Canada

Infrastructure Canada

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

Cliff # 229001
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MINISTER'S OFFICE
MINISTER OF TRANSPORTATION
AUG 0 6 2014
DRAFT REPLY ☐ FYI ☐ FILE ☐

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Date
AUG 0 6 2014

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TO	Name of addressee Nom du destinataire The Honourable Ted Stone, M.L.A. Minister of Transportation & Infrastructure		Facsimile no. Nº de télécopieur (250)356-2290
À	Organization Organisation Government of British Columbia		# of pages, cover sheet included / # de pages, couverture comprise 3
FROM	Name of sender Nom de l'expéditeur The Honourable Denis Lebel. Minister of Infrastructure, GoC	Facsimile no. Nº de télécopieur (613)952-1690	Telephone no. Nº de téléphone (613)952-1703

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Signature

Trans-Canada Highway Malakwa Bridge Project

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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

Ottawa, Canada K1A 1M5

AUG 06 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

Canada

- 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.

Yours sincerely,

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

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

CLIFF# 229264

RECEIVED
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MINISTER OF TRANSPORTATION
AUG 1 9 2014
DRAFT REPLY ☐ FYI ☐ FILE ☐

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 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.

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 ineligible 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;

…2

- 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.

Bruneski, Michelle TRAN:EX

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 s.13,s.17 I believe that Christian Judd has advised accordingly, but do you need a new letter (ADM to ADM) to formalize?
- Another s.13,s.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

Bruneski, Michelle TRAN:EX

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

Bruneski, Michelle TRAN:EX

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

Bruneski, Michelle TRAN:EX

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

Bruneski, Michelle TRAN:EX

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

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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

Bruneski, Michelle TRAN:EX

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

Bruneski, Michelle TRAN:EX

From: Marr, David TRAN:EX
Sent: Wednesday, December 24, 2014 11:21 AM
To: Rutherford, Michael
Cc: Hallas, Mike J TRAN:EX
Subject: 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

Bruneski, Michelle TRAN:EX

From:	Marr, David TRAN:EX
Sent:	Friday, February 13, 2015 8:19 AM
To:	'Wadasinghe, Cheryl'
Cc:	'Rutherford, Michael'; 'Chappell, Tegan'
Subject:	RE: Question regarding Hwy 1 - Illecillewaet

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
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Page 046 to/à Page 267

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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

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 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.

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 ineligible 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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- 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.

BRITISH
COLUMBIA

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:

Project	Federal Contribution		
	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

Ministry of Transportation and Infrastructure

Office of the
Assistant Deputy Minister
Infrastructure Department

Mailing Address:
PO Box 9850 Stn Prov Govt
Victoria BC V8W 9T5
Telephone: 250 387-3260
Fax: 250 387-7671

Location:
5B 940 Blanshard Street
Victoria BC V8W 3E6
www.gov.bc.ca/tran

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

Canada

Infrastructure Canada

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

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Date AUG 0 6 2014

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TO	Name of addressee Nom du destinataire: The Honourable Ted Stone, M.L.A. Minister of Transportation & Infrastructure		Facsimile no. N° de télécopieur: (250)356-2290
À	Organization Organisation: Government of British Columbia		# of pages, cover sheet included / # de pages, couverture comprise: 3
FROM	Name of sender Nom de l'expéditeur: The Honourable Denis Lebel. Minister of Infrastructure, GoC	Facsimile no. N° de télécopieur: (613)952-1690	Telephone no. N° de téléphone: (613)952-1703

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Signature

Trans-Canada Highway Malakwa Bridge Project

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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

Ottawa, Canada K1A 1M5

AUG 06 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

Canada

- 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.

Yours sincerely,

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

Infrastructure
Canada

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,

(for) Jeff Moore
Assistant Deputy Minister
Policy and Communications

cc. Jane Weldon
Director General
Surface Infrastructure Programs
Transport Canada

Canada

BRITISH
COLUMBIA

July 18, 2014

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

Reference: 228692

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

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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:

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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

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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

Ministry of Transportation and Infrastructure

Highway 1: Malakwa Bridge and Four-Laning Business Case

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

Ministry of Transportation and Infrastructure

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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.

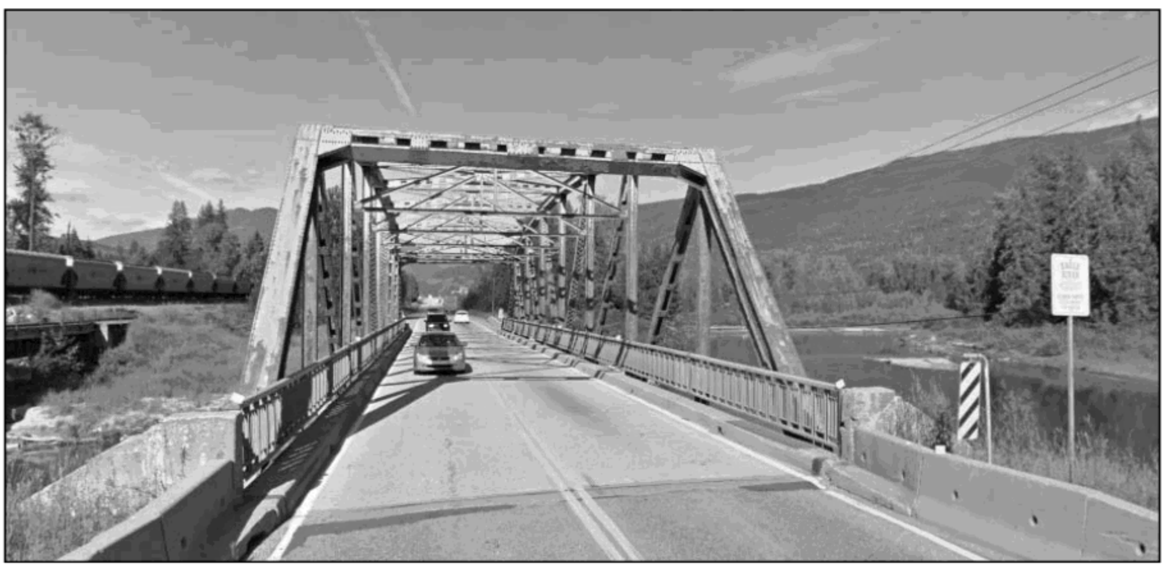

FIGURE 2: MALAKWA BRIDGE

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

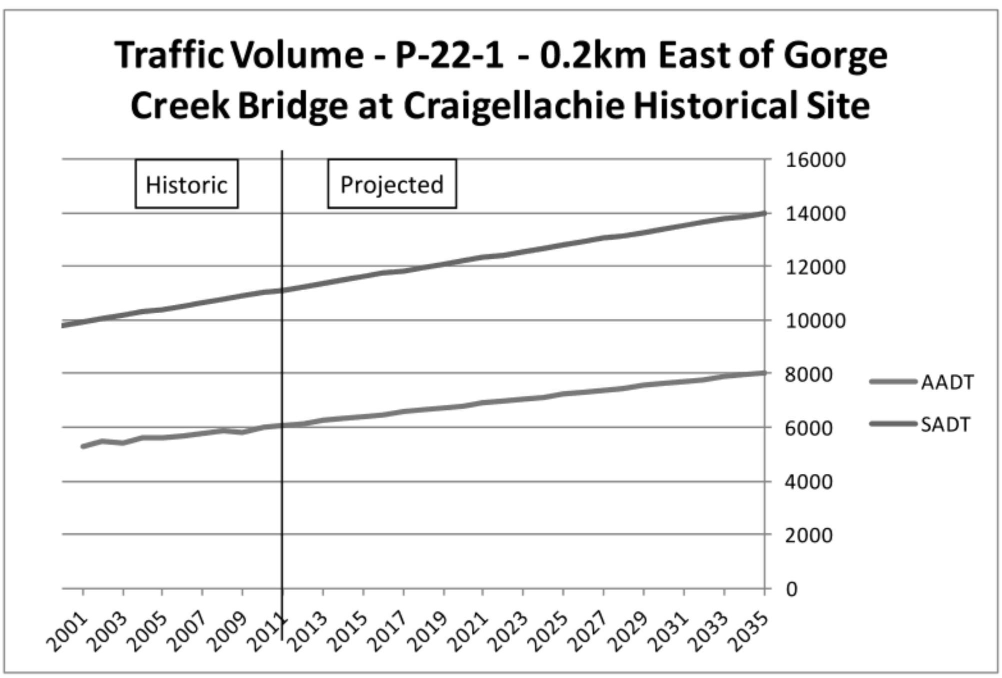

FIGURE 4: HISTORICAL AND PROJECTED AADT

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.

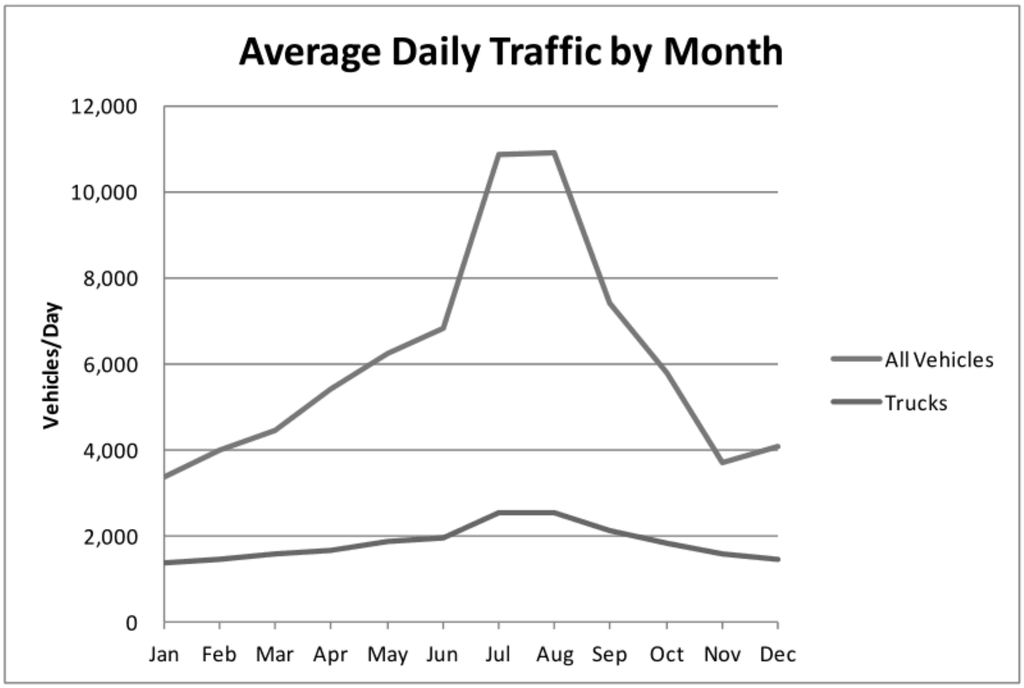

FIGURE 5: TRAFFIC VOLUME BY MONTH

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 single span bridge (WBL) and a new 72.0 m long single span 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	
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 Case	
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):

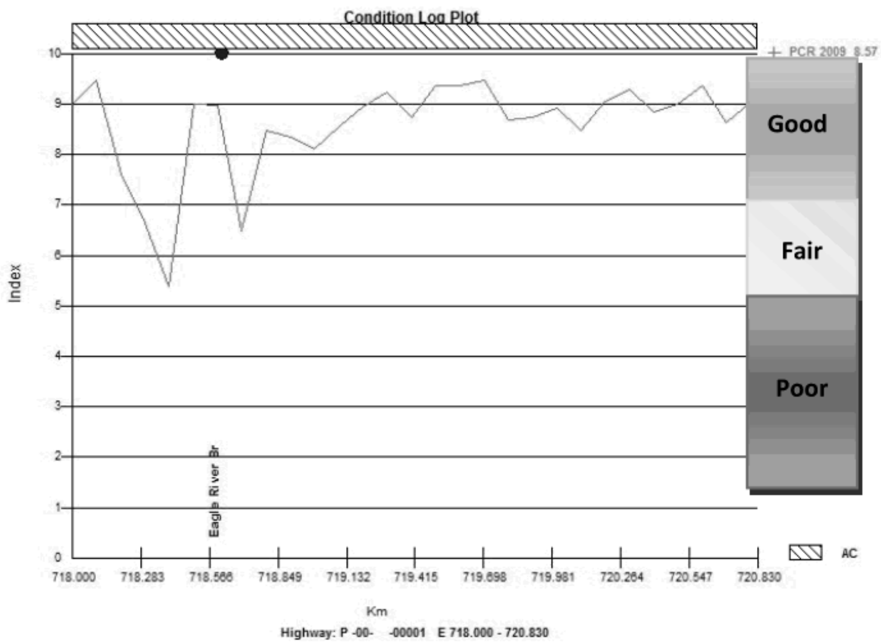

FIGURE 7: PAVEMENT CONDITION HISTOGRAM

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 Histogram Report

Malakwa Collision Histogram 2002-2011

Collision Period From: 2002-01-01 **To:** 2011-12-31

Scale: ▌= 1 collision(s) ▌FAT: # Fatal ▌INJ: # Non-fatal Injury ▌PDO: # Property Damage Only

Histogram for: HWY 1 TRANS-CANADA
SEGMENT 0962 SICAMOUS - REVELSTOKE **FROM KM** 20.1 **TO KM** 23.2

Landmark Description	Km	Histogram of Collision Frequency	FAT	INJ	PDO	Total
Segment 0962						
	20.1		0	0	0	0
EAST END MALAKWA 4 LANE	20.2		0	0	0	0
	20.3		0	0	3	3
MALAKWA DUMP RD #642	20.4		0	1	0	1
	20.5		0	0	0	0
	20.6		0	1	2	3
W END EAGLE RIVER / MALAKWA BRIDGE 0871	20.7		1	4	4	9
E END MALAKWA BRIDGE 0871	20.8		1	0	0	1
	20.9		0	0	1	1
	21.0		0	0	0	0
	21.1		0	0	1	1
	21.2		0	0	0	0
	21.3		0	1	0	1
	21.4		0	0	0	0
	21.5		0	0	0	0
	21.6		0	0	0	0
	21.7		0	0	0	0
	21.8		0	0	0	0
ACKERMAN RD #925	21.9		0	2	3	5
	22.0		0	0	0	0
	22.1		0	0	0	0
CUNNINGHAM FRONTAGE RD #700-12	22.2		0	2	0	2
	22.3		0	0	0	0
	22.4		0	0	0	0
	22.5		0	1	0	1
	22.6		0	0	0	0
	22.7		0	0	0	0
	22.8		0	0	2	2
	22.9		0	0	0	0
	23.0		0	0	0	0
# 4703 ACCESS	23.1		0	0	4	4
	23.2		0	0	0	0
Segment 0962 Totals			**2**	**12**	**20**	**34**

TABLE 2: COLLISION HISTOGRAM

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.

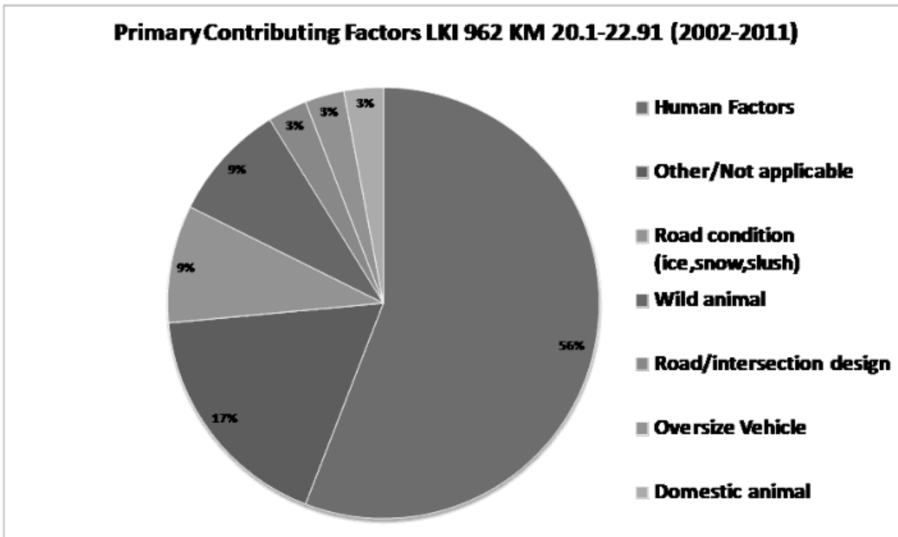

FIGURE 9: PRIMARY CONTRIBUTING FACTORS

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.

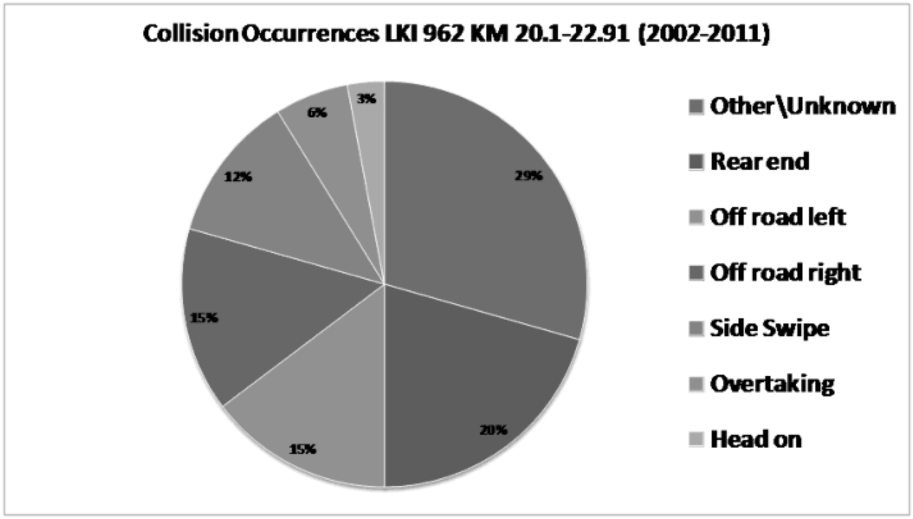

FIGURE 10: COLLISION OCCURRENCES

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.

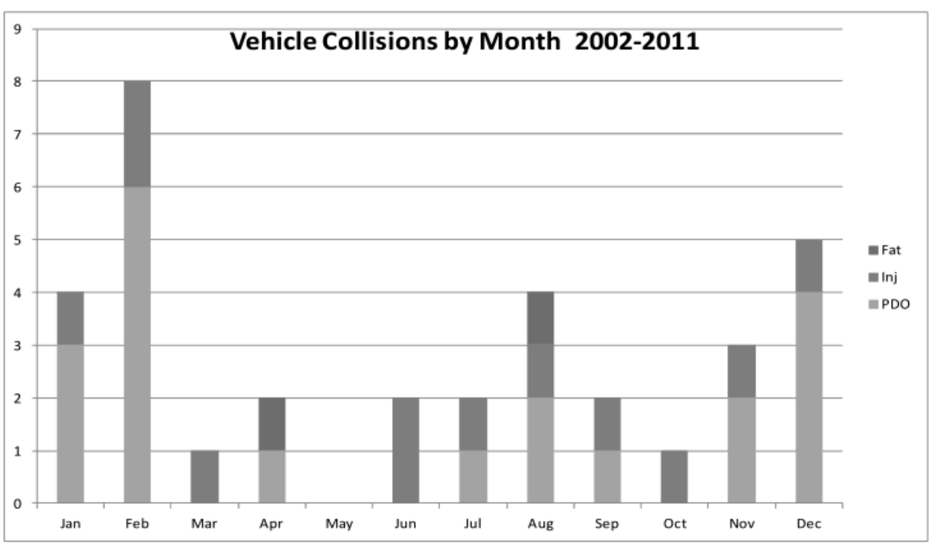

FIGURE 11: VEHICLE COLLISIONS BY MONTH

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**	**A**
Peak: >= 579 vph (>=10% of AADT)	31.1%	82.3	D	72%	**96.7**	**A**

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 Account Evaluation 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

	6% Discount Rate (Baseline)	4% Discount Rate	10% Discount Rate	-25% Construction Costs	+25% Construction Costs	Traffic Growth 1%	Traffic Growth 2%	Catastrophic Failure 1 in 25 Year Event @ 6% Discount Rate	Catastrophic Failure 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	**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

Deliverable	Projected Completion Date
Project Initiation meeting	May 17, 2011
50% Functional Hwy Design / 50% Conceptual Bridge Design	July 10, 2012
Value Audit – Hwy Design/Bridge Design	August 28, 2012
Open House	September 12, 2012
100% Functional Hwy Design /100% Conceptual Bridge Design	October, 2012
Final Property Acquisition Plans	October, 2012
100% Detailed Design	July, 2013
Tender Package	June, 2014

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 As of June 06, 2014

	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**

*Contractual obligations with First Nations

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.

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.

Table 4.5 Provincially red and blue-listed animal species found in the ICH biogeoclimatic zone within the Okanagan Shuswap Forest District with potential to occur in the project area (BC CDC 2006a and b).

Scientific Name	English Name	BC Status	COS-EWIC*	Last seen within 20 Km**	Obs-erved October, 2006***	Habitat Requirements
Mammals						
Corynorhinus townsendii	Townsend's Big-eared Bat	Blue				Roosts in caves or cave-like roosts; forages in arid areas 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				Forage in diverse habitats; usually natal dens in large cavities in cottonwoods
Myotis septentrionalis	Northern Long-eared Myotis	Blue				Inhabits forested areas, especially mines, caves and tunnels, but also open areas
Ovis canadensis	Bighorn Sheep	Blue				Grasslands and shrublands adjacent to escape terrain (e.g., cliffs, talus slopes)
s.18						
s.18						
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						
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 lentiginosus	American Bittern	Blue				Breeds in marshes of 2.5 ha or more with open water and dense graminoid or shrubby vegetation
Dolichonyx oryzivorus	Bobolink	Blue				Nests in fields of tall grass
Hirundo rustica	Barn Swallow	Blue				Forages in open areas, frequently near water; nests under the overhang of a building, bridge or cliff
s.18						
			2000)			
s.18						
Patagioenas fasciata	Band-tailed Pigeon	Blue				Inhabits temperate and mountain coniferous and mixed forests and woodlands
Reptiles and Amphibians						
Chrysemys picta	Painted Turtle	Blue	E/SC (Apr 2006)	Eagle River, 2002	•	Found in lakes, ponds, slow-moving streams
Eumeces skiltonianus	Western Skink	Blue	SC (May 2002)	Shuswap Lake, 1969		Grassland, open forests, rocky areas near streams; digs burrows in soil
Fish						
Acrocheilus alutaceus	Chiselmouth	Blue	NAR (May 2003)	Mara Lake, 1964		Flowing pools to fast water over sand and gravel in small to medium rivers and lake margins
Cottus hubbsi	Columbia Mottled Sculpin	Blue	SC (May 2000)			Isolated streams, upstream tributaries and mainstem rivers
s.18						
Salvelinus confluentus	Bull Trout	Blue				Bottom of deep pools in cold rivers and large tributary streams; also large coldwater lakes and reservoirs.
Invertebrates						
Anodonta nuttalliana	Winged Floater (Freshwater Clam)	Blue				Lakes and slow rivers in southern B.C.
Fossaria truncatula	Attenuate Fossaria (Snail)	Blue				Prefers water bodies with mud bottoms
Hemphillia camelus	Pale Jumping-slug (Slug)	Blue				Found in dry to moist coniferous forests, lives near mossy stumps, rocks and logs and in leaf litter

*COSEWIC provides federal designations for species at risk: E=Endangered; SC=Special Concern; T=Threatened; NAR=Not at Risk. **These species have been recorded within 20 km of the project area. ***A fresh painted turtle shell was found just upstream of the Malakwa Bridge during the field reconnaissance. A great blue heron was also observed foraging along the Eagle River.

Summit Environmental Consultants Ltd. **FINAL REPORT**
Project #561-31.03 Malakwa to Perry River EA 30-Nov-2006

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.

Ministry of Transportation and Infrastructure

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

Current Year	2012
Construction Year	2013
Benefit Period (yrs)	24

Notes:

- future costs are discounted to the end of the current year for B/C analysis
- Construction is assumed to occur in the current year + 1
- typically the lesser of: 24 years or the service life of the improvement

Base Case - Opening Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2014										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU2	RAU2									
$AADT_{major}$	6287.55	6287.55									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170
Observed PDO/yr	0.300	0.900									1.200
Observed Severe/yr	0.300	0.600									0.900
Empirical Bayes Method Applicable?[2]	yes	yes									

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.005706	0.005706	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7523	0.7523	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9222	0.9222	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.9	2.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.057	2.338	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.396
alpha	0.910	0.199	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected PDO (coll/yr)	0.079	1.186	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.265
(E.B.)/(Predicted)	1.380	0.507	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Severe											
a0	0.005242	0.005242	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7279	0.7279	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9403	0.9403	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	5.02	5.02	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.040	1.771	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.812
alpha	0.961	0.362	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected Severe (coll/yr)	0.051	1.024	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.074
(E.B.)/(Predicted)	1.248	0.578	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.510	1.536	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.046
Predicted Severe (coll/yr)	0.325	1.326	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.651

Proposed Case - Opening Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2014										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU4	RAU4									
$AADT_{major}$	6287.55	6287.55									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170
Observed PDO/yr	0.300	0.900									1.200
Observed Severe/yr	0.300	0.600									0.900
E.B. Applicable?[2]	yes	yes									

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.000737	0.000737	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.9394	0.9394	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9832	0.9832	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	1.92	1.92	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.032	1.662	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.694
alpha	0.923	0.188	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected PDO (coll/yr)	0.053	1.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.096
(E.B.)/(Predicted)	1.644	0.628	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Severe											
a0	0.008982	0.008982	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.6875	0.6875	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9676	0.9676	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.39	2.39	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.045	2.199	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.244
alpha	0.914	0.179	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected Severe (coll/yr)	0.067	0.886	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.953
(E.B.)/(Predicted)	1.487	0.403	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.053	0.984	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.037
Predicted Severe (coll/yr)	0.067	0.836	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.903

Notes (Opening Year):

- Opening year assumed to occur 1 year after the construction year
- spreadsheet revisions required if more than 10 elements (segments and intersections)
- Select 'S' for segments, 'SI' for signalized intersections, 'UI' for unsignalized intersections, or 'blank' for no segment or I/S.
- Select one of the service classes for segments or one of the intersection types for signalized intersections. For unsignalized intersections select only All I/S, 4-leg, or 3-leg.
- AADT on segment or AADT on major leg at intersections for the "Analysis Year"
- AADT on minor leg at intersections for the "Analysis Year" or enter zero or blank for segments
- leave blank or enter zero for intersections
- Preferably use 3 to 5 years of collision data, but enter the average number of collisions per year
- Preferably use 3 to 5 years of collision data, but enter the average number of collisions per year
- Enter "yes" to apply the E.B. method for the full analysis period. Enter "no" or blank to not apply the E.B. method. Refer to HSM 1st Ed. Vol 2 Appendix 'A' Section A.2.1 to determine whether the E.B. method is applicable. If "yes" is entered, observed PDO and Severe collisions must be provided in the cells above.
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- alpha = k/(k+ Predicted)
- E.B. Expected = (alpha)(Predicted) + (1-alpha)(Observed)
- This ratio is used to factor the Predicted frequency in the Interim and Horizon years
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- alpha = k/(k+ Predicted)
- E.B. Expected = (alpha)(Predicted) + (1-alpha)(Observed)
- This ratio is used to factor the Predicted frequency in the Interim and Horizon years
- from CMF worksheet
- from CMF worksheet
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF

Base Case - Interim Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2025										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU2	RAU2									
$AADT_{major}$	7301.6858	7301.696									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.005706	0.005706	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7523	0.7523	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9222	0.9222	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.9	2.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.064	2.623	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.687
E.B. Expected PDO (coll/yr)	0.089	1.330	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.419
Severe											
a0	0.005242	0.005242	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7279	0.7279	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9403	0.9403	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	5.02	5.02	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.045	1.980	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.025
E.B. Expected Severe (coll/yr)	0.056	1.144	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.201

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.572	1.724	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.295
Predicted Severe (coll/yr)	0.363	1.482	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.845

Proposed Case - Interim Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2025										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU4	RAU4									
$AADT_{major}$	7301.696	7301.696									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.000737	0.000737	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.9394	0.9394	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9832	0.9832	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	1.92	1.92	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.037	1.918	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.955
E.B. Expected PDO (coll/yr)	0.061	1.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.265
Severe											
a0	0.008982	0.008982	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.6875	0.6875	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9676	0.9676	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.39	2.39	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.050	2.443	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.493
E.B. Expected Severe (coll/yr)	0.074	0.984	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.058

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.061	1.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.197
Predicted Severe (coll/yr)	0.074	0.928	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.003

Notes (Interim Year):

- construction year + roundup(benefit period/2)
- spreadsheet revisions required if more than 10 elements (segments and intersections)
- Select 'S' for segments, 'SI' for signalized intersections, 'UI' for unsignalized intersections, or 'blank' for no segment or I/S.
- Select one of the service classes for segments or one of the intersection types for signalized intersections. For unsignalized intersections select only All I/S, 4-leg, or 3-leg.
- AADT on segment or AADT on major leg at intersections for the "Analysis Year"
- AADT on minor leg at intersections for the "Analysis Year" or enter zero or blank for segments
- leave blank or enter zero for intersections
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- E.B. Expected = Predicted x ((E.B Expected/Predicted) *from opening year*)
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- E.B. Expected = Predicted x ((E.B Expected/Predicted) *from opening year*)
- from CMF worksheet: assumes same values as opening year
- from CMF worksheet: assumes same values as opening year
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF

Base Case - Horizon Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2037										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU2	RAU2									
$AADT_{major}$	8429.8548	8429.855									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.005706	0.005706	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7523	0.7523	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9222	0.9222	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.9	2.9	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.072	2.922	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.994
E.B. Expected PDO (coll/yr)	0.099	1.482	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.581
Severe											
a0	0.005242	0.005242	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.7279	0.7279	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9403	0.9403	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	5.02	5.02	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.050	2.198	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.248
E.B. Expected Severe (coll/yr)	0.063	1.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.333

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	6.422	1.296	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.637	1.920	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.557
Predicted Severe (coll/yr)	0.403	1.646	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.049

Proposed Case - Horizon Year

Inputs (see notes to the right ----->)

Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Analysis Year	2037										
Segment or I/S?	S	S									
Service Class or I/S Type	RAU4	RAU4									
$AADT_{major}$	8429.855	8429.855									
$AADT_{minor}$											
Length (km)	0.056	3.114									3.170

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

	1	2	3	4	5	6	7	8	9	10	Total
PDO											
a0	0.000737	0.000737	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.9394	0.9394	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9832	0.9832	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	1.92	1.92	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.042	2.195	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.237
E.B. Expected PDO (coll/yr)	0.069	1.378	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.447
Severe											
a0	0.008982	0.008982	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	0.6875	0.6875	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	0.9676	0.9676	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	2.39	2.39	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.055	2.696	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.751
E.B. Expected Severe (coll/yr)	0.082	1.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.168

Composite CMF for Selected Design Features

	1	2	3	4	5	6	7	8	9	10
Composite CMF_{pdo}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	0.944	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

	1	2	3	4	5	6	7	8	9	10	Total
Predicted PDO (coll/yr)	0.069	1.300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.370
Predicted Severe (coll/yr)	0.082	1.025	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.107

Notes (Horizon Year):

- construction year + benefit period
- spreadsheet revisions required if more than 10 elements (segments and intersections)
- Select 'S' for segments, 'SI' for signalized intersections, 'UI' for unsignalized intersections, or 'blank' for no segment or I/S.
- Select one of the service classes for segments or one of the intersection types for signalized intersections. For unsignalized intersections select only All I/S, 4-leg, or 3-leg.
- AADT on segment or AADT on major leg at intersections for the "Analysis Year"
- AADT on minor leg at intersections for the "Analysis Year" or enter zero or blank for segments
- leave blank or enter zero for intersections
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- E.B. Expected = Predicted x ((E.B Expected/Predicted) *from opening year*)
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- from CPM worksheet
- see model form on CPM worksheet
- E.B. Expected = Predicted x ((E.B Expected/Predicted) *from opening year*)
- from CMF worksheet: assumes same values as opening year
- from CMF worksheet: assumes same values as opening year
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF
- (Frequency from Base CPM with E.B. adjustment if applicable) x Composite CMF

Ministry of Transportation and Infrastructure

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Collision Modification Factor Calculations

This sheet calculates a Composite CMF_{severe} and a Composite CMF_{pdo} for each segment of the base and proposed cases, based on user input values for CMF_{target} and P_{target} for each of the selected design features.
Use the upper table for CMFs that apply equally to all severities, and use the lower table for CMFs that have a different value for each severity (e.g. CMFs for median barrier)

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

Base Case

CMFs that apply equally to all severities
CMF_{target}, P_{target}, and CMF_{total} for each Design Feature (see notes to the right ----->)

Design Feature #	Design Feature Description		Segment or Intersection # 1	2	3	4	5	6	7	8	9	10
1	Bridge Narrowing	$CMF_{target1}$	12.251									
		$P_{target1}$	0.482									
		CMF_{total1}	6.422	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	Median Width	$CMF_{target2}$		1.292								
		$P_{target2}$		1.000								
		CMF_{total2}	1.000	1.292	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3	Lane Width (p.46 CMF for BC)	$CMF_{target3}$		1.005								
		$P_{target3}$		0.570								
		CMF_{total3}	1.000	1.003	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4		$CMF_{target4}$										
		$P_{target4}$										
		CMF_{total4}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5		$CMF_{target5}$										
		$P_{target5}$										
		CMF_{total5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6		$CMF_{target6}$										
		$P_{target6}$										
		CMF_{total6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7		$CMF_{target7}$										
		$P_{target7}$										
		CMF_{total7}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8		$CMF_{target8}$										
		$P_{target8}$										
		CMF_{total8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9		$CMF_{target9}$										
		$P_{target9}$										
		CMF_{total9}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10		$CMF_{target10}$										
		$P_{target10}$										
		$CMF_{total10}$	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

Proposed Case

CMFs that apply equally to all severities
CMF_{target}, P_{target}, and CMF_{total} for each Design Feature (see notes to the right ----->)

Design Feature #	Design Feature Description		Segment or Intersection # 1	2	3	4	5	6	7	8	9	10
1	Bridge Narrowing (Not applicable to 4 lane Hwy)	$CMF_{target1}$										
		$P_{target1}$										
		CMF_{total1}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	Median Width	$CMF_{target2}$		1.261								
		$P_{target2}$		1.000								
		CMF_{total2}	1.000	1.261	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3	Lane Width (p.46 CMF for BC)	$CMF_{target3}$		0.994								
		$P_{target3}$		0.367								
		CMF_{total3}	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4	Passing Lane (4 Lanes)	$CMF_{target4}$		0.750								
		$P_{target4}$		1.000								
		CMF_{total4}	1.000	0.750	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5		$CMF_{target5}$										
		$P_{target5}$										
		CMF_{total5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6		$CMF_{target6}$										
		$P_{target6}$										
		CMF_{total6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7		$CMF_{target7}$										
		$P_{target7}$										
		CMF_{total7}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8		$CMF_{target8}$										
		$P_{target8}$										
		CMF_{total8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9		$CMF_{target9}$										
		$P_{target9}$										
		CMF_{total9}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10		$CMF_{target10}$										
		$P_{target10}$										
		$CMF_{total10}$	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

Ministry of Transportation and Infrastructure

BRITISH COLUMBIA The Best Place on Earth

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	

Notes:

Defaults

		Notes
Fatal Unit Cost	$ 6,385,999	
Injury Unit Cost	$ 135,577	
PDO Unit Cost	$ 11,367	
Discount Rate	6%	6% for provincial projects, 10% for federal cost shared projects

Looked-up Values

		Notes
Current Year	2012	from 'Coll Freq' worksheet
Construction Year	2013	from 'Coll Freq' worksheet
Benefit Period	24	from 'Coll Freq' worksheet

Severity Distribution Inputs

	Base Case	Proposed Case	Notes
			input values used to calculate Severe Unit Cost
Fatal proportion	3.00%	2.12%	refer to "default coll proportns" worksheet
Injury proportion	41.20%	44.83%	refer to "default coll proportns" worksheet
PDO proportion	56.79%	53.05%	refer to "default coll proportns" worksheet
Severe (F+I) Unit Cost	$ 559,814	$ 418,283	

Agency Costs ($)

	Base Case	Proposed Case	Notes
Property	$ -	$ -	**Property Purchased: Sunk Cost**
Engineering	$ -	$ 1,728,245	**7.075M Sunk Cost. 4,278,609 from properties, remainder subtracted from engineering**
Construction	$ -	$ 26,196,754	
Total Capital Cost	$ -	$ 27,924,999	
Annual Maintenance ($/yr)	$ 25,360	$ 69,740	Typically $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Periodic Resurfacing ($)	$ 480,000	$ 960,000	Typically $45,000 to $80,000/Ln-km
Resurfacing Years:	2022	2028	Typical pavement life is 15 yrs from the last resurfacing
	2037	2043	2nd resurfacing yr is ignored if > horizon yr (const. yr + benefit period)
Salvage Value in Horizon Yr	$ 480,000	$ 21,053,403	Typical is 100% of prpty + 80% of const.+ resurf. residual
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	Present Value of Capital + Maintenance + Resurfacing - Salvage

User Safety Costs and Benefits ($)

Year	Discounted Safety Costs Base Case	Discounted Safety Costs Proposed Case	Discounted 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

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

Summary of Results (Present Values, $)

	Base Case	Proposed Case	Incremental	Notes
Agency Costs	$ 568,291	$ 22,642,544	$ 22,074,253	Incremental Agency Costs = Proposed - Base
User Safety Costs	$ 12,265,276	$ 5,018,946	$ 7,246,330	Incremental User Benefits = Base - Proposed
B/C Ratio	0.33			Incremental User Benefits/Incremental Agency Costs
Net Present Value	-$14,827,923			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, interim year, and horizon year (down the page).
2. Inputs are required for both cases and all 3 time periods. Generally, inputs for the interim and horizon years will be the same as the opening year except for growth in AADT.
3. The Empirical Bayes method of combining predicted and observed crash frequency can be included or omitted for each segment in the base case or the proposed case depending on whether or not it is applicable (see HSM 1st Ed. Vol 2 Appendix 'A' Section A.2.1), availability of crash data, or practitioners preference.

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

Current Year	2012
Construction Year	2013
Benefit Period (yrs)	24

Base Case - Opening Year

Inputs (see notes to the right ----->)

Analysis Year	2014										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			6450.1								
$AADT_{minor}$			149.175								
Length (km)											0.000
Observed PDO/yr			0.300								0.300
Observed Severe/yr			0.100								0.100
Empirical Bayes Method Applicable?[3]			yes								

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
alpha	#N/A	#N/A	0.997	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected PDO (coll/yr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
(E.B.)/(Predicted)	N/A	N/A	1.003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101
alpha	#N/A	#N/A	0.998	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected Severe (coll/yr)	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101
(E.B.)/(Predicted)	N/A	N/A	1.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
Predicted Severe (coll/yr)	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101

Proposed Case - Opening Year

Inputs (see notes to the right ----->)

Analysis Year	2014										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			6450.1								
$AADT_{minor}$			149.175								
Length (km)											0.000
Observed PDO/yr			0.300								0.300
Observed Severe/yr			0.100								0.100
E.B. Applicable?[3]			yes								

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
alpha	#N/A	#N/A	0.997	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected PDO (coll/yr)	0.000	0.000	0.151	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.151
(E.B.)/(Predicted)	N/A	N/A	1.003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101
alpha	#N/A	#N/A	0.998	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
E.B. Expected Severe (coll/yr)	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.101
(E.B.)/(Predicted)	N/A	N/A	1.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	0.523	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	0.482	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.079	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.079
Predicted Severe (coll/yr)	0.000	0.000	0.048	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048

Base Case - Interim Year

Inputs (see notes to the right ----->)

Analysis Year	2025										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			7514.387								
$AADT_{minor}$			173.7889								
Length (km)											0.000

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.176
E.B. Expected PDO (coll/yr)	0.000	0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118
E.B. Expected Severe (coll/yr)	0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177
Predicted Severe (coll/yr)	0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118

Proposed Case - Interim Year

Inputs (see notes to the right ----->)

Analysis Year	2025										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			7514.387								
$AADT_{minor}$			173.7889								
Length (km)											0.000

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.176
E.B. Expected PDO (coll/yr)	0.000	0.000	0.177	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted Severe (coll/yr)	0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118
E.B. Expected Severe (coll/yr)	0.000	0.000	0.118	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.118

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	0.523	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	0.482	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.092	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
Predicted Severe (coll/yr)	0.000	0.000	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.057

Base Case - Horizon Year

Inputs (see notes to the right ----->)

Analysis Year	2037										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			8875.385								
$AADT_{minor}$			200.6404								
Length (km)											0.000

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.204
E.B. Expected PDO (coll/yr)	0.000	0.000	0.205	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.205
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/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	0.136
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	0.136

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.205	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.205
Predicted Severe (coll/yr)	0.000	0.000	0.136	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136

Proposed Case - Horizon Year

Inputs (see notes to the right ----->)

Analysis Year	2037										
Seg or I/S #	1	2	3	4	5	6	7	8	9	10	Total
Segment or I/S?			I/S								
Service Class or I/S Type			4-Leg								
$AADT_{major}$			8875.385								
$AADT_{minor}$			200.6404								
Length (km)											0.000

Predicted Collision Frequency using Base CPMs, adjusted using Empirical Bayes if applicable

PDO											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
Predicted PDO (coll/yr)	0.000	0.000	0.204	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.204
E.B. Expected PDO (coll/yr)	0.000	0.000	0.205	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.205
Severe											
a0	#N/A	#N/A	0.002074	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a1	#N/A	#N/A	0.3471	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
a2	#N/A	#N/A	0.6719	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
k	#N/A	#N/A	263.2	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/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	0.136
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	0.136

Composite CMF for Selected Design Features

Composite CMF_{pdo}	1.000	1.000	0.523	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Composite CMF_{severe}	1.000	1.000	0.482	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Predicted Collision Frequency Accounting for Design Features of Facility and E.B. if applicable.

Predicted PDO (coll/yr)	0.000	0.000	0.107	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.107
Predicted Severe (coll/yr)	0.000	0.000	0.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.066

Ministry of Transportation and Infrastructure

Collision Modification Factor Calculations

This sheet calculates a Composite CMF_{severe} and a Composite CMF_{pdo} for each segment of the base and proposed cases, based on user input values for CMF_{target} and P_{target} for each of the selected design features.
Use the upper table for CMFs that apply equally to all severities, and use the lower table for CMFs that have a different value for each severity (e.g. CMFs for median barrier)

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

Base Case

CMFs that apply equally to all severities
CMF_{target}, P_{target}, and CMF_{total} for each Design Feature (see notes to the right ----->)

Design Feature #	Design Feature Description		Segment or Intersection # 1	2	3	4	5	6	7	8	9	10
1		$CMF_{target1}$										
		$P_{target1}$										
		CMF_{total1}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2		$CMF_{target2}$										
		$P_{target2}$										
		CMF_{total2}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3		$CMF_{target3}$										
		$P_{target3}$										
		CMF_{total3}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4		$CMF_{target4}$										
		$P_{target4}$										
		CMF_{total4}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5		$CMF_{target5}$										
		$P_{target5}$										
		CMF_{total5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6		$CMF_{target6}$										
		$P_{target6}$										
		CMF_{total6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7		$CMF_{target7}$										
		$P_{target7}$										
		CMF_{total7}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8		$CMF_{target8}$										
		$P_{target8}$										
		CMF_{total8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9		$CMF_{target9}$										
		$P_{target9}$										
		CMF_{total9}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10		$CMF_{target10}$										
		$P_{target10}$										
		$CMF_{total10}$	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

Proposed Case

CMFs that apply equally to all severities
CMF_{target}, P_{target}, and CMF_{total} for each Design Feature (see notes to the right ----->)

Design Feature #	Design Feature Description		Segment or Intersection # 1	2	3	4	5	6	7	8	9	10
1	Add Right Turn Lanes at Rural Unsig Intersections	$CMF_{target1}$			0.860							
		$P_{target1}$			1.000							
		CMF_{total1}	1.000	1.000	0.860	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	Add left-turn lane at Rural Stop Controlled Intersections	$CMF_{target2}$			0.560							
		$P_{target2}$			1.000							
		CMF_{total2}	1.000	1.000	0.560	1.000	1.000	1.000	1.000	1.000	1.000	1.000
3		$CMF_{target3}$										
		$P_{target3}$										
		CMF_{total3}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
4		$CMF_{target4}$										
		$P_{target4}$										
		CMF_{total4}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
5		$CMF_{target5}$										
		$P_{target5}$										
		CMF_{total5}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6		$CMF_{target6}$										
		$P_{target6}$										
		CMF_{total6}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7		$CMF_{target7}$										
		$P_{target7}$										
		CMF_{total7}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8		$CMF_{target8}$										
		$P_{target8}$										
		CMF_{total8}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9		$CMF_{target9}$										
		$P_{target9}$										
		CMF_{total9}	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10		$CMF_{target10}$										
		$P_{target10}$										
		$CMF_{total10}$	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

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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.

Notes:

Defaults

		Notes
Fatal Unit Cost	$ 6,385,999	
Injury Unit Cost	$ 135,577	
PDO Unit Cost	$ 11,367	
Discount Rate	6%	6% for provincial projects, 10% for federal cost shared projects

Looked-up Values

		Notes
Current Year	2012	from 'Coll Freq' worksheet
Construction Year	2013	from 'Coll Freq' worksheet
Benefit Period	24	from 'Coll Freq' worksheet

Severity Distribution Inputs

	Base Case	Proposed Case	Notes
			input values used to calculate Severe Unit Cost
Fatal proportion	1.01%	1.01%	refer to "default coll proportns" worksheet
Injury proportion	43.22%	43.22%	refer to "default coll proportns" worksheet
PDO proportion	55.77%	55.77%	refer to "default coll proportns" worksheet
Severe (F+I) Unit Cost	$ 278,179	$ 278,179	

Agency Costs ($)

	Base Case	Proposed Case	Notes
Property	$ -		
Engineering	$ -	$ -	Typically 10% to 20% of construction
Construction	$ -	$ -	
Total Capital Cost	$ -	$ -	
Annual Maintenance ($/yr)	$ -	$ -	Typically $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Periodic Resurfacing ($)	$ -	$ -	Typically $45,000 to $80,000/Ln-km
Resurfacing Years:	2011	2028	Typical pavement life is 15 yrs from the last resurfacing
	2026	2043	2nd resurfacing yr is ignored if > horizon yr (const. yr + benefit period)
Salvage Value in Horizon Yr	$ -	$ -	Typical is 100% of prpty + 80% of const.+ resurf. residual
Discounted Capital Costs	$ -	$ -	
Discounted Maint. and Resurf.	$ -	$ -	
Discounted Salvage Value	$0	$0	
Total Discounted Agency Costs	$ -	$ -	Present Value of Capital + Maintenance + Resurfacing - Salvage

User Safety Costs and Benefits ($)

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

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

A-x

SHORTBEN – TRAVEL TIME AND VEHICLE OPERATING COSTS

BRITISH COLUMBIA
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Ministry of Transportation and Infrastructure

SHORTBEN.XLS

Version **21 September 2008**

Required Inputs in Yellow
Optional Inputs in Green

Note: This spreadsheet provides TTS and VOC used to calculate NPV and B/C ratio in Safetyben spreadsheet tool

Intended for use as a screening tool prior to more complete benefit cost analysis
Make an original copy before using.

TREATED SECTION	Base	Proposed		Notes
General Information				
Segment Length (km)	2.80	2.80		Important to show any differences between base & prop.
AADT	6,450	6,450		Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%		Compound growth
% Trucks	30.0%	30.0%		
Base Year	2014	2014	Construction in 2013-Benefits start 2014	Should be same for base and proposed.
Benefit Period (yrs)	24	24		Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%		
Financial Account				
Property ($)	$0	$0	All costs in SafetyBencost	
Engineering ($)	$0	$0	All costs in SafetyBencost	Typical 10% to 20% of Construction
Construction ($)	$0	$0	All costs in SafetyBencost	
Total ($)	$0	$0		
Maintenance ($/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 $80,000/Ln-km
Resurfacing Years	2022	2029		Typical Pavement life is 15 yrs from the last resurfacing
	2037	2044		2nd resurf yr is ignored if 0 or >(base yr + benefit period)
Salvage Value ($) in Horizon Yr	$630,000	$140,000		Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value	$756,786	$1,324,653		Present Value of capital + maint.+ resurf. - salvage
Customer Service Account				
Time Costs				
% of AADT				% of AADT occurring in each period. For example
Peak	13.1%	13.1%	Source: HCS Summary	a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	55.9%	55.9%	Source: HCS Summary	These splits are used to differentiate speed, delay and
Low	31.1%	31.1%	Source: HCS Summary	veh. Op. costs during different periods of the day.
Total	100.0%	100.0%		Total must equal 100%
Auto Speed (km/hr)				
Peak	82.3	96.7	Source: HCS Summary	Representative average speeds in peak and shoulder
Shoulder	87.1	96.7	Source: HCS Summary	periods are usually not much lower than speeds in
Low	92.4	96.7	Source: HCS Summary	the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				
Peak	82.3	96.7	Source: HCS Summary	
Shoulder	87.1	96.7	Source: HCS Summary	
Low	92.4	96.7	Source: HCS Summary	
Avg. Control Delay (sec/veh)				
Peak	0	0		
Shoulder	0	0		
Low	0	0		
% of Vehicles Stopping				% Vehicles Stopping during each period should be 0
Peak				if control delay is 0. Values are used for fuel calculatons only.
Shoulder				They do not impact delay calculations.
Low				
Value of Travel Time				
Passenger Veh Occupancy	1.3	1.3		Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94		
Car ($/veh)	$20.72	$20.72		
Truck Driver ($/veh)	$29.16	$29.16		Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1				Excludes cross street delay.
Car	52,438	47,719		
Truck	22,473	20,451		
Present Value of Time Costs ($mill) for Benefit Period				
Car	$15.751	$14.334		
Truck	$9.499	$8.644		
Total	$25.250	$22.978		
Accident Costs				
Rate (coll/mvk)	0.00	0.00	Reference Safety Bencost instead	
Severity				
% Fatal	0.0%	0.0%	Reference Safety Bencost instead	
% Injury	0.0%	0.0%	Reference Safety Bencost instead	
% PDO	0.0%	0.0%	Reference Safety Bencost instead	
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	$7,759	$7,759		
Weighted Average	$0	$0		
Present Value Coll. Costs ($ mill)	$0.000	$0.000		
Vehicle Operating Costs (VOC)				
Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.101	0.111		
Composite Truck	0.442	0.486		35%SU, semi - 20%empty 30% full, Btrain- 7%empty 8%full
Control Delay Fuel (L/veh)				Additional fuel consumed due to control delay.
Car	0.000	0.000		includes deceleration, stop time and acceleration
Composite Truck	0.000	0.000		
Fuel (Litres/yr)				Annual Fuel Consumption (L)
Cars	465,889	512,005		
Composite Truck	873,931	960,950		
Fuel Price ($/L)				Price net of taxes is about 55% of pump price
Car	$0.90	$0.90		
Composite Truck	$0.98	$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)				
Car	$418,369	$459,781		Includes excess fuel consumption due to control delay, if any.
Composite Truck	$854,704	$939,809		
Other Vehicle Costs				
Car ($/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)	$0.358	$0.358		
Annual Cost ($/yr)				Composite values based on peak, shoulder and
Car	$905,188	$946,600		low period speeds. Assumes 0% grade.
Truck Time	$463,208	$422,106		
Truck Distance	$1,562,144	$1,647,248		
Present Value of VOC ($millions)				
Car	$13.121	$13.721		
Truck	$29.358	$29.996		
Total	$42.480	$43.718		
Summary of Discounted Costs ($millions)				
Capital	$0.000	$0.000		
Maintenance & Resurf	$0.904	$1.357		
Salvage	($0.147)	($0.033)		
Total	$0.757	$1.325		Sum of discounted Costs
Summary of Discounted Benefits				
Time Savings		$2.272		Savings due to higher speeds or shorter distance
Accident Savings				Savings due to reduced accident rate or severity
Vehicle Operating Savings		($1.238)		Often negative with increasing fuel at higher speed
Total Benefits		$1.034		
Summary of Results (Present Values in $millions)				
Financial Account	$0.757	$1.325		
Incremental Cost		$0.568		= Proposed - Base
Customer Service Account	$67.730	$66.696		
Incremental Benefit				=Base -Proposed
B/C Ratio		0.00		= Incremental benefits/incremental costs
Net Present Value		-$0.568		= Incremental Benefits - Incremental Costs

Greenhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	-346
0.262	0.08	Nitrogen Oxide	-19
0.122	0.12	Hydrcarbons	-16
		Annual Saving (tonnes/yr)	-382

LOS for Signalized I/S (sec/veh)

LOS	A	B	C	D	E
Max Delay	10	20	35	55	80

Typical acc. rates and severities by service class (2001 - 2005 data)

Service Class	UAU2	UAU4	UAD4	UED4	UFD4	RAU2
Rate (coll/mvk	0.75	0.77	1.37	0.51	0.35	0.54
Fatal	0.93%	0.93%	0.21%	0.63%	0.91%	2.34%
Injury	41.5%	45.5%	44.5%	39.2%	38.7%	41.8%
PDO	57.5%	53.6%	55.3%	60.2%	60.4%	55.9%

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SHORTBEN.XLS Required Inputs in Yellow
Version **21 September 2008** Optional Inputs in Green
Intended for use as a screening tool prior to more complete benefit cost analysis
Make an original copy before using.

Note: TTS apply to the Treated & Downstream Segments; SafetyBen spreadsheet includes Safety Benefits for Treated, Upstream & Downstream sections

TREATED SECTION	Base	Proposed		Incremental	Notes
General Information					
Segment Length (km)	5.70	5.70	Effective Length = 10 -AADT/1500		Important to show any differences between base & prop.
AADT	6,450	6,450			Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%			Compound growth
% Trucks	30.0%	30.0%			
Base Year	2014	2014			Should be same for base and proposed.
Benefit Period (yrs)	24	24			Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%			
Financial Account					
Property ($)	$0	$0	All costs in SafetyBencost		
Engineering ($)	$0	$0	All costs in SafetyBencost		Typical 10% to 20% of Construction
Construction ($)	$0	$0	All costs in SafetyBencost		
Total ($)	$0	$0			
Maintenance ($/km/yr)	$0	$0	All costs in SafetyBencost		Typical $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Resurfacing Cost ($/km)	$0	$0	All costs in SafetyBencost		Typical $45,000 to $80,000/Ln-km
Resurfacing Years	2022	2029			Typical Pavement life is 15 yrs from the last resurfacing
	2037	2044			2nd resurf yr is ignored if 0 or >(base yr + benefit period)
Salvage Value ($) in Horizon Yr	$0	$0			Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value	$0	$0			Present Value of capital + maint.+ resurf. - salvage
Customer Service Account					
Time Costs					
% of AADT					% of AADT occurring in each period. For example
Peak	13.1%	13.1%			a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	55.9%	55.9%			These splits are used to differentiate speed, delay and
Low	31.1%	31.1%			veh. Op. costs during different periods of the day.
Total	100.0%	100.0%			Total must equal 100%
Auto Speed (km/hr)					
Peak	82.3	82.9	Downstream TTS from HCS Summary	0.6	Representative average speeds in peak and shoulder
Shoulder	87.1	89.0	Downstream TTS from HCS Summary	1.9	periods are usually not much lower than speeds in
Low	92.4	96.2	Downstream TTS from HCS Summary	3.8	the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)					
Peak	82.3	82.9	Downstream TTS from HCS Summary		
Shoulder	87.1	89.0	Downstream TTS from HCS Summary		
Low	92.4	96.2	Downstream TTS from HCS Summary		
Avg. Control Delay (sec/veh)					
Peak	0	0			
Shoulder	0	0			
Low	0	0			
% of Vehicles Stopping					% Vehicles Stopping during each period should be 0
Peak					if control delay is 0. Values are used for fuel calculatons only.
Shoulder					They do not impact delay calculations.
Low					
Value of Travel Time					
Passenger Veh Occupancy	1.3	1.3			Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94			
Car ($/veh)	$20.72	$20.72			
Truck Driver ($/veh)	$29.16	$29.16			Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1					Excludes cross street delay.
Car	106,747	104,098			
Truck	45,749	44,613			
Present Value of Time Costs ($mill) for Benefit Period					
Car	$32.064	$31.268			
Truck	$19.337	$18.858			
Total	$51.402	$50.126			
Accident Costs					
Rate (coll/mvk)	0.00	0.00	Up & Downstream Safety Benefits in SafetyBencost		
Severity					
% Fatal	0.0%	0.0%	Up & Downstream Safety Benefits in SafetyBencost		
% Injury	0.0%	0.0%	Up & Downstream Safety Benefits in SafetyBencost		
% PDO	0.0%	0.0%	Up & Downstream Safety Benefits in SafetyBencost		
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	$7,759	$7,759			
Weighted Average	$0	$0			
Present Value Coll. Costs ($ mill)	$0.000	$0.000			
Vehicle Operating Costs (VOC)					
Running Fuel (L/km)					Fuel consumed at running speed, no control delay
Car	0.101	0.104			
Composite Truck	0.442	0.454			35% SU, semi - 20% empty 30% full, Btrain - 7% empty 8% full
Control Delay Fuel (L/veh)					Additional fuel consumed due to control delay.
Car	0.000	0.000			includes deceleration, stop time and acceleration
Composite Truck	0.000	0.000			
Fuel (Litres/yr)					Annual Fuel Consumption (L)
Cars	948,407	973,267			
Composite Truck	1,779,052	1,826,215			
Fuel Price ($/L)					Price net of taxes is about 55% of pump price
Car	$0.90	$0.90			
Composite Truck	$0.98	$0.98			Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)					
Car	$851,669	$873,993			Includes excess fuel consumption due to control delay, if any.
Composite Truck	$1,739,913	$1,786,038			
Other Vehicle Costs					
Car ($/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)	$0.358	$0.358			
Annual Cost ($/yr)					Composite values based on peak, shoulder and
Car	$1,842,683	$1,865,007			low period speeds. Assumes 0% grade.
Truck Time	$942,948	$918,705			
Truck Distance	$3,180,041	$3,226,166			
Present Value of VOC ($millions)					
Car	$26.711	$27.034			
Truck	$59.765	$60.082			
Total	$86.475	$87.116			
Summary of Discounted Costs ($millions)					
Capital	$0.000	$0.000			
Maintenance & Resurf	$0.000	$0.000			
Salvage	$0.000	$0.000			
Total	$0.000	$0.000			Sum of discounted Costs
Summary of Discounted Benefits					
Time Savings		$1.276			Savings due to higher speeds or shorter distance
Accident Savings					Savings due to reduced accident rate or severity
Vehicle Operating Savings		($0.641)			Often negative with increasing fuel at higher speed
Total Benefits		$0.635			
Summary of Results (Present Values in $millions)					
Financial Account	$0.000	$0.000			
Incremental Cost		$0.000			= Proposed - Base
Customer Service Account	$137.877	$137.242			
Incremental Benefit					=Base -Proposed
B/C Ratio		#DIV/0!			= Incremental benefits/incremental costs
Net Present Value		$0.000			= Incremental Benefits - Incremental Costs

LOS for Signalized I/S (sec/veh)

LOS	A	B	C	D	E
Max Delay	10	20	35	55	80

Typical acc. rates and severities by service class (2001 - 2005 data)

Service Class	UAU2	UAU4	UAD4	UED4	UFD4	RAU2
Rate (coll/mvk)	0.75	0.77	1.37	0.51	0.35	0.54
Fatal	0.93%	0.93%	0.21%	0.63%	0.91%	2.34%
Injury	41.5%	45.5%	44.5%	39.2%	38.7%	41.8%
PDO	57.5%	53.6%	55.3%	60.2%	60.4%	55.9%

Greenhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	-187
0.262	0.08	Nitrogen Oxide	-10
0.122	0.12	Hydrcarbons	-9
		Annual Saving (tonnes/yr)	-207

SHORTBEN – RELIABILITY

ORTBEN.XLS

sion **21 September 2008**

nded for use as a screening tool prior to more complete benefit cost analysis

ke an original copy before using.

Required Inputs in Yellow
Optional Inputs in Green

Took AADT and divided by total number of vehicles experiencing the delay over the year
Used avg control delay to replicate the seconds of delay per day on average

	Base	Proposed			Notes
neral Information					
Segment Length (km)	0.00	0.00	6000		Important to show any differences between base & prop.
AADT	1,091.7	1,092	0.1819		Base & Proposed AADT should nomally be the same.
Annual Traffic Growth (%)	1.50%	1.50%			Compound growth
% Trucks	30.0%	30.0%			
Base Year	2012	2012			Should be same for base and proposed.
Benefit Period (yrs)	24	24			Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%			
ancial Account					
Property ($)	$0	$0			
Engineering ($)	$0	$0			Typical 10% to 20% of Construction
Construction ($)	$0				
Total ($)	$0	$0			
Maintenance ($/km/yr)	$0	$0			Typical $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Resurfacing Cost ($/km)	$0	$0			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	$0	$0			Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value	$0	$0			Present Value of capital + maint.+ resurf. - salvage
stomer Service Account					
Time Costs					
% of AADT					% of AADT occurring in each period. For example
Peak	40.0%	40.0%			a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%			These splits are used to differentiate speed, delay and
Low	30.0%	30.0%			veh. Op. costs during different periods of the day.
Total	100.0%	100.0%			Total must equal 100%
Auto Speed (km/hr)					
Peak	100.0	100.0			Representative average speeds in peak and shoulder
Shoulder	100.0	100.0			periods are usually not much lower than speeds in
Low	100.0	100.0			the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)					
Peak	100	100			
Shoulder	100	100			
Low	100	100			
Avg. Control Delay (sec/veh)					LOS for Signalized I/S (sec/veh)
Peak	43	0	262	Ave. Minutes/Year	LOS: A, B, C, D, E
Shoulder	43	0			Max Delay: 10, 20, 35, 55, 80
Low	43	0			
% of Vehicles Stopping					% Vehicles Stopping during each period should be 0
Peak	100%				if control delay is 0. Values are used for fuel calculatons only.
Shoulder	100%				They do not impact delay calculations.
Low	100%				
Value of Travel Time					
Passenger Veh Occupancy	1.3	1.3			Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94			
Car ($/veh)	$41.44	$20.72	x2=non-work VTTS adjustment factor (UBCS		Guidebook P. B37)
Truck Driver ($/veh)	$64.70	$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjustn		Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1					Excludes cross street delay.
Car	3,337	0	$138,293	Year 1	
Truck	1,430	0	$92,524	Year 1	
Present Value of Time Costs ($mill)			$230,816	Year 1 sum	
for Benefit Period					
Car	$2.005	$0.000			
Truck	$1.341	$0.000			
Total	$3.346	$0.000			
Accident Costs					
Rate (coll/mvk)	0.00	0.00			
Severity					
% Fatal	2.6%	2.1%			
% Injury	41.0%	44.8%			
% PDO	56.9%	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	$7,759	$7,759			
Weighted Average	$214,436	$193,307			
Present Value Coll. Costs ($ mill)	$0.000	$0.000			
Vehicle Operating Costs (VOC)					
Running Fuel (L/km)					Fuel consumed at running speed, no control delay
Car	0.116	0.116			
Composite Truck	0.505	0.505			35%SU, semi - 20%empty 30% full, Btrain- 7%empty 8% full
Control Delay Fuel (L/veh)					Additional fuel consumed due to control delay.
Car	0.116	0.000			includes deceleration, stop time and acceleration
Composite Truck	0.545	0.000			
Fuel (Litres/yr)					Annual Fuel Consumption (L)
Cars	32,220	0			
Composite Truck	65,143	0			
Fuel Price ($/L)					Price net of taxes is about 55% of pump price
Car	$0.90	$0.90			
Composite Truck	$0.98	$0.98			Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)					
Car	$28,933	$0			Includes excess fuel consumption due to control delay, if any.
Composite Truck	$63,710	$0			
Other Vehicle Costs					
Car ($/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)	$0.358	$0.358			
Annual Cost ($/yr)					Composite values based on peak, shoulder and
Car	$28,933	$0			low period speeds. Assumes 0% grade.
Truck Time	$29,517	$0			
Truck Distance	$63,710	$0			
Present Value of VOC ($millions)					
Car	$0.419	$0.000			
Truck	$1.351	$0.000			
Total	$1.771	$0.000			
mary of Discounted Costs ($millions)					
Capital	$0.000	$0.000			
Maintenance & Resurf	$0.000	$0.000			
Salvage	$0.000	$0.000			
Total	$0.000	$0.000			Sum of discounted Costs
mary of Discounted Benefits					
Time Savings		$3.346			Savings due to higher speeds or shorter distance
Accident Savings		$0.000			Savings due to reduced accident rate or severity
Vehicle Operating Savings		$1.771			Often negative with increasing fuel at higher speed
Total Benefits		$5.117			
mary of Results (Present Values in $millions)					
Financial Account	$0.000	$0.000			
Incremental Cost		$0.000			= Proposed - Base
Customer Service Account	$5.117	$0.000			
Incremental Benefit		$5.117			=Base -Proposed
B/C Ratio		#DIV/0!			= Incremental benefits/incremental costs
Net Present Value		$5.117			= Incremental Benefits - Incremental Costs

nhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	254
0.262	0.08	Nitrogen Oxide	14
0.122	0.12	Hydrcarbons	12
		Annual Saving (tonnes/yr)	280

SHORTBEN – CATASTROPHIC FAILURE AVOIDANCE

SHORTBEN.XLS

Version **21 September 2008**

Required Inputs in Yellow
Optional Inputs in Green

Intended for use as a screening tool prior to more complete benefit cost analysis
Make an original copy before using.

Disbenefits due to 3.75 hour detour

	Base	Proposed		Notes
General Information				
Segment Length (km)	0.00	0.00		Important to show any differences between base & prop.
AADT	6,000.0	6,000		Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%		Compound growth
% Trucks	30.0%	30.0%		
Base Year	2012	2012		Should be same for base and proposed.
Benefit Period (yrs)	0.08333333	0.08333333	1 Month duration	Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%		
Financial Account				
Property ($)	$0	$0		
Engineering ($)	$0	$0		Typical 10% to 20% of Construction
Construction ($)	$0			
Total ($)	$0	$0		
Maintenance ($/km/yr)	$0	$0		Typical $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Resurfacing Cost ($/km)	$0	$0		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	$0	$0		Typical is 100% of ppty + 80% of Const.+ resurf. Residual
Present Value	$0	$0		Present Value of capital + maint.+ resurf. - salvage
Customer Service Account				
Time Costs				
% of AADT				% of AADT occurring in each period. For example
Peak	40.0%	40.0%		a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%		These splits are used to differentiate speed, delay and
Low	30.0%	30.0%		veh. Op. costs during different periods of the day.
Total	100.0%	100.0%		Total must equal 100%
Auto Speed (km/hr)				
Peak	100.0	100.0		Representative average speeds in peak and shoulder
Shoulder	100.0	100.0		periods are usually not much lower than speeds in
Low	100.0	100.0		the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				
Peak	100	100		
Shoulder	100	100		
Low	100	100		
Avg. Control Delay (sec/veh)				LOS for Signalized I/S (sec/veh)
Peak	0	13500	3.75 hours delay	
Shoulder	0	13500		
Low	0	13500		
% of Vehicles Stopping				% Vehicles Stopping during each period should be 0
Peak	100%			if control delay is 0. Values are used for fuel calculatons only.
Shoulder	100%			They do not impact delay calculations.
Low	100%			
Value of Travel Time				
Passenger Veh Occupancy	1.3	1.3		Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94		
Car ($/veh)	$41.44	$41.44	x2=non-work VTTS adjustment factor (UBCS Guidebook P. B37)	
Truck Driver ($/veh)	$64.70	$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjustm	Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1				Excludes cross street delay.
Car	0	5,748,750	$0 Year 1	
Truck	0	2,463,750	$0 Year 1	
Present Value of Time Costs ($mill)			$0 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	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	$7,759	$7,759		
Weighted Average	$214,436	$193,307		
Present Value Coll. Costs ($ mill)	$0.000	$0.000		
Vehicle Operating Costs (VOC)				
Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.116	0.116		
Composite Truck	0.505	0.505		35% SU, semi - 20%empty 30% full, Btrain- 7%empty 8% full
Control Delay Fuel (L/veh)				Additional fuel consumed due to control delay.
Car	0.095	6.494		includes deceleration, stop time and acceleration
Composite Truck	0.132	129.600		
Fuel (Litres/yr)				Annual Fuel Consumption (L)
Cars	145,328	9,954,536		
Composite Truck	86,396	85,147,200		
Fuel Price ($/L)				Price net of taxes is about 55% of pump price
Car	$0.90	$0.90		
Composite Truck	$0.98	$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)				
Car	$130,505	$8,939,173		Includes excess fuel consumption due to control delay, if any.
Composite Truck	$84,495	$83,273,962		
Other Vehicle Costs				
Car ($/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)	$0.358	$0.358		
Annual Cost ($/yr)				Composite values based on peak, shoulder and
Car	$130,505	$8,939,173		low period speeds. Assumes 0% grade.
Truck Time	$0	$50,851,800		
Truck Distance	$84,495	$83,273,962		
Present Value of VOC ($millions)				
Car	$0.011	$0.727		
Truck	$0.007	$10.913		
Total	$0.017	$11.640		
Summary of Discounted Costs ($millions)				
Capital	$0.000	$0.000		
Maintenance & Resurf	$0.000	$0.000		
Salvage	$0.000	$0.000		
Total	$0.000	$0.000		Sum of discounted Costs
Summary of Discounted Benefits				
Time Savings		($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		($43.977)		
Summary of Results (Present Values in $millions)				
Financial Account	$0.000	$0.000		
Incremental Cost		$0.000		= Proposed - Base
Customer Service Account	$0.017	$43.994		
Incremental Benefit		-$43.977		=Base -Proposed
B/C Ratio		#DIV/0!		= Incremental benefits/incremental costs
Net Present Value		-$43.977		= Incremental Benefits - Incremental Costs

LOS for Signalized I/S (sec/veh)

LOS	A	B	C	D	E
Max Delay	10	20	35	55	80

Greenhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	-255375
0.262	0.08	Nitrogen Oxide	-9545
0.122	0.12	Hydrcarbons	-11574
		Annual Saving (tonnes/yr)	-276494

SHORTBEN.XLS

Version **21 September 2008**

Required Inputs in Yellow
Optional Inputs in Green

Intended for use as a screening tool prior to more complete benefit cost analysis

Make an original copy before using.

Disbenefits due to detour bridge during repairs

	Base	Proposed		Notes
General Information				
Segment Length (km)	1.50	1.50		Important to show any differences between base & prop.
AADT	6,000.0	6,000		Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%		Compound growth
% Trucks	30.0%	30.0%		
Base Year	2012	2012		Should be same for base and proposed.
Benefit Period (yrs)	1.5	1.5	18 months	Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%		
Financial Account				
Property ($)	$0	$0		
Engineering ($)	$0	$0		Typical 10% to 20% of Construction
Construction ($)	$0			
Total ($)	$0	$0		
Maintenance ($/km/yr)	$0	$0		Typical $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Resurfacing Cost ($/km)	$0	$0		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	$0	$0		Typical is 100% of prpty + 80% of Const.+ resurf. Residual
Present Value	$0	$0		Present Value of capital + maint.+ resurf. - salvage
Customer Service Account				
Time Costs				
% of AADT				% of AADT occurring in each period. For example
Peak	40.0%	40.0%		a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%		These splits are used to differentiate speed, delay and
Low	30.0%	30.0%		veh. Op. costs during different periods of the day.
Total	100.0%	100.0%		Total must equal 100%
Auto Speed (km/hr)				
Peak	100.0	50.0	reduced speed to 50km	Representative average speeds in peak and shoulder
Shoulder	100.0	50.0		periods are usually not much lower than speeds in
Low	100.0	50.0		the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				
Peak	100	50		
Shoulder	100	50		
Low	100	50		
Avg. Control Delay (sec/veh)				
Peak	0	0		
Shoulder	0	0		
Low	0	0		
% of Vehicles Stopping				% Vehicles Stopping during each period should be 0
Peak	100%			if control delay is 0. Values are used for fuel calculatons only.
Shoulder	100%			They do not impact delay calculations.
Low	100%			
Value of Travel Time				
Passenger Veh Occupancy	1.3	1.3		Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94		
Car ($/veh)	$41.44	$41.44	x2=non-work VTTS adjustment factor (UBCS Guidebook P. B37)	
Truck Driver ($/veh)	$64.70	$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjustm	Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1				Excludes cross street delay.
Car	22,995	45,990	$953,005 Year 1	
Truck	9,855	19,710	$637,599 Year 1	
Present Value of Time Costs ($mill)			$1,590,604 Year 1 sum	
for Benefit Period				
Car	$1.353	$2.706		
Truck	$0.905	$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	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	$7,759	$7,759		
Weighted Average	$214,436	$193,307		
Present Value Coll. Costs ($ mill)	$0.000	$0.000		
Vehicle Operating Costs (VOC)				
Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.116	0.091		
Composite Truck	0.505	0.354		35%SU, semi - 20%empty 30% full, Btrain- 7%empty 8% full
Control Delay Fuel (L/veh)				Additional fuel consumed due to control delay.
Car	0.095	0.000		includes deceleration, stop time and acceleration
Composite Truck	0.132	0.000		
Fuel (Litres/yr)				Annual Fuel Consumption (L)
Cars	410,944	208,990		
Composite Truck	584,379	348,433		
Fuel Price ($/L)				Price net of taxes is about 55% of pump price
Car	$0.90	$0.90		
Composite Truck	$0.98	$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)				
Car	$369,027	$187,673		Includes excess fuel consumption due to control delay, if any.
Composite Truck	$571,522	$340,768		
Other Vehicle Costs				
Car ($/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)	$0.358	$0.358		
Annual Cost ($/yr)				Composite values based on peak, shoulder and
Car	$611,625	$430,270		low period speeds. Assumes 0% grade.
Truck Time	$203,407	$406,814		
Truck Distance	$924,061	$693,307		
Present Value of VOC ($millions)				
Car	$0.868	$0.611		
Truck	$1.601	$1.562		
Total	$2.469	$2.173		
Summary of Discounted Costs ($millions)				
Capital	$0.000	$0.000		
Maintenance & Resurf	$0.000	$0.000		
Salvage	$0.000	$0.000		
Total	$0.000	$0.000		Sum of discounted Costs
Summary of Discounted Benefits				
Time Savings		($2.258)		Savings due to higher speeds or shorter distance
Accident Savings		$0.000		Savings due to reduced accident rate or severity
Vehicle Operating Savings		$0.296		Often negative with increasing fuel at higher speed
Total Benefits		($1.962)		
Summary of Results (Present Values in $millions)				
Financial Account	$0.000	$0.000		
Incremental Cost		$0.000		= Proposed - Base
Customer Service Account	$4.728	$6.690		
Incremental Benefit		-$1.962		=Base -Proposed
B/C Ratio		#DIV/0!		= Incremental benefits/incremental costs
Net Present Value		-$1.962		= Incremental Benefits - Incremental Costs

LOS for Signalized I/S (sec/veh)

LOS	A	B	C	D	E
Max Delay	10	20	35	55	80

Greenhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	1121
0.262	0.08	Nitrogen Oxide	72
0.122	0.12	Hydrcarbons	53
		Annual Saving (tonnes/yr)	1246

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SHORTBEN.XLS

Version **21 September 2008**

Required Inputs in Yellow
Optional Inputs in Green

Intended for use as a screening tool prior to more complete benefit cost analysis
Make an original copy before using.

Disbenefits due to added traffic on detour route

	Base	Proposed		Notes
General Information				
Segment Length (km)	625.00	625.00	Average distance hwy 3 & hwy 5	Important to show any differences between base & prop.
AADT	3,500.0	3,500	Alternate route traffic	Base & Proposed AADT should normally be the same.
Annual Traffic Growth (%)	1.50%	1.50%		Compound growth
% Trucks	30.0%	30.0%		
Base Year	2012	2012		Should be same for base and proposed.
Benefit Period (yrs)	0.08333333	0.08333333	1 month	Assumes 1 yr of construction prior to benefits starting.
Discount Rate	6%	6%		
Financial Account				
Property ($)	$0	$0		
Engineering ($)	$0	$0		Typical 10% to 20% of Construction
Construction ($)	$0			
Total ($)	$0	$0		
Maintenance ($/km/yr)	$0	$0		Typical $4,000/Ln-km for 2 Ln and $5,500/Ln-km for 4-Ln
Resurfacing Cost ($/km)	$0	$0		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	$0	$0		Typical is 100% of ppty + 80% of Const.+ resurf. Residual
Present Value	$0	$0		Present Value of capital + maint.+ resurf. - salvage
Customer Service Account				
Time Costs				
% of AADT				% of AADT occurring in each period. For example
Peak	40.0%	40.0%		a 3 hr peak period with 10% of AADT per hr = 30% of AADT
Shoulder	30.0%	30.0%		These splits are used to differentiate speed, delay and
Low	30.0%	30.0%		veh. Op. costs during different periods of the day.
Total	100.0%	100.0%		Total must equal 100%
Auto Speed (km/hr)				
Peak	100.0	90.0	10km speed reduction	Representative average speeds in peak and shoulder
Shoulder	100.0	90.0		periods are usually not much lower than speeds in
Low	100.0	90.0		the low period unless demand is exceeding 80% of capacity.
Truck Speed (km/hr)				
Peak	100	90		
Shoulder	100	90		
Low	100	90		
Avg. Control Delay (sec/veh)				LOS for Signalized I/S (sec/veh)
Peak	0	0		
Shoulder	0	0		
Low	0	0		
% of Vehicles Stopping				% Vehicles Stopping during each period should be 0
Peak	100%			if control delay is 0. Values are used for fuel calculatons only.
Shoulder	100%			They do not impact delay calculations.
Low	100%			
Value of Travel Time				
Passenger Veh Occupancy	1.3	1.3		Use the same for base and proposed.
Value of Time ($/occupant)	$15.94	$15.94		
Car ($/veh)	$41.44	$41.44	x2=non-work VTTS adjustment factor (UBCS Guidebook P. B37)	
Truck Driver ($/veh)	$64.70	$64.70	x2 = value of cargo, TTI 1997; x1.23 = adjustm	Assumes occupancy 1.0
Travel Time (veh-hrs) in Year 1				Excludes cross street delay.
Car	5,589,063	6,210,069	$231,633,106 Year 1	
Truck	2,395,313	2,661,458	$154,971,928 Year 1	
Present Value of Time Costs ($mill)			$386,605,034 Year 1 sum	
for Benefit Period				
Car	$18.846	$20.941		
Truck	$12.609	$14.010		
Total	$31.456	$34.951		
Accident Costs				
Rate (coll/mvk)	0.59	0.61		
Severity				
% Fatal	2.6%	2.8%		
% Injury	41.0%	40.7%		
% PDO	56.5%	56.5%		
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		
PDO	$7,759	$7,759		
Weighted Average	$214,436	$229,571		
Present Value Coll. Costs ($ mill)	$8.219	$9.053		
Vehicle Operating Costs (VOC)				
Running Fuel (L/km)				Fuel consumed at running speed, no control delay
Car	0.116	0.103		
Composite Truck	0.505	0.450		35% SU, semi - 20%empty 30% full, Btrain- 7%empty 8% full
Control Delay Fuel (L/veh)				Additional fuel consumed due to control delay.
Car	0.095	0.000		includes deceleration, stop time and acceleration
Composite Truck	0.132	0.000		
Fuel (Litres/yr)				Annual Fuel Consumption (L)
Cars	64,644,036	57,451,650		
Composite Truck	121,087,933	107,869,545		
Fuel Price ($/L)				Price net of taxes is about 55% of pump price
Car	$0.90	$0.90		
Composite Truck	$0.98	$0.98		Truck fuel is usually diesel which is less costly than gasoline.
Fuel Cost ($/yr)				
Car	$58,050,344	$51,591,582		Includes excess fuel consumption due to control delay, if any.
Composite Truck	$118,423,999	$105,496,415		
Other Vehicle Costs				
Car ($/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)	$0.358	$0.358		
Annual Cost ($/yr)				Composite values based on peak, shoulder and
Car	$117,014,954	$110,556,191		low period speeds. Assumes 0% grade.
Truck Time	$49,439,250	$54,932,500		
Truck Distance	$204,110,590	$191,183,007		
Present Value of VOC ($millions)				
Car	$9.521	$8.995		
Truck	$20.630	$20.025		
Total	$30.150	$29.020		
Summary of Discounted Costs ($millions)				
Capital	$0.000	$0.000		
Maintenance & Resurf	$0.000	$0.000		
Salvage	$0.000	$0.000		
Total	$0.000	$0.000		Sum of discounted Costs
Summary of Discounted Benefits				
Time Savings		($3.495)		Savings due to higher speeds or shorter distance
Accident Savings		($0.834)		Savings due to reduced accident rate or severity
Vehicle Operating Savings		$1.130		Often negative with increasing fuel at higher speed
Total Benefits		($3.198)		
Summary of Results (Present Values in $millions)				
Financial Account	$0.000	$0.000		
Incremental Cost		$0.000		= Proposed - Base
Customer Service Account	$69.825	$73.023		
Incremental Benefit		-$3.198		=Base -Proposed
B/C Ratio		#DIV/0!		= Incremental benefits/incremental costs
Net Present Value		-$3.198		= Incremental Benefits - Incremental Costs

LOS for Signalized I/S (sec/veh)

LOS	A	B	C	D	E
Max Delay	10	20	35	55	80

Greenhouse Gas Reduction

Gas	Dies		
Kg/Litre			
2.36	2.73	Carbon Dioxide	53062
0.262	0.08	Nitrogen Oxide	2968
0.122	0.12	Hydrcarbons	2490
		Annual Saving (tonnes/yr)	58521

SHORTBEN – CATASTROPHIC FAILURE AVOIDANCE SUMMARY

Sum of Dis-benefits	% Chance of Catastrophic Failure		Detour Construction Cost	PV of disbenefits over 25 years 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

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Appendix 3. HCS ANALYSIS

Malakwa Bridge and 4-Laning

Input Assumptions Base Case: HCS Two-Lane Module

Length:	2.8	km	study area
AADT:	6,085	vpd	
Free-flow Speed:	100	km/h	<200 vph
Analysis Hourly Volume:	variable	vpd	input hourly analysis volume
Grade:	level terrain		Photolog
Length of Grade:	n/a	km	not applicable to module
% Trucks:	30%		P-22-1 (including 20% of 6 to 12.5m bin)
%RVs:	13%		50% of 6 to 12.5m length bin
% No-passing:	60%		Google Street View
Access Points/Km:	1.1		Google Street View

Assumptions Proposed Case: HCS Multilane Module - Operational Analysis

Length:	2.8	km	study area
AADT:	6,085	vpd	
Free-flow Speed:	100	km/h	<200 vph
Analysis Hourly Volume:	variable	vpd	input hourly analysis volume
Grade:	level terrain		Photolog
Length of Grade:	n/a	km	not applicable to module
% Trucks:	30%		max. 25% multilane module
%RVs:	13%		50% of 6 to 12.5m length bin
Free Flow Speed	100	km/h	proposed design speed
Access Points/Km:	1.1		same as Base Case

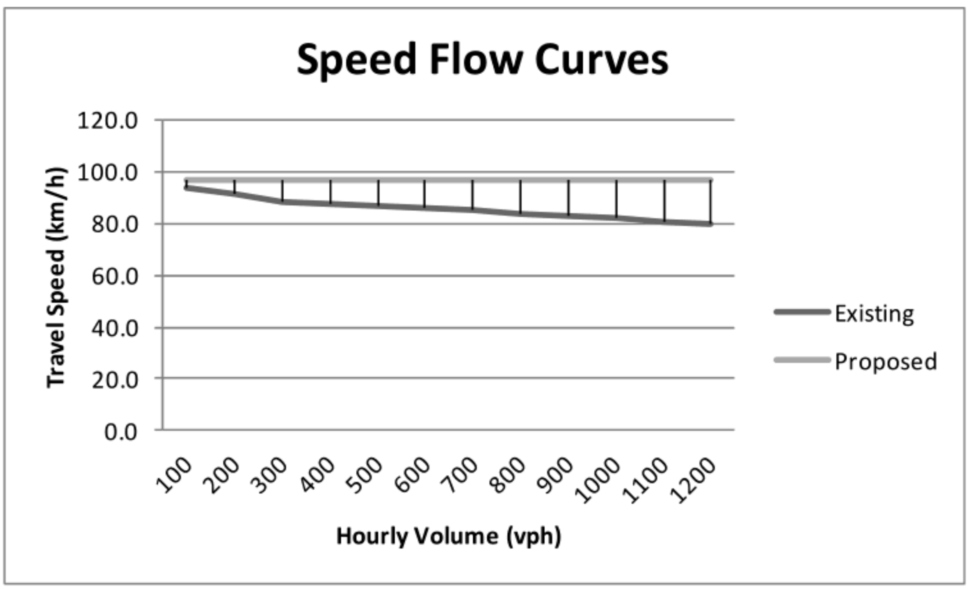
Highway Capacity Software - Output Summaries:

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8	Scenario 9	Scenario 10	Scenario 11	Scenario 12	Units
Hourly 2-Way Volume:	100	200	300	400	500	600	700	800	900	1000	1100	1200	vpd
Directional Hourly Volume:	50	100	150	200	250	300	350	400	450	500	550	600	vpd (assume 50/50 for directional)
Average Travel Speed (2-Lane):	93.6	91.2	88.4	87.3	86.8	85.9	84.9	83.8	82.8	82	80.8	79.6	km/h
LoS (2-Lane):	A	B	B	C	C	C	D	D	D	D	D	D	
V/C Ratio (2-Lane):	0.04	0.08	0.12	0.16	0.18	0.21	0.25	0.28	0.32	0.34	0.38	0.41	
% Time Following (2-Lane):	31.8%	39.2%	48.6%	55.0%	59.2%	62.5%	65.3%	68.9%	71.6%	73.5%	74.9%	77.0%	
Average Travel Speed (4-Lane):	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	96.7	km/h
LoS (4- Lane):	A	A	A	A	A	A	A	A	A	A	A	A	
Density (4-Lane):	0.3	0.7	1.0	1.3	1.7	2.0	2.4	2.7	3.0	3.4	3.7	4.1	pc/km/ln

Speed Flow Curves:

Treated Section:

	Base Case: Existing 2-Lane Hwy				Proposed Case: 4-Lane			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	A	0.04	31.8%	96.7	A	0.3	3.1	3.3%
100	91.2	B	0.08	39.2%	96.7	A	0.7	5.5	6.0%
150	88.4	B	0.12	48.6%	96.7	A	1.0	8.3	9.4%
200	87.3	C	0.16	55.0%	96.7	A	1.3	9.4	10.8%
250	86.8	C	0.18	59.2%	96.7	A	1.7	9.9	11.4%
300	85.9	C	0.21	62.5%	96.7	A	2.0	10.8	12.6%
350	84.9	D	0.25	65.3%	96.7	A	2.4	11.8	13.9%
400	83.8	D	0.28	68.9%	96.7	A	2.7	12.9	15.4%
450	82.8	D	0.32	71.6%	96.7	A	3.0	13.9	16.8%
500	82.0	D	0.34	73.5%	96.7	A	3.4	14.7	17.9%
550	80.8	D	0.38	74.9%	96.7	A	3.7	15.9	19.7%
600	79.6	D	0.41	77.0%	96.7	A	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 30th 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.

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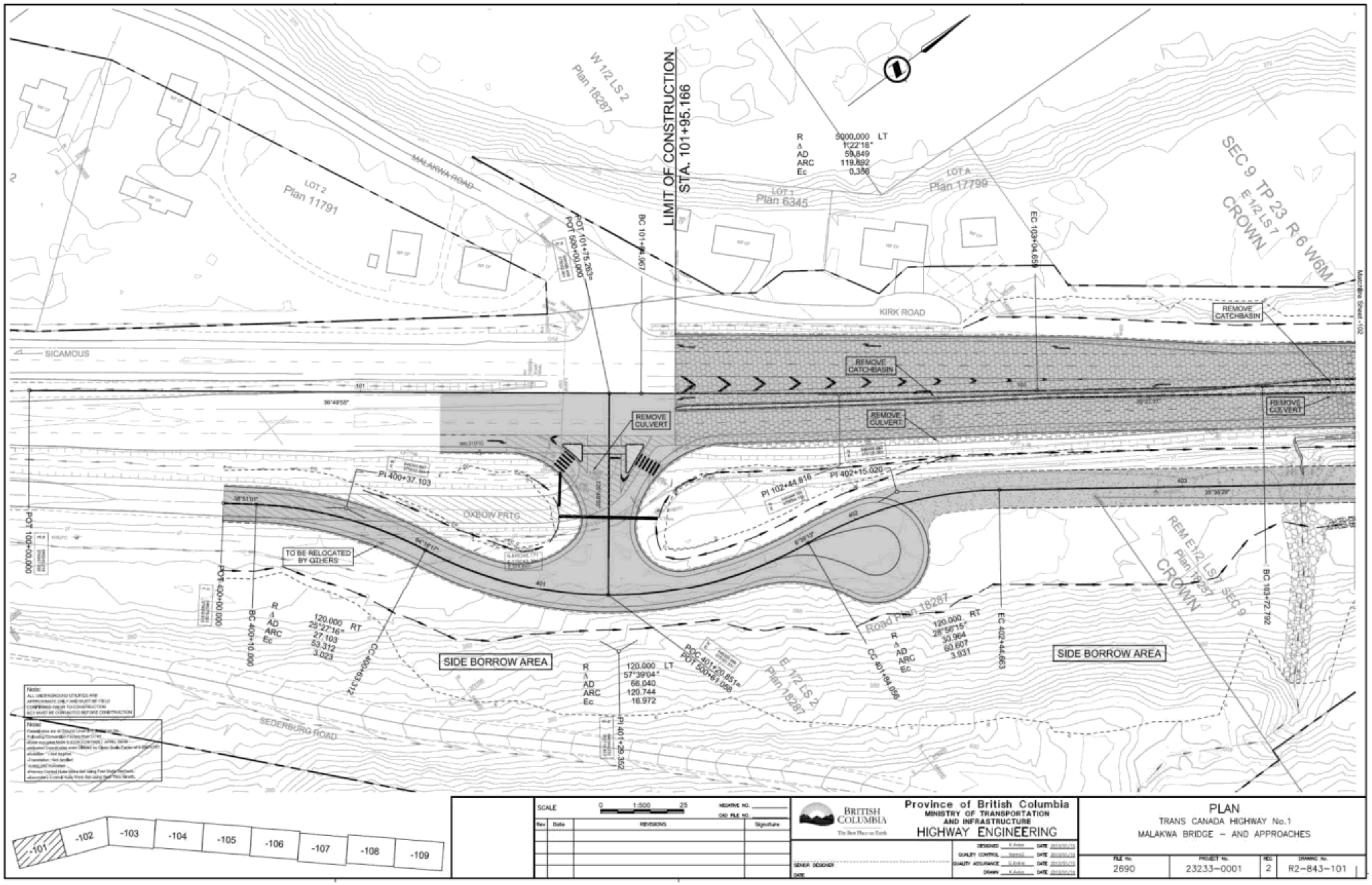

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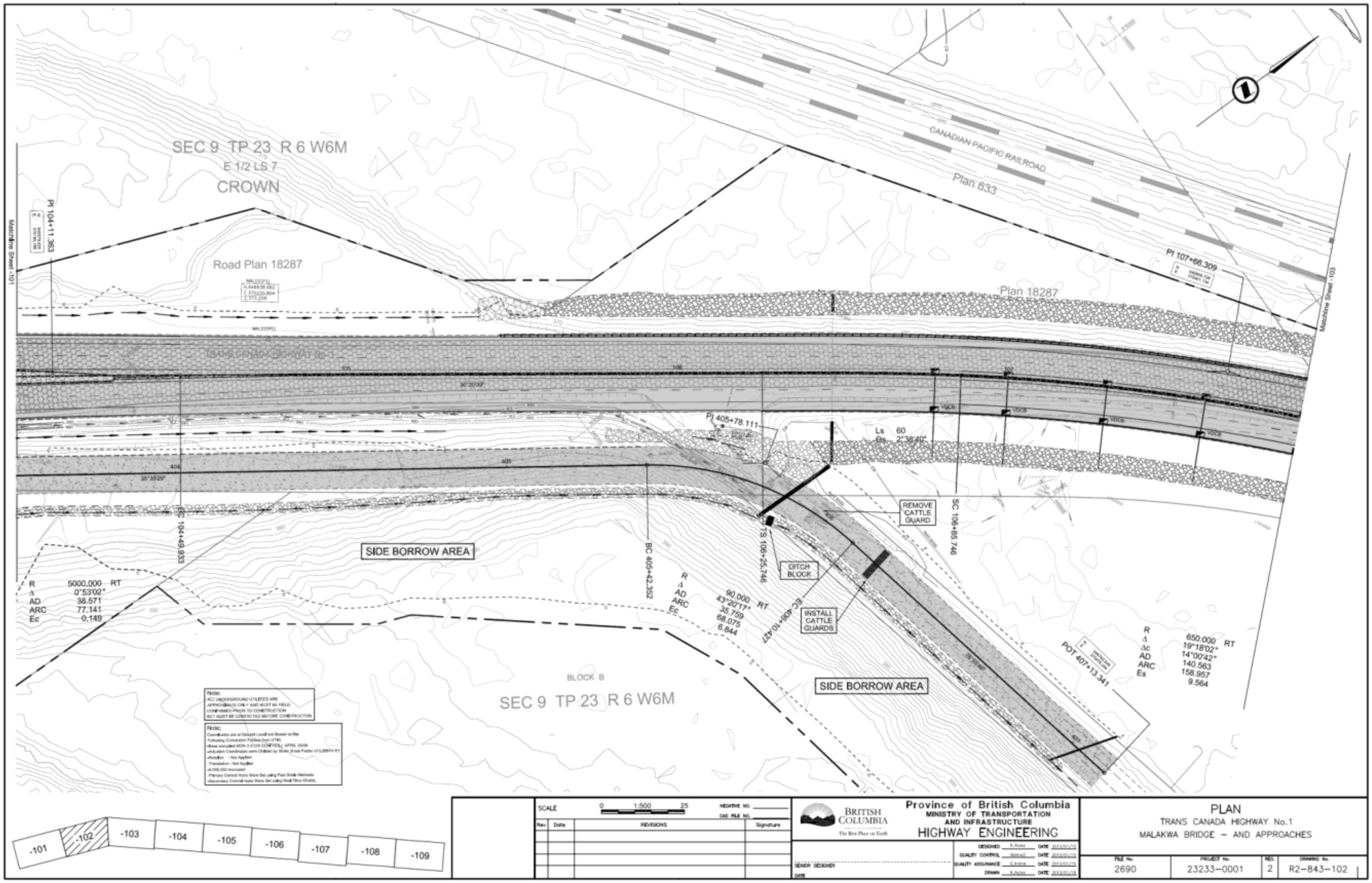

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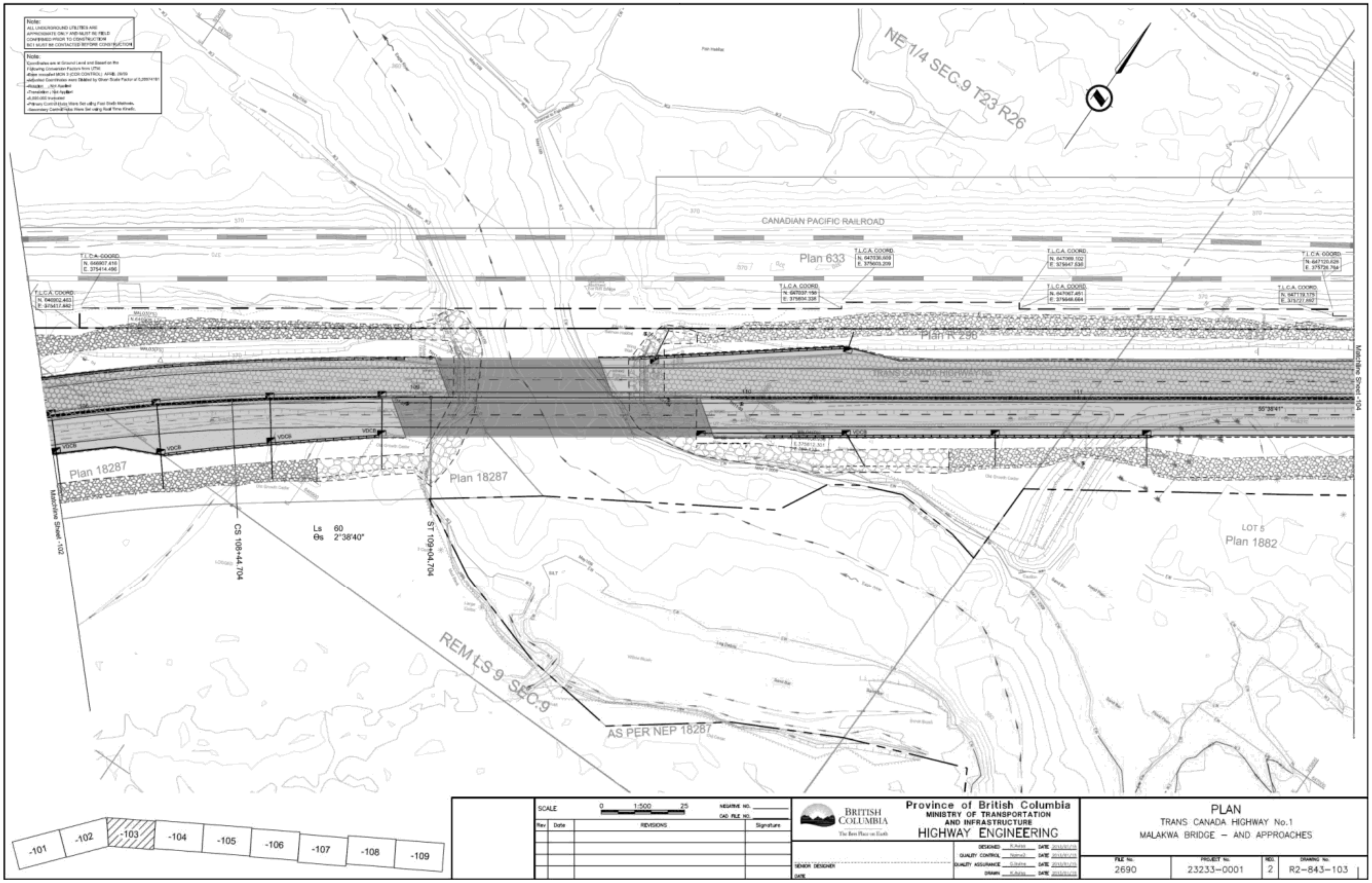

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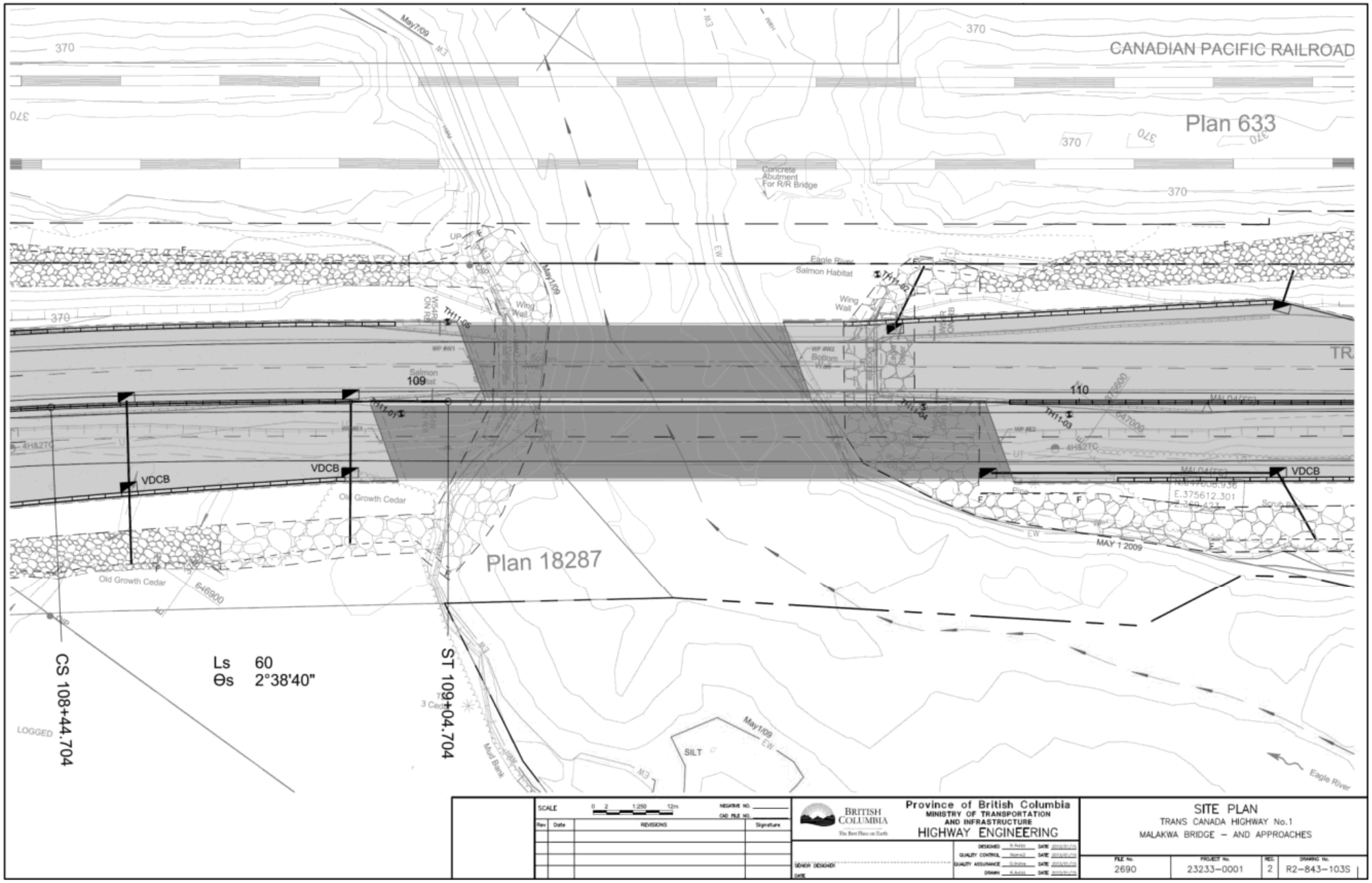
CANADIAN PACIFIC RAILROAD
Plan 633
Concrete Abutment For R/R Bridge
Eagle River Salmon Habitat
Wing Wall
Bottom Wall
109
110
VDCB
VDCB
VDCB
Old Growth Cedar
Old Growth Cedar
Plan 18287
Ls 60
Θs 2°38'40"
CS 108+44.704
ST 109+04.704
LOGGED
SILT
Mud Bank
MAY 1 2009
Eagle River
Province of British Columbia
MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
HIGHWAY ENGINEERING
SITE PLAN
TRANS CANADA HIGHWAY No.1
MALAKWA BRIDGE – AND APPROACHES
2690
23233-0001
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R2-843-103S

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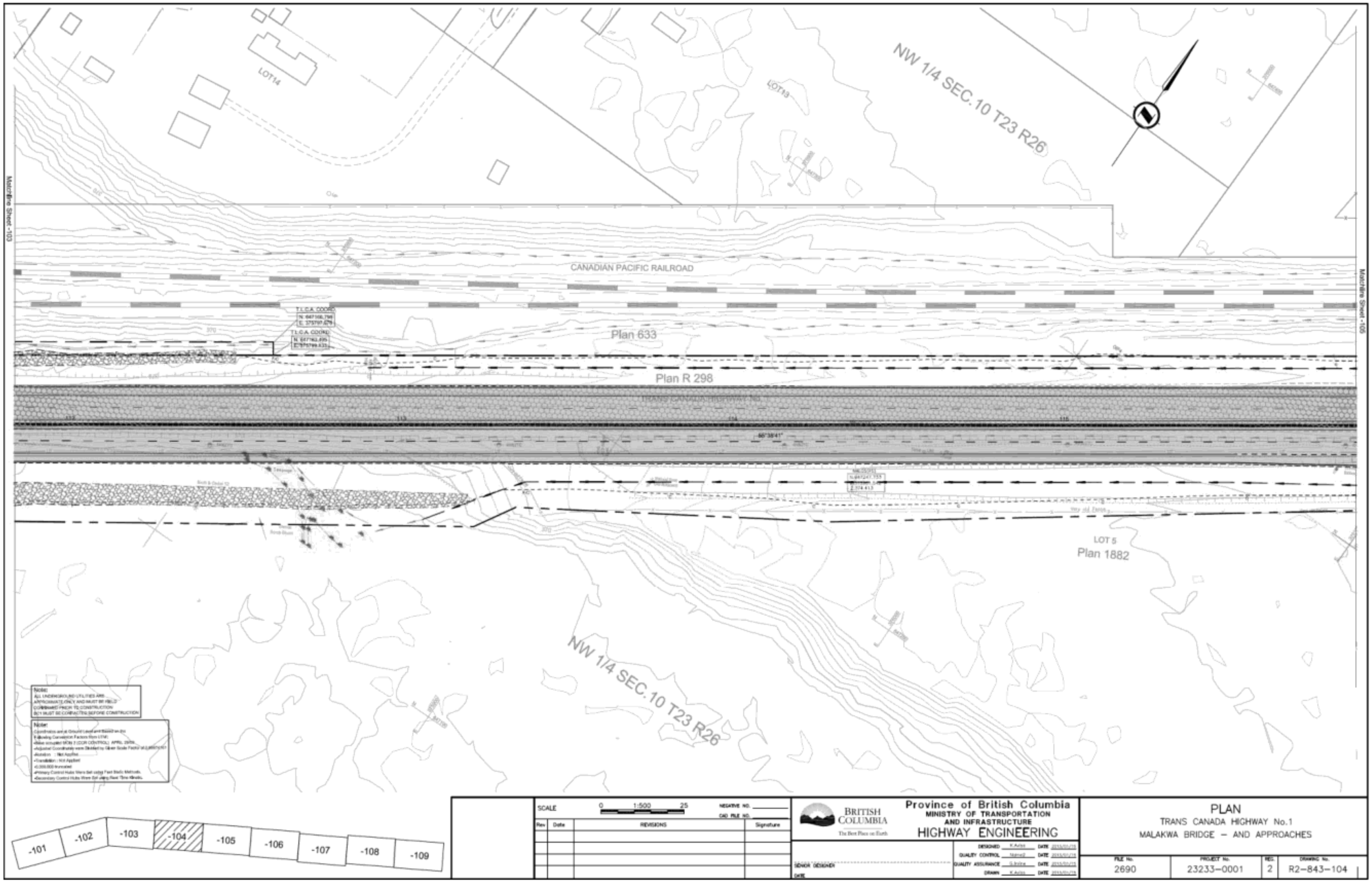

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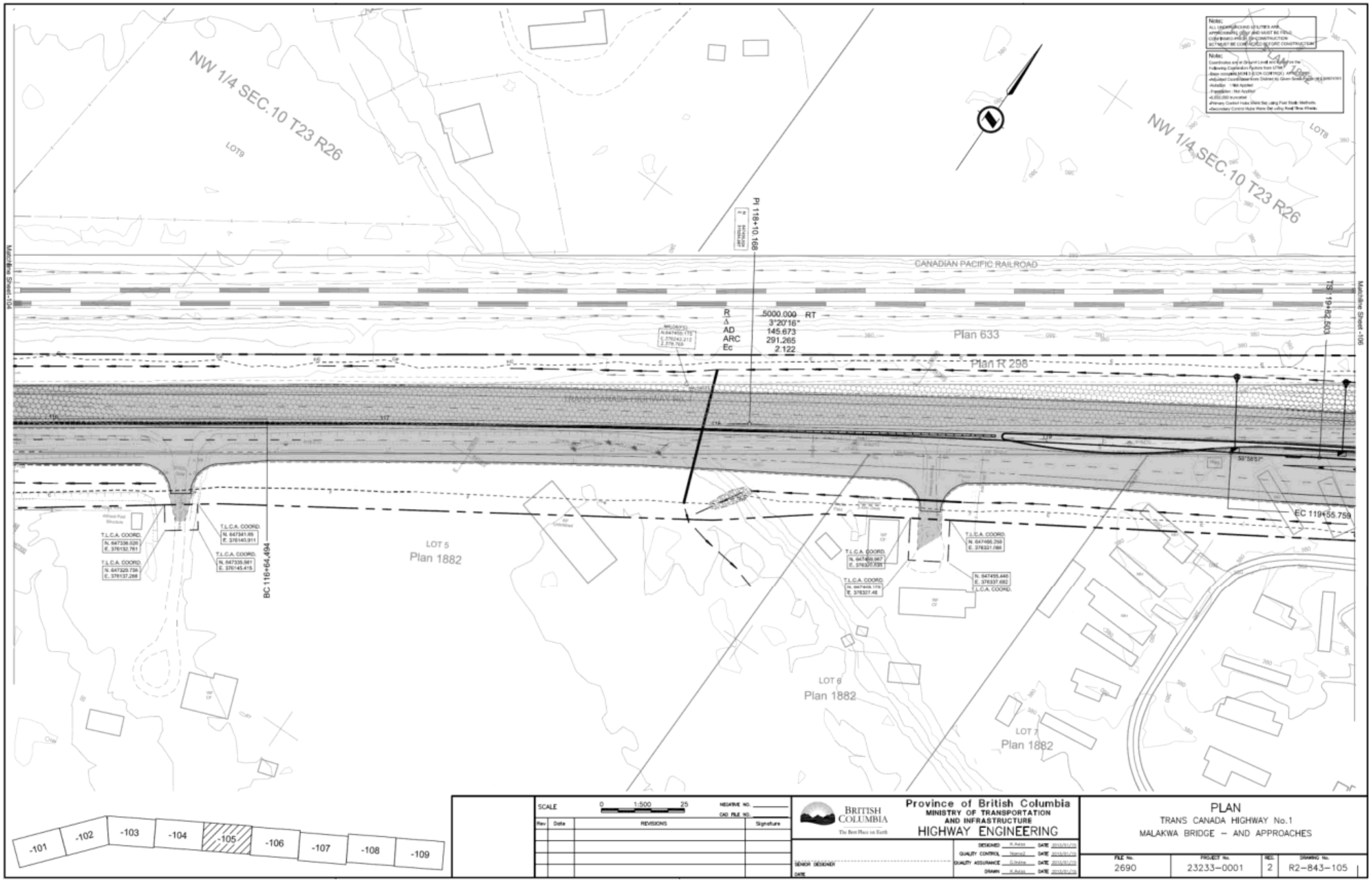
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LOT9
NW 1/4 SEC.10 T23 R26
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R 5000.000 RT
Δ 3°20'16"
AD 145.673
ARC 291.265
Ec 2.122
Plan 633
Plan R 298
TS 119+82.503
EC 119+55.759
BC 116+64.494
LOT 5
Plan 1882
LOT 6
Plan 1882
LOT 7
Plan 1882
T.L.C.A. COORD.
Matchline Sheet -104
Matchline Sheet -106
-101
-102
-103
-104
-105
-106
-107
-108
-109
SCALE
1:500
REVISIONS
Province of British Columbia
MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE
HIGHWAY ENGINEERING
PLAN
TRANS CANADA HIGHWAY No.1
MALAKWA BRIDGE – AND APPROACHES
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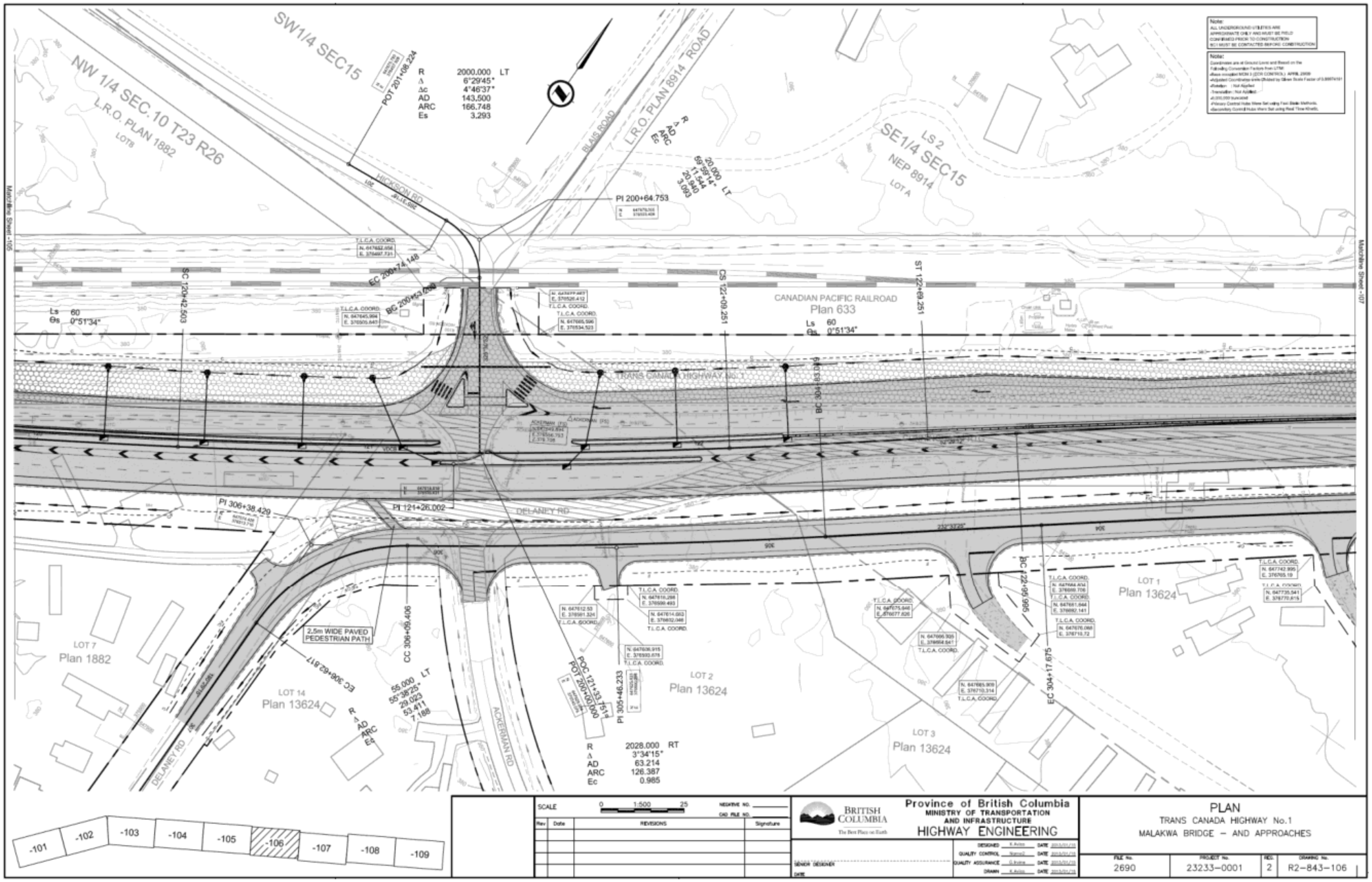

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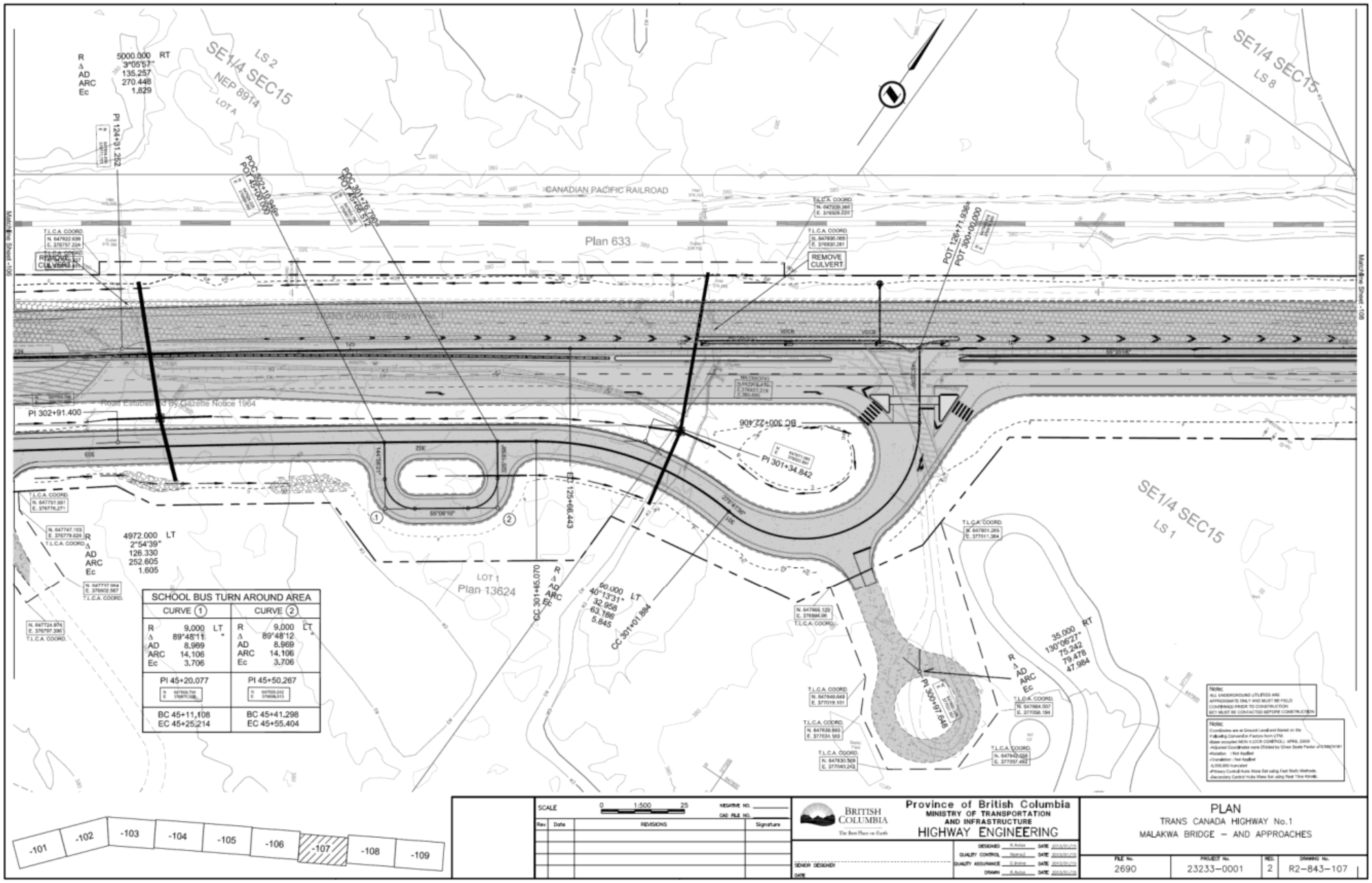

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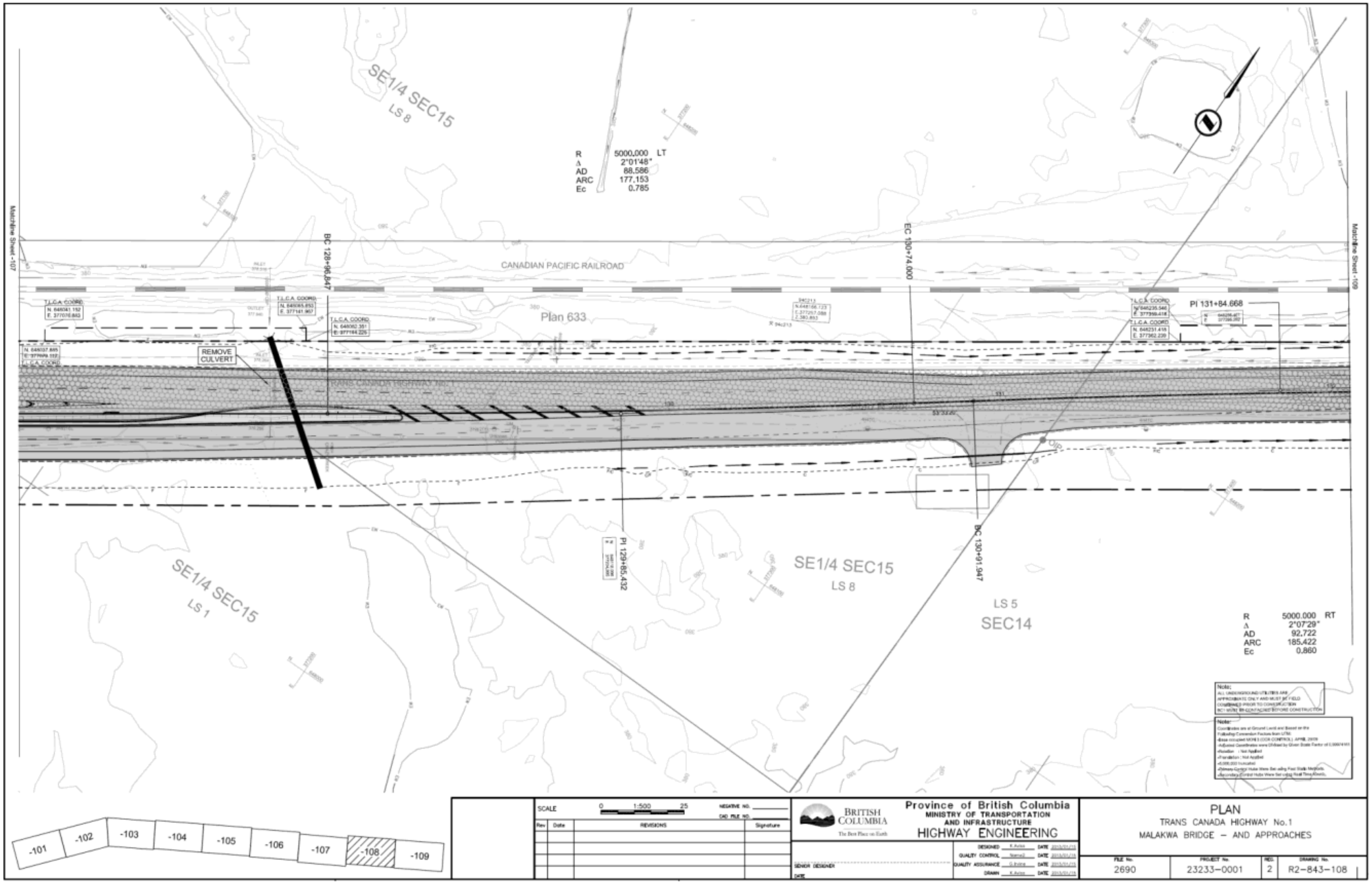

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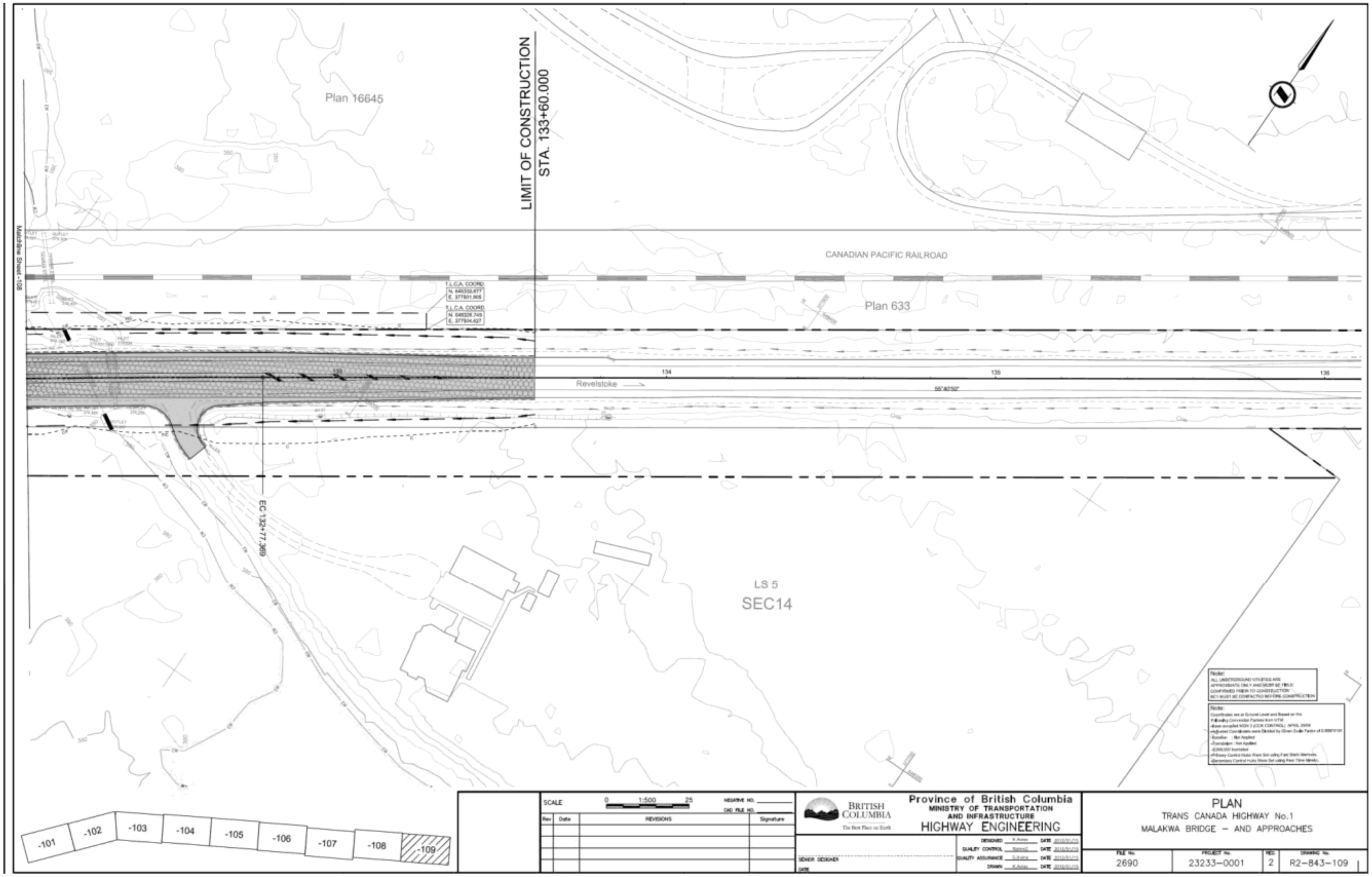

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Appendix 5. SAFETY DATA

Collision Details:

HIGHNUM	SEGNUM	KMMARK	CLSNDATE	CLSNTIME	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	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	

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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.

Route	Description	Start Segment	Start Km	End Segment	End Km
1	Malakwa Bridge and 4-Laning	962	20.1	962	23.2

Start Km	20.1
End km	23.2
Total Km	3.20

Leave blank except when prompted to enter a value or put in 1 km if analysing intersections

Year	Fatal	Injury	Property Damage	P-22-1 Perm Count Total	AADT	Estimate?	Annual Vol.	mV	A/Mv(km)
2002				0	5,440	No	1,985,600	1.99	0.00
2003				0	5,383	No	1,964,795	1.96	0.00
2004				0	5,572	No	2,033,899	2.03	0.00
2005				0	5,621	No	2,051,730	2.05	0.00
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 =	1.36	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	
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