factor (UB) x2 = value of cango, TTI 1997; x1.23 = adju \$231,633,106 Year 1 \$134,971,928 Year 1 \$386,605,034 Year 1 sum	CS Guidebook P. B37) stn Assumes occupan	cy 1.0			
Car (Sveb) Car (Sveb) Traced Time (ech das) in Year 1 Car Car Track Present Value of Time Casts (Smill) for Benefit Petind Cair Car Track Track Cair Cair S Accident Costs Secrety S S S S S S S S S S S S S S S S S S S	841.44 864.70 89,063 85,313 88.846 12.609 81.456	\$41.44 \$64.70 6.210,069 2,661,458 \$20,941 \$14,010 \$34,951	x2mon-work VTTS adjustment factor (UB) x2 = value of cango, TTI 1997; x1.23 = adju \$231,633,106 Year 1 \$134,971,928 Year 1 \$386,605,034 Year 1 sum	stn Assumes occupan				
Track Driver (Svels) Track Track the color is year 1 Car 5,5 Track Track Track 2,9 Present Value of Time Costs (Smill) for Benefit Petind	64.70 89,063 85,313 18.846 12.609 81.456	\$64.70 6,210,069 2,661,458 \$20,941 \$14.010 \$34.951	n2 = value of cargo, TTI 1997; n1 23 = adju \$231,633,106 Year 1 \$154,971,928 Year 1 \$386,695,034 Year 1 sum	stn Assumes occupan				_
Tracel Time (whe sheet) in Year 1 Car	89,063 15,313 18,846 12,609 31,456	6,210,069 2,661,458 \$20,941 \$14,010 \$34,951	\$231,633,106 Year I \$154,971,928 Year I \$386,605,034 Year I sum					
Track Present Value of Time Costs (Smill) for Benefit Period Care S Track S Total S Secident Costs Rus (co/Dink) 0.5 Secident Costs Rus (composite Track Composite Track Composite Track Composite Track Put (Larsely) Car Composite Track Composite Track Put (Larsely) Car Composite Track Put (Larsely) Car Composite Track Composite Track Track Time (Sha) Track Time (Sha) Track Time (Sha) Track Dintsec (Shan)	18.846 12.609 31.456	\$20,941 \$14,010 \$34,951	\$154,971,928 Year I \$386,605,034 Year I sum					
Present Value of Time Costs (Smill) for Reseaft Product of Track	18.846 12.609 31.456	\$20,941 \$14,010 \$34,951	\$386,605,034 Year 1 sum					
for Reactif Period Car Track S Trotal S Accident Costs Rure (co/Bunk) Severy Se	12.609 31.456 9	\$14.010 \$34.951						
Track S Total S Accident Costs Rate (co/Brack) 0.5 Severity Se Fatal 2.6 Se Interp 4.10 Se Interp 4.10 Se Interp 5.10 Se Interp 5.10 Se Interp 5.10 Se Interp 6.10 Se Interp 6.10 Se Interp 7.10 Se Int	12.609 31.456 9	\$14.010 \$34.951	,					
Total S	9	\$34.951						
Rea	6							
Rate (colinek) Severity Severi	6							_
Severty Seve	6		I .			_		
\$ Fatal 2,6 \$ Injuny 410 \$ Injuny 4410 \$ PDO 56.5 Fatal 50,0 Injuny 51 Injuny 51 Injuny 52 Fatal 50,0 Injuny 51 Injuny 51 Injuny 51 Injuny 51 Injuny 51 Injuny 61 In		0.61						
"a PDO 56.5 Cost/Colision Fatal 50,0 Injury PDO 15.5 Proceed to the Coli Cost (Coli) Solicity Cost (Coli) Solicity Cost (Coli) Solicity Cost (Coli) Solicity Cost (Coli) Running Fuel (L/Run) Cur Composite Track Costrol Delay Fuel (L/reh) Car Composite Track Composite Track Fuel Larvely 1 Cur Composite Track Fuel Pare (NL) Cur Composite Track Fuel Cost (Coli) Composite Track Solicity Colif Composite Track Fuel Cost (Colif) Cur Composite Track Fuel Cost (Colif) Cur Composite Track Fuel Cost (Colif) Cur Composite Track Fuel Cost (Colif) Track Track Track Fuel Cost (Colif) Track Track Track Fuel Cost (Colif) Track Distance (Schut) Track Distance (Schut)	56	2.8%						
Cost/Collision Fatal Injury Stat Injury FDO Stat Present Value Coll Costs (5 mill) Static Costs (5 mill) Static Costs (5 mill) Static Costs (7 mill) Costs Costs (7 mill) Costs Costs (7 mill) Car Composite Track Fuel Larsely Car Composite Track Fuel Larsely Car Composite Track Fuel Cast (5 mill) Car Composite Track Fuel Cast (5 mill) Costs (5 mill) Costs (5 mill) Costs (5 mill) Track Static Costs Costs (5 mill) Track Time (5 mill) Track Time (5 mill) Track Distance (5 mill) Track Distance (5 mill)		40.7% 56.5%						
Fatal \$50.0 Injury PDO \$51. PDO \$1. PDO PWeighted Average \$2. Pwei	98	30.3%						_
PDO Weighted Average Present Value Coll Costs (smil) Vehicle Operating Costs (VICC) Renning Fred (d/Am) Cur Cumposite Track Counted Deby Fred (d/Am) Cur Composite Track Part (d/Am) Cur Composite Track Fuel Cost (Syst) Cur Cumposite Track Fuel Cost (Syst) Track Time (Syst) Track Time (Syst) Track Time (Syst) Track Distance (Skst)	3,419			This is perfutal co	lision. Not per fatality (typi	ical is 1.2 fata	dities/fat acc	:.)
Weighted Average Preset Nation Coll Costs (St mill) S Vehicle Operating Cents (VOC) Renning Factor Cur Cur Cur Composite Track Coarrol Delay Facil (Lych) Car Cur Cur Cur Cur Cur Cur Cur Cur Cur Cu	14,824 57,759							
Pencent Value Coll Costs (S mil) Pencent Value Coll Costs (WCC) Renning Fuel (d.Arm) Cur Composite Track Station Cur Cur Cur Cur Cur Cur Cur Cu	4,436							
Remining Fuel (L/Lm) Cur Composite Track Control Delay Fael (L/veh) Cur Composite Track Fuel (Laterely) Cair Composite Track Fuel (Laterely) Cair Composite Track Fuel Fael Cur Composite Track Fuel Cair (Sy) Fuel Cair (Sy) Fuel Cair (Sy) Cur Composite Track Fuel Cair (Sy) Fuel Cair (Sy) Track Time (Syln) Track Time (Syln) Track Time (Syln) Track Distance (Syln)	8.219	\$9.053						
Cur Composite Track Coarrol Delay Fuel (L/veh) Cur Composite Track Fuel (Larery) Car Composite Track Fuel Darery) Cur Composite Track Fuel Prizer (FL) Cur Composite Track Fuel Chat (Syly) Cur Cumposite Track Fuel Chat (Syly) Cur Cumposite Track Cumposite Track Fuel Chat (Syly) Cur Cumposite Track Cumposite Track Track Time (Syln) Track Time (Syln) Track Time (Syln) Track Time (Syln)			1	End consumed at a	unning speed, no control d	-h		
Control Delay Fuel (Levels) Car Composite Track Fuel Clarery) Cars Composite Track Fuel Prizer (FL) Cars Composite Track Fuel Prizer (FL) Car Composite Track Fuel Chat (Syly) Car Composite Track County Car Composite Track Fuel Chat (Syly) Car Composite Track Track Time (Syln) Track Time (Syln) Track Time (Syln) Track Time (Syln)	0.116	0.103		Puer consumed at:	unning speed, no control o	iemy		
Cur Cumposite Track Cumposite Track Fuel Larsely() Car Composite Track Fuel Proc (SL) Cir Cumposite Track Composite Track Composite Track Composite Track Cumposite	0.505	0.450		35% SU, semi - 20%	empty 30% full, Btrain-7%	empty 8% ful	1	
Composite Track Fuel Clarary) Gars Composite Track Fuel Proce (SL) Composite Track Fuel Proce (SL) Composite Track Fuel Chat (Spriy) Cur Composite Track Composite Track Composite Track Track Time (Shr) Track Time (Shr) Track Time (Shr)	0.095	0.000			isumed due to control delay on, stop time and accelerati			
Fuel (Larsely) Cars Cars Composite Track 121,00 Fuel Price (ML) Car Composite Track Fuel Cast (Sty) Composite Track Track Time (Shr) Track Time (Shr) Track Time (Shr)	0.132							
Composite Truck 121,65 Fuel Proce (SEL) Cur Composite Truck Fuel Cost (Sfyr) Cur Composite Truck Fuel Cost (Sfyr) Composite Truck Composite Truck S118,4 Other Vehick Costs Cur (Sf/8m) Truck Time (Sf/m) Truck Time (Sf/m)				Annual Fuel Cons	imption (L)			
Fuel Prace (SL) Composite Truck Composite Truck Fuel Cast (Syr) Cut Composite Truck Composite Truck Composite Truck SSIRA Composite Truck SIBA Truck Time (Shrb) Truck Distance (Skrm)								
Composite Truck Fuel Cost (Slyr) Cur Composite Truck Other Vehick Costs Cur (Slum) Truck Time (Slur) Truck Distance (Slum)				Price net of taxes it	about 55% of pump price			_
Fuel Cost (S/yr) 588,07 Composite Truck 5118,45 Other Vehicke Costs Car (S/sm) Truck Time (S/hr) Truck Time (S/hr)	50.90							
Car Composite Truck Other Vehick Costs Car (\$/lam) Truck Time (\$/lar) Truck Distance (\$/lam)	50.98	\$0.98	1	Truck fuel is usual	ly diesel which is less costly	y than gasoli	ne.	
Other Vehicle Costs Car (\$/lam) Truck Time (\$/hr) Truck Distance (\$/km)	90,344			Includes excess fu	el consumption due to cont	rol delay, if a	iny.	
Car (\$/\an) Truck Time (\$/\text{hr}) Truck Distance (\$/\text{km})	23,999	\$105,496,415	1					_
Truck Time (\$/hr) Truck Distance (\$/km)	0.106	\$0.106		Use-related costs	other than fuel)			
Truck Distance (S/km)	20.64	\$20.64			0000km/yr, year 2007			
Annual Cost (S/ST)	0.358	50.358		Courses	hazad on ek -k	4		_
	4,954	\$110,556,191			based on peak, shoulder an Assumes 0% grade.			
Truck Time \$49,4	99,250	\$54,932,500)	- primarpetus				
Truck Distance \$204,1	10,590	\$191,183,007	1					_
Present Value of VOC (Smillions) Car	9.521	\$8,995						
Truck S	00.630	\$20,025	5					
	90.150	\$29,020						_
mary of Discounted Costs (Smillions) Capital S	0.000	\$0.000	1					_
Maintenance & Resurf \$	0.000	\$0.000						
Salvage \$	0.000	\$8,000		P	C			
Total \$ mary of Discounted Benefits	0.000	\$0.000	1	Sum of discounted	Costs			_
Time Savings		(\$3.495)		Savings due to hig	her speeds or shorter distar	nce		_
Accident Savings		(\$0.834)		Savings due to red	uced accident rate or seven	ity		
Vehicle Operating Savings Fotal Benefits		\$1.130 (\$3.198)		Often negative wit	h increasing fuel at higher s	peed		
rotal Benefits mary of Results (Present Values in Smillions)								_
Financial Account 5			1					_
Incremental Cost	0.000	\$0.000 \$73.023		= Proposed - Base				
Customer Service Account St Incremental Benefit				=Base -Proposed				
B/C Ratio	0.000 99.825			-seermpostd	nefits/incremental costs			
Net Present Value		-\$3.198 #DIV/05		= Incremental be	nefite - Innovemental Contr	;		
nhouse Gas Reduction		-\$3.198		= Incremental be = Incremental Be	nents - incremental Costs			
Gas Dies Kg/Litre		-\$3.198 #DIV/05		= Incremental be = Incremental Be	nents - incremental Costs			
2.36 2.73 Carbon Dioxide		-\$3.198 #DIV/05		= Incremental be = Incremental Be	nents - incremental Costs			
II.262 0.08 Nitrogen Oxide II.122 0.12 Hydrcarbons		-\$3.198 #DIV/05		= Incremental be = Incremental Be	nents - incremental Costs			



SHORTBEN - CATASTROPHIC FAILURE AVOIDANCE SUMMARY

PV of disbenefits over 25 years

Sum of Dis-benefits	% Chance of Catastrophic Failure	Detour Construction Cost	6%	4%	10%
-\$ 49,137,408.43	4.0% 1 in 25 year	\$600,000.00	\$25,725,640	\$31,305,141	\$18,440,889
	2.0% 1 in 50 yr		\$13,162,820	\$15,952,570	\$9,520,444
	1.3% 1 in 75 yr		\$8,975,213	\$10,835,047	\$6,546,963
	1.0% 1 in 100 yr		\$6,881,410	\$8,276,285	\$5,060,222



Appendix 3. HCS ANALYSIS

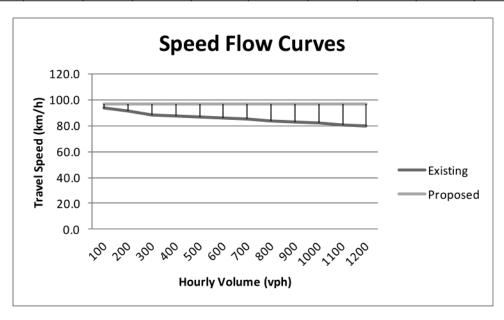
Malakwa Bridge Input Assumptions Base Case: H				Assumptions Proposed Case: H	CS Multilane N	Module - Operations	l Analysis
Length:	2.8	km	study area	Length:	2.8	km	study area
AADT:	6,085	vpd		AADT:	6.085	vpd	,
Free-flow Speed:	100	km/h	<200 vph	Free-flow Speed:	100	km/h	<200 vph
Analysis Hourly Volume:	variable	vpd	input hourly analysis volume	Analysis Hourly Volume:	variable	vpd	input hourly analysis volur
Grade:	level terrain		Photolog	Grade:	level terrain		Photolog
Length of Grade:	n/a	km	not applicable to module	Length of Grade:	n/a	km	not applicable to module
% Trucks:	30%		P-22-1 (including 20% of 6 to 12.5m bin)	% Trucks:	30%		max. 25% multilane modu
%RVs:	13%		50% of 6 to 12.5m length bin	%RVs:	13%		50% of 6 to 12.5m length i
% No-passing:	60%		Google Street View	Free Flow Speed	100	km/h	proposed design speed
Access Points/Km:	1.1		Google Street View	Access Points/Km:	1.1		same as Base Case
lighway Capacity Soft	ware - Ou	ıtput Sumr	maries:				
enario 1: Hourly 2-Way Volume:	100	and		Scenario 2: Hourly 2-Way Volume:	200	und	
Directional Hourly Volume:	100 50	vpd vpd	assume 50/50 for directional	Directional Hourly Volume:	100	vpd vpd	assume 50/50 for direction
Average Travel Speed (2-Lane):	93.6	km/h		Average Travel Speed (2-Lane):	91.2	km/h	
LoS (2-Lane):	A			LoS (2-Lane):	В		
V/C Ratio (2-Lane):	0.04			V/C Ratio (2-Lane):	0.08		
% Time Following (2-Lane):	31.8%			% Time Following (2-Lane):	39.2%		
0, ,							
Average Travel Speed (4-Lane):	96.7	km/h		Average Travel Speed (4-Lane):	96.7	km/h	
LoS (4- Lane):	A			LoS (4- Lane):	A		
Density (4-Lane):	0.3	pc/km/ln		Density (4-Lane):	0.7	pc/km/ln	
annoin 2:				Canada 4:			
benario 3: Hourly 2-Way Volume:	300	vpd		Scenario 4: Hourly 2-Way Volume:	400	vpd	
Directional Hourly Volume:	150	vpa vpd	assume 50/50 for directional	Directional Hourly Volume:	200	vpd vpd	assume 50/50 for direction
Directional ricony volume:	130	m,u	washing out on our directional	Directional Floury Volume:	200	np.cl	assuring purpor for direction
Average Travel Speed (2-Lane):	88.4	km/h		Average Travel Speed (2-Lane):	87.3	km/h	
LoS (2-Lane):	00.4 B	2011		LoS (2-Lane):	C C	.01611	
V/C Ratio (2-Lane):	0.12			V/C Ratio (2-Lane):	0.16		
% Time Following (2-Lane):	48.6%			% Time Following (2-Lane):	55.0%		
				l committee of the comm			
Average Travel Speed (4-Lane):	96.7	km/h		Average Travel Speed (4-Lane):	96.7	km/h	
LoS (4- Lane):	A			LoS (4- Lane):	A		
Density (4-Lane):	1.0	pc/km/ln		Density (4-Lane):	1.3	pc/km/ln	
enario 5:				Scenario 6:			
Hourly 2-Way Volume:	500	vpd		Hourly 2-Way Volume:	600	vpd	
Directional Hourly Volume:	250	vpd	assume 50/50 for directional	Directional Hourly Volume:	300	vpd	assume 50/50 for directio
Average Travel Speed (2-Lane):	86.8	km/h		Average Travel Speed (2-Lane):	85.9	km/h	
LoS (2-Lane):	С			LoS (2-Lane):	С		
V/C Ratio (2-Lane):	0.18			V/C Ratio (2-Lane):	0.21		
% Time Following (2-Lane):	59.2%			% Time Following (2-Lane):	62.5%		
Average Travel Speed (4-Lane):	96.7	km/h		Average Travel Speed (4-Lane):	96.7	km/h	
LoS (4- Lane):	Α.	KIIIII		LoS (4- Lane):	Α.	KIIDII	
Density (4-Lane):	1.7	pc/km/ln		Density (4-Lane):	2.0	pc/km/ln	
Denony (+ zane).		permin		Deliving (4 Edito).	2.0	pontitoni	
cenario 7:				Scenario 8:			
Hourly 2-Way Volume:	700	vpd		Hourly 2-Way Volume:	800	vpd	
Directional Hourly Volume:	350	vpd	assume 50/50 for directional	Directional Hourly Volume:	400	vpd	assume 50/50 for direction
						-	
Average Travel Speed (2-Lane):	84.9	km/h		Average Travel Speed (2-Lane):	83.8	km/h	
LoS (2-Lane):	D			LoS (2-Lane):	D		
V/C Ratio (2-Lane):	0.25			V/C Ratio (2-Lane):	0.28		
% Time Following (2-Lane):	65.3%			% Time Following (2-Lane):	68.9%		
				II			
Average Travel Speed (4-Lane):	96.7	km/h		Average Travel Speed (4-Lane):	96.7	km/h	
LoS (4- Lane):	A 2.4	no (km (l-)		LoS (4- Lane):	A	no lkm/l=	
Density (4-Lane):	2.4	pc/km/ln		Density (4-Lane):	2.7	pc/km/ln	
cenario 9:				Scenario 10:			
Hourly 2-Way Volume:	900	ypd		Hourly 2-Way Volume:	1000	vpd	
Directional Hourly Volume:	450	vpd vpd	assume 50/50 for directional	Directional Hourly Volume:	500	vpd	assume 50/50 for direction
	-100			Directions Flooring Volume.			and an an amount
Average Travel Speed (2-Lane):	82.8	km/h		Average Travel Speed (2-Lane):	82	km/h	
LoS (2-Lane):	D			LoS (2-Lane):	D		
V/C Ratio (2-Lane):	0.32			V/C Ratio (2-Lane):	0.34		
% Time Following (2-Lane):	71.6%			% Time Following (2-Lane):	73.5%		
Average Travel Speed (4-Lane):	96.7	km/h		Average Travel Speed (4-Lane):	96.7	km/h	
LoS (4- Lane):	A			LoS (4- Lane):	A		
Density (4-Lane):	3.0	pc/km/ln		Density (4-Lane):	3.4	pc/km/ln	
				1 -			
enario 11:				Scenario 12:			
Hourly 2-Way Volume:	1100	vpd		Hourly 2-Way Volume:	1200	vpd	
Directional Hourly Volume:	550	vpd	assume 50/50 for directional	Directional Hourly Volume:	600	vpd	assume 50/50 for direction
				II	_		
Average Travel Speed (2-Lane):	80.8	km/h		Average Travel Speed (2-Lane):	79.6	km/h	
LoS (2-Lane):	D			LoS (2-Lane):	D		
V/C Ratio (2-Lane):	0.38			V/C Ratio (2-Lane):	0.41		
% Time Following (2-Lane):	74.9%			% Time Following (2-Lane):	77.0%		
				11			
Augropa Troug Coand /4 Lar-1-	06.7	kem/h		Augmon Trough Conned /4 Lorests	OF 7	km/h	
Average Travel Speed (4-Lane): LoS (4- Lane):	96.7 A	km/h		Average Travel Speed (4-Lane): LoS (4- Lane):	96.7 A	km/h	



Speed Flow Curves:

Treated Section:

	Base	Case: Ex	isting 2-Lane	Hwy	Propos	ed Case:	Net Improvements		
Directional Hourly Volume (vpd):	Average Travel Speed (km/h)	Level of Service	Volume to Capacity Ratio	% Time Following	Average Travel Speed (km/h)	Level of Service	Density	Speed Differential (km/h) with Four-Lane	Speed Differential Improvement with Four- Lane
50	93.6	Α	0.04	31.8%	96.7	Α	0.3	3.1	3.3%
100	91.2	В	0.08	39.2%	96.7	Α	0.7	5.5	6.0%
150	88.4	В	0.12	48.6%	96.7	Α	1.0	8.3	9.4%
200	87.3	С	0.16	55.0%	96.7	Α	1.3	9.4	10.8%
250	86.8	С	0.18	59.2%	96.7	Α	1.7	9.9	11.4%
300	85.9	С	0.21	62.5%	96.7	Α	2.0	10.8	12.6%
350	84.9	D	0.25	65.3%	96.7	Α	2.4	11.8	13.9%
400	83.8	D	0.28	68.9%	96.7	Α	2.7	12.9	15.4%
450	82.8	D	0.32	71.6%	96.7	Α	3.0	13.9	16.8%
500	82.0	D	0.34	73.5%	96.7	Α	3.4	14.7	17.9%
550	80.8	D	0.38	74.9%	96.7	Α	3.7	15.9	19.7%
600	79.6	D	0.41	77.0%	96.7	Α	4.1	17.1	21.5%





Design Hour Volume Calculation Methodology:

Design hour statistics were estimated utilizing factoring tools as follows:

- A daily profile by hour of the day was developed utilizing the most recent perm count data available.
- Note: Count Site P-22-1 is categorized as highly seasonal.
- These forecast hourly volumes were then sorted in descending order to provide estimates for design hour volumes.

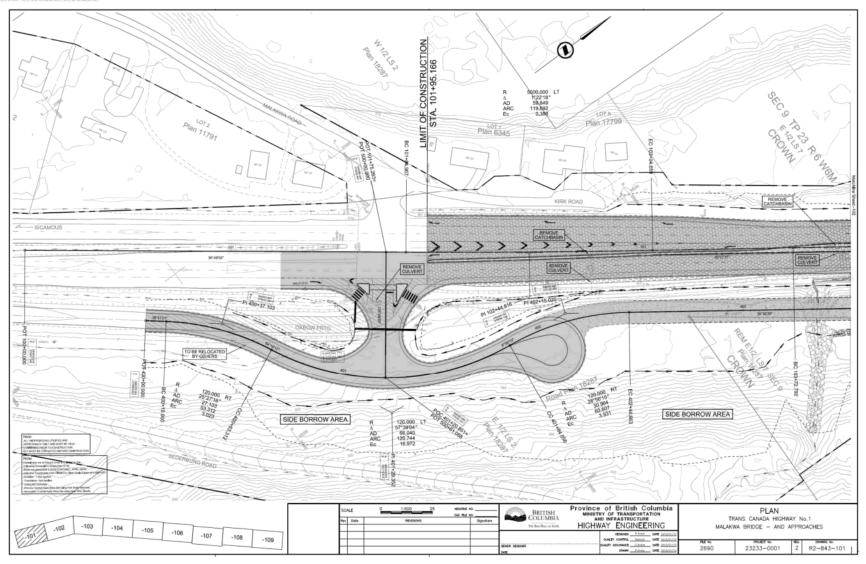
The design hour volume recommendation is for the 30^{th} highest volume hour (30HV). For 2010 the 30HV is estimated at 1290 vph.



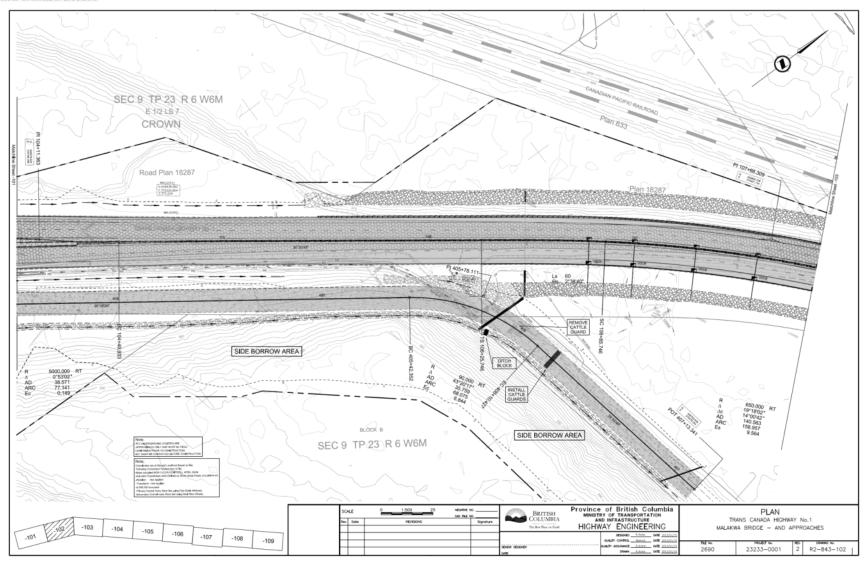
Appendix 4. OPTION DRAWING

The benefit-cost calculations were based on the 05-04-2012 100% functional design presented at the public open house in September 2012.



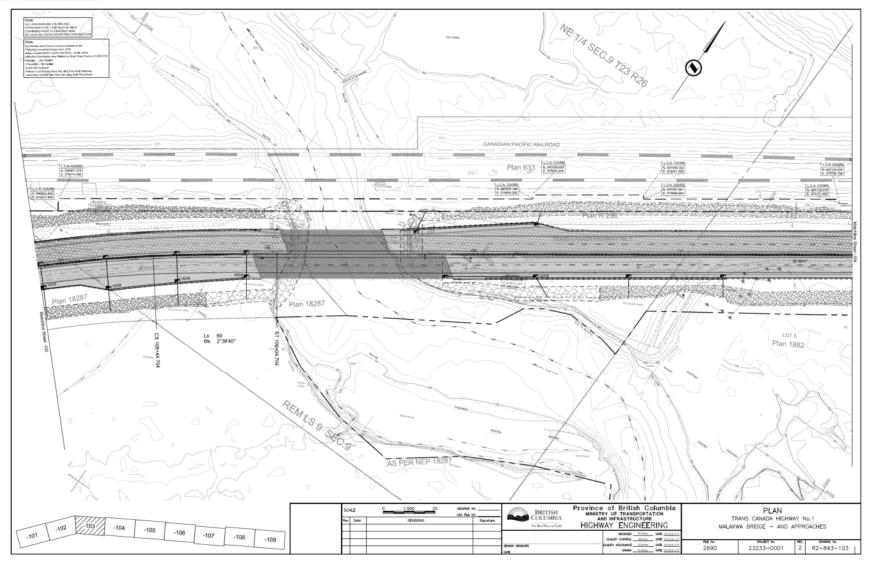






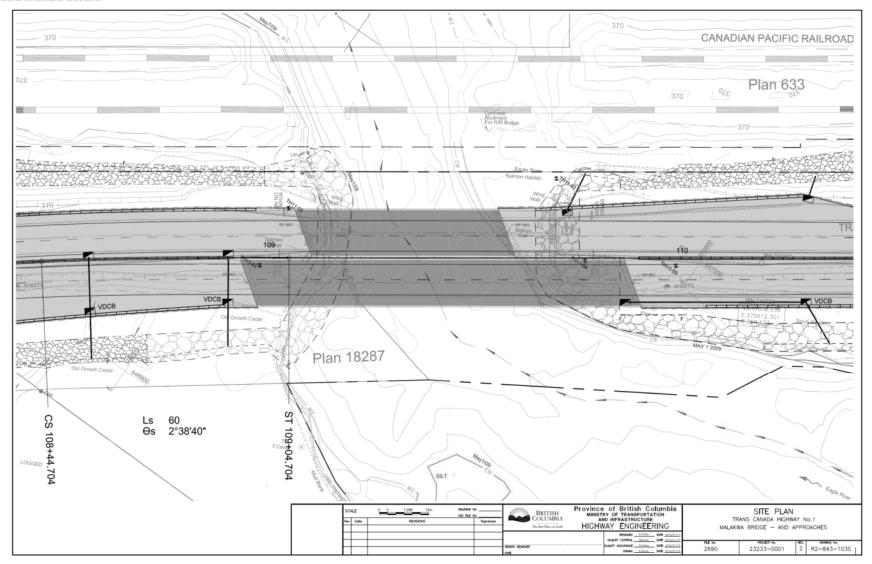
A-xxvi





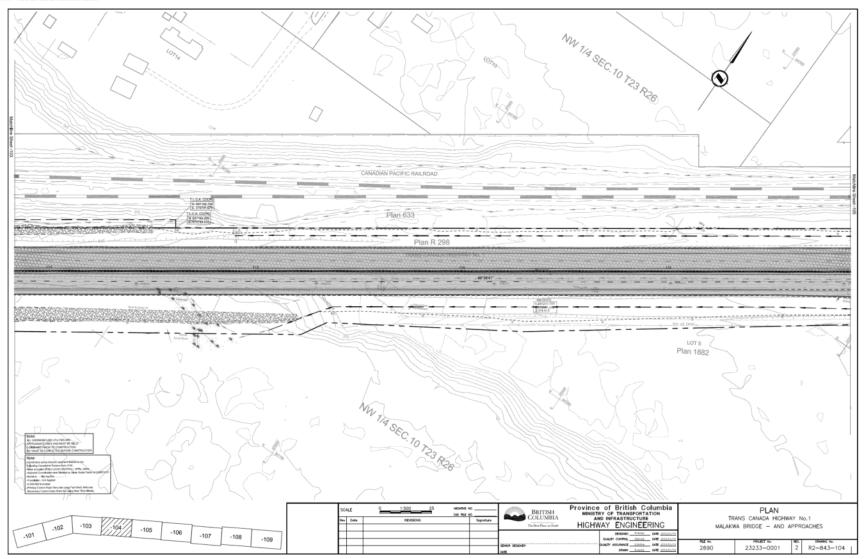
A-xxvii





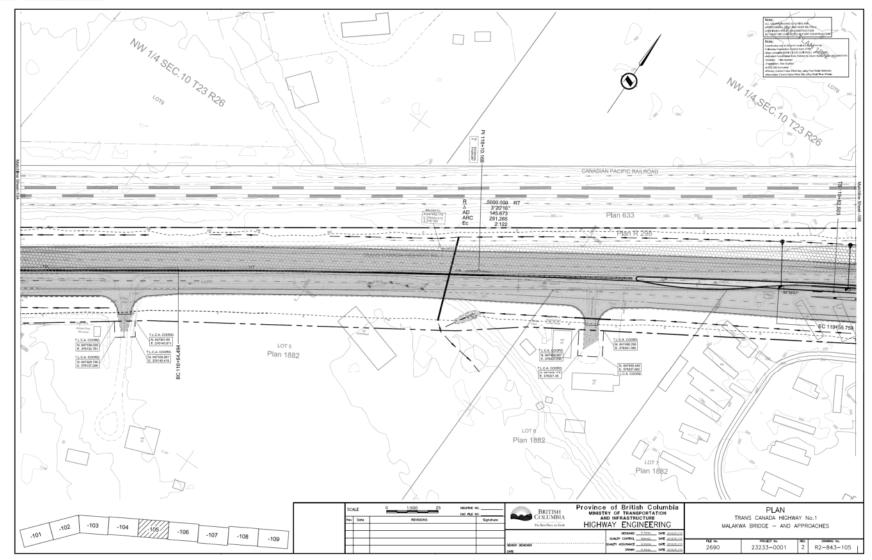
A-xxviii





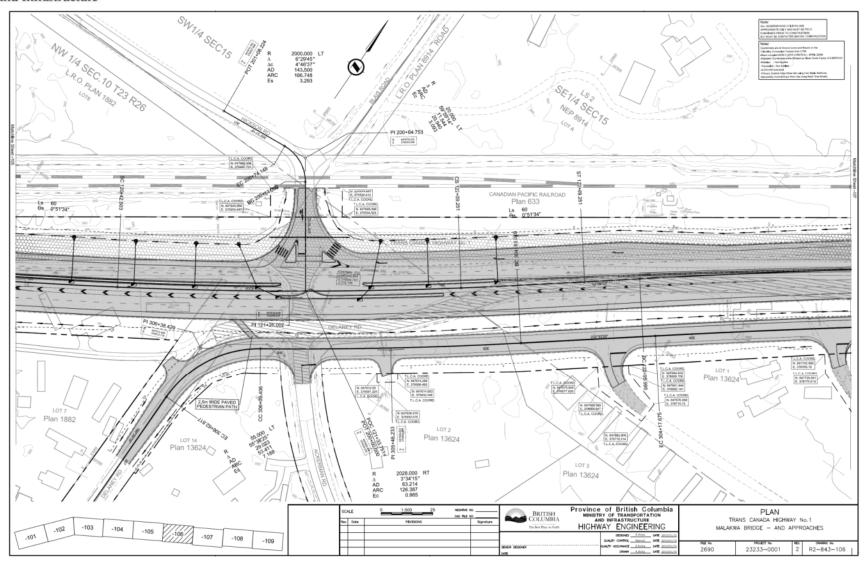
A-xxix





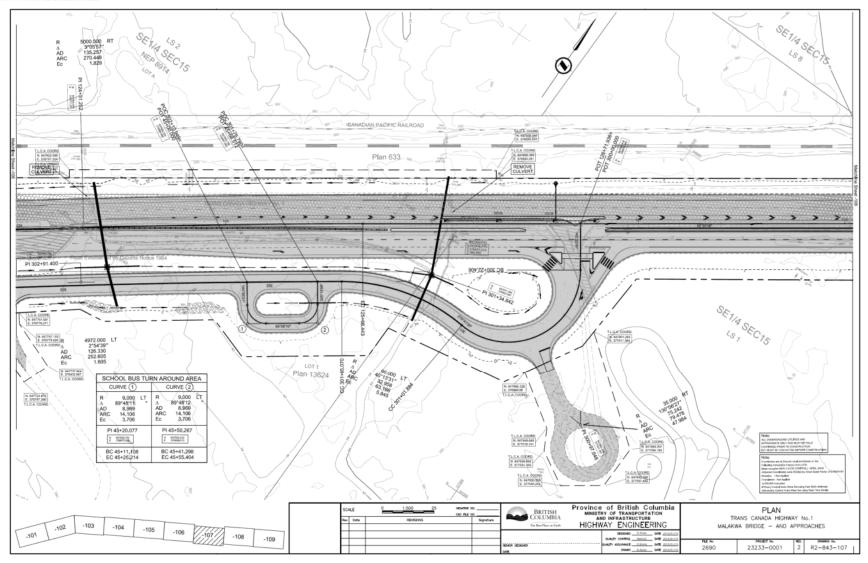
A-xxx





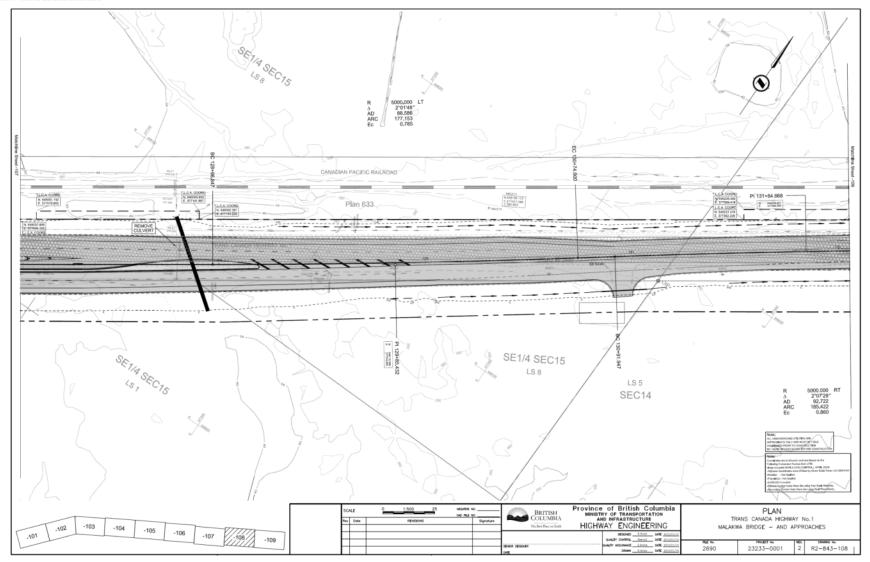
A-xxxi





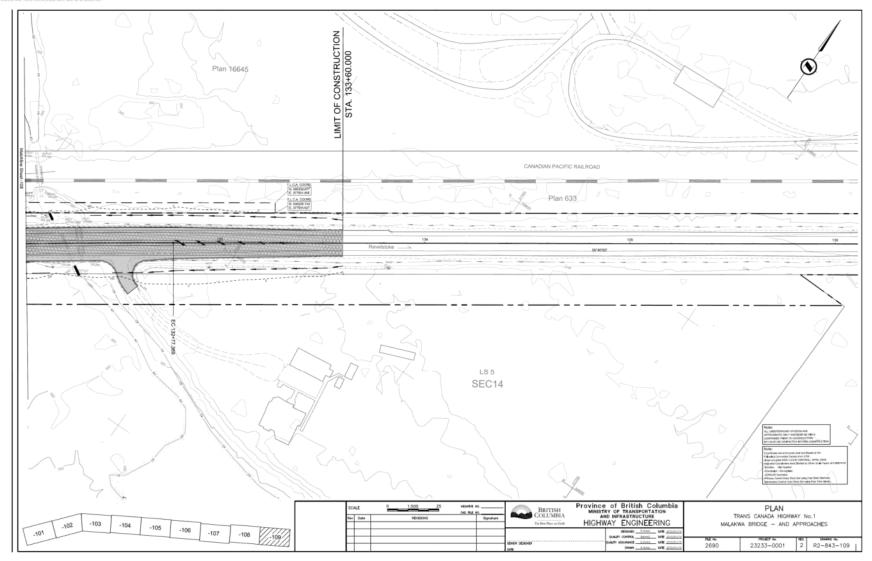
A-xxxii





A-xxxiii





A-xxxiv



Appendix 5. SAFETY DATA

Collision Details:

HIGHNUM SE	GNUM KM	MARK CLSNDATE CL	SNTIME SEVERITY_TYPE Description	LOCN_TYPE Description	DIAGRAM Description	CONTRB11 Description	CONTRB12 Description	VEHDIR1 Description	VEHTYPE1 Description	VEHTYPE2 Description	ROADSURF Description	ROADCURV Description	ROADGRAD Description	WEATHER Description	LIGHTING Description SPEEDLIM Description	on ON	AT
1	962	20.3 2002-02-07	23:04 Property damage only	Btwn intersection/exchs	Rear end	Not applicable	Not applicable	East	Comb unit tractor/trl	Truck: pickup	Ice	Straight	Flat	Fog	Dark/no illum.	90	1
1	962	20.3 2004-11-01	16:34 Property damage only	Btwn intersection/exchs	Overtaking	Driving too fast for condition	Improper passing	East	Passenger car	Comb unit tractor/trl	Slush	Straight	Flat	Snowing/sleet	Dusk	100	1
1	962	20.3 2007-07-31	23:25 Property damage only	At intersection	Other	Improper turning	Driver error/confusion	North	Passenger car		Dry	Straight	Flat	Clear	Dark/some illum.	100	1
1	962	20.4 2009-07-04	11:22 Personal injury	Btwn intersection/exchs	Other	Tires-failure/inadequate	Not applicable	East	Motorcycle		Dry	Straight	Flat	Clear	Daylight	100	1
1	962	20.6 2002-02-21	9:30 Property damage only	Btwn intersection/exchs	Off road right	Unsafe speed	Weather (fog,sleet,rain,snow)	West	Comb unit tractor/trl & pup		Snow	Straight	Flat	Snowing/sleet	Daylight	100	1
1	962	20.6 2005-12-11	22:00 Property damage only	Bridge	Off road left	Driving too fast for condition	Not applicable	East	Passenger car		Dry	Single curve	Some grade	Cloudy	Dark/no illum.	100	1
1	962	20.6 2008-09-26	14:13 Personal injury	Btwn intersection/exchs	Overtaking	Road/intersection design	Other	East	Truck/camper & trl	Bicycle	Dry	Straight	Flat	Cloudy	Daylight	100 TRANS-CANADA	
1	962	20.7 2003-06-13	23:00 Personal injury	Btwn intersection/exchs	Off road left	Driving without due care	Driving on wrong side of road	East	Passenger car		Wet	Straight	Flat	Cloudy	Dark/no illum.	100	1
1	962	20.7 2003-09-10	8:35 Property damage only	Bridge	Other	Not applicable	Not applicable	East	Passenger car		Dry	Single curve	Flat	Clear	Daylight	100	1
1	962	20.7 2005-01-14	1:00 Property damage only	Bridge	Side swipe	Not applicable	Not applicable	East	Comb unit tractor/trl	Bus-intercity	Dry	Single curve	Some grade	Cloudy	Dark/no illum.	100	1
1	962	20.7 2007-06-18	13:58 Personal injury	Bridge	Rear end	Not applicable	Not applicable	East	Truck: pickup	Passenger car	Wet	Single curve	Flat	Cloudy	Daylight	90	1
1	962	20.7 2009-02-16	23:00 Personal injury	Btwn intersection/exchs	Other	Drugs suspected	Driver inattentive	West	Trail bike		Dry	Straight	Flat	Clear	Dark/some illum.	100 TRANS-CANADA	
1	962	20.7 2009-02-23	10:55 Property damage only	Btwn intersection/exchs	Off road left	Driving too fast for condition	Road condition (ice, snow, slush	West	Comb unit tractor/trl		Ice	Single curve	Sag	Snowing/sleet	Daylight	100	1
1	962	20.7 2010-12-03	23:51 Property damage only	Btwn intersection/exchs	Side swipe	Extreme fatigue	Driver inattentive	East	Comb unit tractor/trl	Comb unit tractor/trl	Wet	Straight	Flat	Fog	Dark/no illum.	90 TRANS-CANADA	4500
1	962	20.7 2011-04-09	20:21 Fatal	Bridge	Side swipe	Oversize vehicle	Other	East	Comb unit tractor/trl	Comb unit tractor/trl	Dry	Straight	Flat	Cloudy	Dusk	100	1
1	962	20.7 2011-11-25	15:15 Personal injury	Btwn intersection/exchs	Off road left	Driver internal/external distr	Following too closely	West	Comb unit tractor/trl	Comb unit tractor/trl & pup	Wet	Single curve	Flat	Clear	Daylight	90 TRANS-CANADA	
1	962	20.8 2011-08-19	20:59 Fatal	Btwn intersection/exchs	Rear end	Exceeding speed limit	Cutting in	West	Motorcycle	Comb unit tractor/trl	Dry	Straight	Flat	Clear	Dark/no illum.	90 TRANS-CANADA	
1	962	20.9 2006-11-24	11:06 Property damage only	Btwn intersection/exchs	Head on	Wild animal	Not applicable	West	Comb unit tractor/trl		Snow	Straight	Flat	Cloudy	Dark/no illum.	100	1
1	962	21.1 2005-12-13	16:10 Property damage only	Btwn intersection/exchs	Side swipe	Avoiding veh./ped./cycle	Not applicable	East	Comb unit tractor/trl	Passenger car	Wet	Straight	Flat	Clear	Dark/full illum.	90	1
1	962	21.3 2010-08-03	16:06 Personal injury	Btwn intersection/exchs	Rear end	Driver inattentive	Driver error/confusion	West	Van: panel or mini	Truck: pickup	Dry	Straight	Flat	Clear	Daylight	90 TRANS-CANADA	
1	962	21.9 2003-04-24	21:00 Property damage only	At intersection	Other	Wild animal	Other	West	Passenger car		Dry	Straight	Flat	Clear	Dusk	90	1
1	962	21.9 2006-10-19	9:36 Personal injury	At intersection	Unknown	Failing to yield right of way	Improper turning	South	Passenger car	Passenger car	Wet	Straight	Flat	Cloudy	Daylight	100	1 ACKERMAN
1	962	21.9 2008-01-29	16:00 Property damage only	Btwn intersection/exchs	Rear end	Not applicable	Not applicable	West	Van: panel or mini	Truck: pickup	Snow	Straight	Flat	Snowing/sleet	Dusk	100	1
1	962	21.9 2009-01-10	20:27 Property damage only	Btwn intersection/exchs	Off road right	Road condition (ice,snow,slush	Windows obstructed	East	Comb unit tractor/trl	Sport Utility Vehicle	Snow	Straight	Flat	Snowing/sleet	Dark/no illum.	100	1 HICKSON
1	962	21.9 2011-02-22	13:58 Personal injury	Btwn intersection/exchs	Off road right	Road condition (ice,snow,slush	Roadway surface defects	East	Sport Utility Vehicle		Wet	Single curve	Steep grade	Clear	Daylight	90	1
1	962	22.2 2003-01-01	18:40 Personal injury	Btwn intersection/exchs	Other	Domestic animal	Not applicable	East	Passenger car		Slush	Straight	Flat	Snowing/sleet	Dark/no illum.	100	1
1	962	22.2 2007-12-22	Personal injury	Btwn intersection/exchs	Other	Driving too fast for condition	Road condition (ice,snow,slush	West	Passenger car	Truck: pickup	Ice	Straight	Flat	Snowing/sleet	Dusk	100	1 CUNNINGHAM
1	962	22.5 2008-03-23	21:05 Personal injury	Btwn intersection/exchs	Off road left	Road condition (ice,snow,slush	Weather (fog,sleet,rain,snow)	East	Comb unit tractor/trl		Slush	Winding curves	Flat	Snowing/sleet	Dark/no illum.	90 TRANS-CANADA	
1	962	22.8 2003-08-31	9:44 Property damage only	Btwn intersection/exchs	Rear end	Other	Not applicable	West	Truck: pickup	Passenger car	Dry	Straight	Flat	Clear	Daylight	100	1
1	962	22.8 2011-02-08	8:07 Property damage only	Btwn intersection/exchs	Off road right	Driving too fast for condition	Road condition (ice, snow, slush	East	Passenger car		Wet	Single curve	Steep grade	Cloudy	Daylight	90	1



COLLISION DATA

Instructions: Fill in the shaded cells, and follow the arrows. Some cells have comments (indicated by red triangles), read those if you need help.

Note: This worksheet is designed to be used electronically. The formulas are in the spreadsheet and will be calculated automatically.

						St	tart	E	nd	
Route		De	scription			Segment	Km	Segment	Km]
1		Malakwa Br	idge and 4-La	aning		962	20.1	962	23.2	1
						•		Start Km	20.1	-
								End km	23.2	!
								Total Km	3.20	
			Property	P-22-	1 Perm	Count				<u> </u>
Year	Fatal	Injury	Damage	Total	AADT	Estimate?	Annual Vol.	mV	A/Mv(km)	
2002		,		0	5,440	No	1,985,600	1.99	0.00	Leave blank except wher
2003				0	5,383	No	1,964,795	1.96	0.00	prompted to enter a value
2004				0	5,572	No	2,033,899	2.03	0.00	or put in 1 km if analysin
2005				0	5,621	No	2,051,730	2.05	0.00	intersections
2006				0	5,658	No	2,065,012	2.07	0.00	
2007				0	5,745	No	2,096,861	2.10	0.00	
2008				0	5,832	Yes	2,128,710	2.13	0.00	
2009				0	5,767	No	2,105,114	2.11	0.00	
2010				0	6,085	No	2,221,025	2.22	0.00	
2011				0	5,980	No	2,182,700	2.18	0.00	
TOTAL:	2	12	20	34	†			20.84	0.51	
	5.88%	35.29%	58.82%	100.00%	'					•

Leave AADT blank if not including that year

COLLISION ANALYSIS

		_
Million vehicle km for the highway section being analyzed =	66.67	Mv(km)
Total km =	3.20	km
Total accidents =	34.00	accidents
Accident frequency =	3.40	A/year
Accident frequency threshold =	1.06	A/year/km
Provincial average accident rate for the highway =	0.61	A/Mv(km)
Accident rate =	0.51	A/Mv(km)
Level of Significance (0.01%, 0.05%, 0.10%, 0.50%, 1.00%, 5.00%, or 10.00%) =	0.10	%
Critical accident rate for the highway section being analyzed =	0.91	A/Mv(km)
1.5 X Critical accident rate =		A/Mv(km)
Provincial average accident severity for the highway class =	6.17	> factor= 1.50
Accident severity index =	10.00	
Accident severity index threshold =	9.26	
Accident index 1. (rate and frequency) =	no	ĺ
Accident index 2. (severity and frequency) =	yes	

A safety audit is recommended based severity and frequency.

The accident rate is less than the critical accident rate for this section of highway, and is not considered poor.

The Accident Severity index is greater than the Accident Severity Threshold.

^{* (}The Provincial Highway Plan designates an accident rate equal to or greater than 1.5 times the critical rate as "poor"). Check the histogram for clusters of more than 1 fatality or more than 10 accidents in any 300m.

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Withheld pursuant to/removed as

s.22