

Memorandum

To:	Chuck Hutchinson, P.Eng.	Date:	23 May, 2007
Company:	BC MoTH, Planning and Major Projects	From:	Peter Lyall, ptoe, P.Eng
Re:	2007 Update for Microbencost Default Values	Project #	MOT-76

1 Purpose

This memo documents the default data needed to bring the benefit cost model, MicroBencost (MBC) up to date for 2007 values for British Columbia. The default data file BCDEF07.DD, may be used for MBC versions 1.0 or version 2. This data set replaces the previous default data set BCDEF03.DD. Appendix B compares the results of several projects using the 2007 and 2003 default values. Results suggest the B/C ratio generally increases by about 0.1.

The steps to implement the default data file for MBC are:

1. Copy the default data file BCDEF07.DD into the Microbencost directory.
2. Start MBC
3. Select CONFIGURE from the MBC Menu
4. Enter the new default data file name using the full path name
5. Save the default data setting.

The default data includes changes to:

- Vehicle Operating Costs
- Value of time
- Accident Costs
- Maintenance Costs.

New in this edition – Truck depreciation has been segregated into time related and distance related components. The time related component has been moved from the vehicle operating cost to the time cost default data and will provide a more realistic estimate of time and VOC savings related to commercial traffic.

Historical – The original default economic data were developed by MoT Planning Services Branch in 1992 as part of their program to develop tools for economic analysis of highway improvements. These values were integrated into the UBCS (User Benefit Cost Spreadsheets) model developed concurrently by the Ministry. In 1997 the default values were updated and the Microbencost model was implemented to replace UBCS.

The default values were subsequently updated in 2003 and again in 2007 with this edition of the default values.

2 Vehicle Operating Costs

2.1 Autos

Fuel – The fuel price net of taxes is used for social cost benefit. Gasoline and diesel are used as proxy for car and truck fuel in Microbencost

Cents/Litre	Gasoline	Diesel
Fuel	76.3	75.9
Taxes	32.1	26.2
Total	108.4	102.1

Oil - \$4.00 per litre

Tires - The following passenger tire prices were used to represent each vehicle category.

Category	Tire	Price (\$/tire)	Tires /Veh	\$/Veh
Small pass	Pirelli P175/70R13	\$84	4	\$336
Med/large pass	BF Goodrich P225/60R16	\$144	4	\$576
Pickup/van	BF Goodrich P265/70R17 SUV	\$238	4	\$952
Bus	11 x 24.5	\$634	8	\$5,073

Vehicle Price - The price for cars and buses was factored up from 2003 using the CPI to get 2007 prices.

Category	Average
Small pass	\$19,670
Med/large pass	\$29,849
Pickup/van	\$34,190
Buses	\$143,598

Maintenance - The Canadian Automobile Association publishes typical maintenance and repair costs in their annual brochure "2005 Driving Costs" based on a Chevrolet Cavalier at \$.025/km and a Dodge Caravan at \$.029/km. These would reflect the "small" and "medium" categories in Microbencost. Maintenance and repair for the "Pickup/Van"

category is estimated in Exhibit 2-1 assuming an additional 5% over the medium category. Maintenance costs for buses were assumed equal to a 3-axle truck.

Exhibit 2-1 Unit Prices for Automobile Operating Costs 2007

Vehicle Description	Fuel	Oil	Tires	Depreciation	Maint & Repairs
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2007 Unit Costs

Metric	\$/L	\$/L	\$/veh	Price \$/veh	\$/1000 km
Small pass	\$0.763	\$4.00	\$336	\$19,670	\$25.00
Med/large pass	\$0.763	\$4.00	\$576	\$29,849	\$29.00
Pickup/van	\$0.763	\$4.00	\$952	\$34,190	\$30.45
Buses	\$0.759	\$4.00	\$5,073	\$143,598	\$427.34

US Units	\$/usgal	\$/Quart	\$/veh	\$/veh	\$/1000 miles
Small pass	\$2.89	\$3.79	\$336	\$19,670	\$40.25
Med/large pass	\$2.89	\$3.79	\$576	\$29,849	\$46.69
Pickup/van	\$2.89	\$3.79	\$952	\$34,190	\$49.02
Buses	\$2.87	\$3.79	\$5,073	\$143,598	\$688.02

US Units

Comparable 2003 Unit Costs

Vehicle Description	Fuel \$/usgal-	Oil -\$/qrt-	Tires -\$/veh-	Depreciation -\$/veh-	Maint & Repairs -\$/1000 miles-
Small pass	1.51	2.33	244	18,613	\$46.69
Med/large pass	1.51	2.33	348	28,245	\$49.02
Pickup/van	1.51	2.33	568	32,353	\$51.36
Buses	1.67	3.80	4,800	135,882	\$658.42

2.2 Trucks

Fuel - Excluding taxes, the current price for diesel fuel is \$.759/L.

Oil - \$4.00/litre.

Tires - The default value used in 2003 was \$510/tire. The 2007 value is \$550/tire

Truck Configuration	Tires	Unit Cost	Total
2-Axle Straight Van	6	\$550	\$3,300
3-Axle Straight Van	10	\$550	\$5,500
4-Axle Van Semi	14	\$550	\$7,700
5-Axle Van Semi	18	\$550	\$9,900
6-Axle Van Semi	22	\$550	\$12,100
8-Axle B-Train	30	\$550	\$16,500

Maintenance and repair – These are estimated by Trimac 2005 to be 5% of total cost per km for straight trucks and 10% for combination trucks.

Value for Depreciation (Exhibit 2-2) – In Microbencost, the “Value for Depreciation” for trucks is intended to reflect “use-related depreciation”, or the decline in value of the vehicle according to the number of kilometers it has been driven over its life. The default value used in the model has traditionally been the full initial cost of the truck.

This is fundamentally incorrect because depreciation is a function of both distance and time, not just distance. The portion of a truck’s cost which is subject to use (distance) related depreciation (\$/km) is about 28% of its initial cost¹. The remaining 72% is a fixed cost of ownership which is a function of time, not distance and should be expressed in the model as a time cost. For example if a new 6-axle tractor trailer costs \$165,780 then the portion subject to use related depreciation (\$/km cost) is 28% or \$45,959.

In this edition of the default values, the distance and time related components of truck depreciation have been separated. There is no a change in the overall cost, just a more realistic means of allocating the cost. If for example, all the depreciation were allocated to distance traveled, there would be no cost to a truck sitting in traffic other than the driver’s time and idle fuel consumption. If some of this depreciation cost is allocated to a time basis, this correctly reflects the opportunity cost of the truck asset. As applied to benefit cost, this will give greater value to congestion relief projects since trucks will

¹ This is based on a regression analysis of 37 used truck listings giving the truck price, year and kilometers by Apex Engineering in 2003.

have a higher time value. Time values are presented in Section 3. Values for distance related depreciation are presented in Exhibit 2-2.

Exhibit 2-2 Truck Values for Calculating Distance Related Depreciation

	Tractor	Trailer	Total Price	28% Portion Subject to Distance Related Depreciation
2005 Trimac				
2-Axle Straight	\$82,689	\$0	\$82,689	\$22,924
3-Axle Straight	\$99,790	\$0	\$99,790	\$27,665
4-Axle Semi	\$111,041	\$29,960	\$141,001	\$39,090
5-Axle Semi	\$121,910	\$29,960	\$151,870	\$42,103
6-Axle Semi	\$129,400	\$36,380	\$165,780	\$45,959
8-Axle Train	\$134,750	\$62,060	\$196,810	\$54,561
Estimated 2007				
2-Axle Straight	\$87,385	\$0	\$87,385	\$24,226
3-Axle Straight	\$105,458	\$0	\$105,458	\$29,236
4-Axle Semi	\$117,347	\$31,661	\$149,008	\$41,309
5-Axle Semi	\$128,833	\$31,661	\$160,495	\$44,494
6-Axle Semi	\$136,749	\$38,446	\$175,195	\$48,569
8-Axle Train	\$142,402	\$65,584	\$207,987	\$57,660

The 2007 and 2003 unit costs for truck vehicle operating costs are summarized in Exhibit 2-3. The same unit prices are used for urban or rural environments.

Exhibit 2-3 Unit Prices for Truck Operating Costs

2007 Unit Costs					
Vehicle Description	Fuel	Oil	Tires	Value for distance related Depreciation	Maintenance and Repairs
	-\$/gal-	-\$/qrt-	-\$/veh-	-\$/veh-	-\$/1000 miles-
2-Axle Single Unit	\$2.87	\$3.79	\$3,300	\$24,226	\$625
3-Axle Single Unit	\$2.87	\$3.79	\$5,500	\$29,236	\$688
4-Axle Semi	\$2.87	\$3.79	\$7,700	\$41,309	\$656
5-Axle Semi	\$2.87	\$3.79	\$9,900	\$44,494	\$587
6-Axle Semi	\$2.87	\$3.79	\$12,100	\$48,569	\$689
A, B or C Train	\$2.87	\$3.79	\$16,500	\$57,660	\$772

Comparable 2003 Unit Costs

Vehicle Description	Fuel -\$/gal-	Oil -\$/qrt-	Tires -\$/veh-	Value for distance related Depreciation -\$/veh-	Maintenance and Repairs -\$/1000 miles-
2-Axle Single Unit	\$1.51	\$2.33	\$3,060	\$85,997	\$599
3-Axle Single Unit	\$1.67	\$3.80	\$4,080	\$98,800	\$658
4-Axle Semi	\$1.67	\$3.80	\$7,140	\$136,240	\$600
5-Axle Semi	\$1.67	\$3.80	\$9,180	\$154,050	\$526
6-Axle Semi	\$1.67	\$3.80	\$11,220	\$171,298	\$617
A, B or C Train	\$1.67	\$3.80	\$15,300	\$211,916	\$687

2.3 Rough Pavement Discomfort Costs

Microbencost includes a cost added on for rough pavement travel expressed in 1995 US\$/mile. The 2003 values were updated from the 1995 values using the consumer price index for British Columbia (107.9 in 1995 and 126.5 in 2003) and the exchange rate in 2003 (\$1.37 CDN = \$1.00 US). These are CPI updated to 2007.

Exhibit 2-4 Discomfort Costs Associated with Rough Pavement

	Pavement Condition Rating	1995 US\$	2003 CDN\$/mi	2007 CDN\$/mi
Best	4.5 - 5.0	0.000	0.000	0.000
	4.0 - 4.5	0.000	0.000	0.000
	3.5 - 4.0	0.000	0.000	0.000
	3.0 - 3.5	0.000	0.000	0.000
	2.5 - 3.0	0.005	0.008	0.008
	2.0 - 2.5	0.011	0.018	0.019
	1.5 - 2.0	0.016	0.026	0.027
Worst	<1.5	0.020	0.032	0.034

3 Value of Time

3.1 Auto and Bus

The original values of time used by BC MoT for economic analysis were developed in 1994 by Waters² for use in the User Benefit Cost Spreadsheets (UBCS) model and were disaggregated by age group, driver, passenger, work/non-work and commercial/non-commercial. The weighted average of these values by user group was approximately \$10/hr, which became the default 1997 value used in Microbencost for BC.

Microbencost allows value of time inputs for urban or rural, commercial/non-commercial and vehicle type. The original value of time work was closely related to average Provincial wages. The average Provincial wage was \$610.70/week in 1997, \$682.00 in March 2003 and 743.18 in March 2007, an increase of 9% from 2003. This increase is used to calculate the 2007 value of time of **\$12.17**/person-hour.

3.2 Truck

New to this edition of the Microbencost default values are the truck and cargo values of time added to the driver's value of time.

3.2.1 Truck Time

The time based costs for a truck include fixed costs such as licenses, administration, insurance and time related depreciation.

Time and use related depreciation were introduced in section 2.2. The time related depreciation reflects the time value of a capital asset. It was estimated that 72% of the initial price of the truck is subject to time related depreciation. Time based depreciation costs are presented in exhibit Exhibit 3-1 for combination and straight trucks assuming a 2,600 operating hours per year and annual depreciation of about 15% based on replacement cost.

² Waters W.G. et al, "The Value of Travel Time in British Columbia" prepared for the BC Ministry of Transportation and Highways, Planning Services Branch November 1994.

Exhibit 3-1 Time Related Depreciation

	Combination Truck	Straight Truck
Initial Cost	\$175,195	\$105,458
Portion subject to time related depreciation		
Percent	72%	72%
Value	\$126,626	\$76,222
Annual Depreciation		
Tractor	15.8%	15.8%
Trailer	12.0%	n/a
Combined	15.0%	15.8%
Value	\$18,951	\$12,043
Annual Hours	2600	2600
\$/hr	\$7.29	\$4.63

In addition to time related depreciation, there are other time based fixed costs associated with truck operation. The total time based cost for the truck is estimated in Exhibit 3-2.

Exhibit 3-2 Time Value of Truck

Year	2005	CPI Adjusted 2007
<i>Combination Truck</i>		
	\$/hr	
license & Misc.	\$3.68	\$3.81
Time related depreciation		\$7.29
Admin & interest	\$12.27	\$12.70
Insurance	\$3.68	\$3.81
Total	\$39.26	\$20.31
<i>Straight Truck</i>		
	\$/hr	
license & Misc.	\$0.61	\$0.63
Time related depreciation		\$4.63
Admin & interest	\$6.14	\$6.35
Insurance	\$1.84	\$1.90
Total	\$8.59	\$8.89

Profit margin and interest payments are specifically excluded from truck costs for social cost benefit. Benefit cost considers only the cost of the resource which is used, which excludes profit. Similarly, interest payments are not included separately since they are inherently accounted for in the discount rate used in benefit cost analysis.

3.2.2 Cargo Time

There is an inventory cost associated with goods in transit. To the extent that transit time can be reduced, there is also an inventory cost saving. The cost saving depends on the value of goods on board the truck. The average value of goods and the value of time savings are calculated in Exhibit 3-3.

Exhibit 3-3 Time Value of Cargo

	Straight Truck	Combination
A Payload Value	\$15,000	\$75,000
B Load Factor	40%	65%
C = A x B Average Payload Value	\$6,000	\$48,750
D Discount Rate	6%	6%
E Hours/yr	8,760	8,760
E = C x D/E Time Cost (\$/hr)	\$0.04	\$0.33

3.2.3 Driver Time

The 1997 MBC default values of time for heavy trucks included the driver’s wages plus a 25% wage burden yielding a total \$25/hr for straight trucks and \$28/hr for combination trucks. The comparable figures in the 2005 Trimac Report³ are \$25.42 for combination trucks for wage plus payroll burden and no figure is given for Straight Trucks. The 1997 wage was overstated, reflecting an error in the 1997 Trimac report used to define wages.

Exhibit 3-4 Time Value of Driver

	Truck	Wage (\$/hr)	Payroll Cost (\$/hr)
Bulk Commodity	5-Axle	\$18.75	\$23.44
	6-Axle	\$19.75	\$24.69
	7/8-Axle	\$21.75	\$27.19
General Commodity	5-Axle	\$19.25	\$24.06
	6-Axle	\$20.25	\$25.31
	7/8-Axle	\$22.25	\$27.81
Average 2005		\$20.33	\$25.42
CPI Adjusted 2007			\$26.30

³ "Operating Costs of Trucks in Canada - 2005" Prepared by Trimac Logistics Ltd., Calgary, AB. for Transport Canada, Economic Analysis Directorate, Ottawa, ON.

The payroll cost for straight trucks is not given in the Trimac report but is assumed to be 90% of the wage for combination vehicles or \$23.67/hr for 2007.

3.3 Default Time Values

Exhibit 3-5 summarises the default values of time for use in Microbencost. This model has no provision for separating the value of time for driver, truck or cargo. The values must be added to the driver's value of time. The values in bold print in Exhibit 3-5 can be used. The only proviso is that, **vehicle occupancy for trucks must be left at the default value of 1.0** in order to avoid double counting the time based vehicle or cargo costs. This is the normal default value in any case so the analyst does not have to make any changes to the default values.

The same values are assumed for urban and rural. In economic analysis the main difference between urban and rural trucking is accounted for in the percentage of straight and combination trucks rather than any difference in their operating costs.

Exhibit 3-5 Default Values of Time

		1997	2003	2007
Auto		\$/person-hr		
Urban		\$10.00	\$11.17	\$12.17
Rural		\$10.00	\$11.17	\$12.17
Truck				
	2/3 axle Straight Truck			
	Driver	\$25.00	\$20.90	\$23.48
	Truck Time	\$0.00	\$0.00	\$8.89
	Cargo	\$0.00	\$0.00	\$0.04
	Total	\$25.00	\$20.90	\$32.41
	Combination Truck			
	Driver	\$28.00	\$23.41	\$26.30
	Truck Time	\$0.00	\$0.00	\$20.31
	Cargo	\$0.00	\$0.00	\$0.33
	Total	\$28.00	\$23.41	\$46.94

4 Accident

4.1 Accident Costs

Accident costs used for economic analysis in BC were originally developed in 1992 by Ted Miller of the Urban Institute for BC MoTH⁴. These were adjusted downward by one standard deviation for fatal accidents by MoTH Highway Safety Branch and then rounded off for use in economic analysis.

The 1997 values were generated by taking the 1992 Miller values at a 4% discount rate and factoring them up using the CPI (1992 to 1997) of 1.09. In this case, the unit cost for fatal accidents was not adjusted downward as the Highway Safety Branch had done in 1992.

Exhibit 4-1 Historical Accident Costs

	Miller for MoTH 1992		Highway Safety Branch 1992	Microbencost 1997
	8% discount rate	4% discount rate		
Fatal	\$3,870,324	\$3,824,738	\$2,900,000	\$4,170,000
Injury	\$101,695	\$89,061	\$100,000	\$97,000
PDO	\$5,974	\$5,516	\$6,000	\$6,000

The 2003 values are based on accident costs derived by the US National Safety Council⁵ in 2002 and converted to Canadian values using the Canadian Dollar equivalent of the time of \$1.37 CDN=\$1.00 US. In hindsight, this exchange likely overestimates the accident costs used in BC. The 2007 default values are derived from the latest (2005) National Safety Council figures⁶ and converted to Canadian dollars using a 30 year (1977 to 2007) average exchange rate of \$1.30 CDN = \$1.00 US.

⁴ Miller T.R. "Crash Costs for British Columbia, Contract034535" Letter from Ted Miller to Ross Harris, Planning Service Branch, BC MoTH, Victoria BC, 19 Feb, 1992.

⁵ Mei-Li Lin, et al., "Injury Facts" annual report prepared by the US National Safety Council, Itasca Il., 2002

⁶ Mei-Li Lin, et al., "Injury Facts 2007 Edition", annual report prepared by the US National Safety Council, Itasca Il., 2007

Exhibit 4-2 presents proposed unit accident costs for 2007. The cost of a fatal crash was estimated as the number of fatalities per fatal crash x the unit cost/fatality plus the number of injuries/fatal crash x the unit cost per injury in a fatal crash.

Similarly the cost for non-fatal injury accidents is estimated as the number of injuries per injury crash x the unit cost/injury. The unit cost for injuries is taken from the National Safety Council figures.

The number of fatalities and injuries per fatal crash and the number of injuries per non-fatal injury accident were updated based on the average BC values for 2006.

The average cost of a fatal accident in 2007 is higher than 2003 but the increase is moderated by a reduction in the number of fatalities and injuries per fatal accident and by the lower exchange rate compared to 2003. The value estimated for injury accidents in 2007 is \$134,824 but the value used for analysis remains \$99,999 since this is the largest number available to the Microbencost model. The PDO accident cost is CPI adjusted from the 2003 values. The original PDO accident costs were provided by ICBC from claims based data in 1992. This number was then factored up by 2x by MoT to account for under-reporting of PDO accidents. Since 1992, this number has been updated using the CPI.

Exhibit 4-2 2007 Accident Cost Calculations

		Unit Cost (2005 US \$)	CPI Adjusted Cost (2007 US \$)	2007 Unit Cost (CDN\$) \$1.30/US\$	Number /Crash	2007 Cost	2007 Values for Economic Analysis	Comparable 2003 Values
Fatal Crash								
Economic Cost		\$1,150,000	\$1,189,847	\$1,546,801				
Quality of Life		\$2,690,000	\$2,783,207	\$3,618,169				
Comprehensive Fatal Cost non-fatal incapacitating injury in a fatality crash		\$3,840,000	\$3,973,054	\$5,164,970	1.13	\$5,836,648		
Total cost/fatal crash		\$193,800	\$200,515	\$260,670	0.87	\$226,771		
						\$6,063,419	\$6,063,419	\$5,693,954
Non-fatal injury crash	Assumed %							
Incapacitating Injury	20%	\$165,000	\$200,515					
Non-incapacitating evident injury	50%	\$42,500	\$51,215					
Possible injury	30%	\$20,200	\$24,418					
Weighted Average		\$60,310	\$73,036	\$94,947	1.42	\$134,824	\$99,999	\$99,999
Property damage only crash				\$7,759	1	\$7,759	\$7,759	\$7,342

4.2 Accident Rates and Severity

The default accident rates and severity for highway sections are based on Provincial data prepared by MoT for 2001 to 2005 and smoothed by Apex Engineering to remove anomalies. Accident rates calculated by MoT for freeways and some expressways or divided arterials are based on 1-way traffic. The rates presented here for freeways have been adjusted to reflect 2-way traffic consistent with Microbencost inputs. No adjustment was made to arterials and expressways. The impact is to slightly overstate the accident rate for these classifications. It would be desirable to correct this in future editions of the provincial average accident rate tables.

The smoothing algorithms remove some inconsistencies due to the natural variation in observed data. This also makes it possible to translate the BC data, expressed in 5,000 AADT increments, into the different increments used in Microbencost. For highway sections, the smoothed Provincial accident rates follow a negative exponential curve as AADT increases, approximated as:

$$AR_{AADT} = AR \times (A + B \times e^{C \times AADT / 10,000})$$

Where:

AR _{AADT} =	The section accident rate (a/mvk) for a given service class and AADT.			
AADT =	Average 2-way annual daily traffic of the highway section (including freeways)			
AR =	The average section accident rate (a/mvk) for a given service class.			
e =	2.718282			
	AR	A	B	C
UAU2	0.21	0.40	5.00	-2.60
UAU4	0.07	0.60	5.00	-1.00
UAD4	0.05	0.40	6.50	-0.80
UED4	0.2	0.85	3.20	-1.00
UFD4	0.25	0.95	5.00	-0.75
RAU2	0.34	0.10	1.45	-0.80
RAU4	0.12	0.72	3.90	-1.50
RAD4	0.15	0.70	1.30	-1.30
RFD4	0.31	0.64	3.00	-1.10

The accident rate on an RAU2 highway with 5,000 AADT for example, would be:

$$AR_{5,000} = .34 \times (.10 + 1.45 \times e^{-0.8 \times 5,000 / 10,000}) = .36acc / mvk$$

The accident rates for highway intersections are derived from the IHSDM model developed by the US Federal Highway Administration⁷ and have not changed since the 2003 values.

Accident rates and severity proposed for the Microbencost defaults are presented in Appendix A.

Appendix B contains side by side comparisons of several projects using the 2003 and the 2007 data and the federally prescribed 10% discount rate instead of the Provincial 6% rate.

⁷ Harwood D.W. et al, "Prediction of Expected Safety Performance of Rural Two-Lane Highways", prepared for the Office of Safety Research and Development, US Federal Highway Administration, McLean, Virginia, 2000.

5 Financial

5.1 Annual Maintenance Costs

The 2002/2003 maintenance contract costs are \$334.9 million for 84,415 lane-km of highway, equivalent to \$3,967/lane-km. The latest 2006 data is \$300.5 million for 84,415 lane-km or \$3,560 per lane-km (\$5,732 per lane-mile for use in Microbencost).

5.2 Project Cost Categories

The default project cost categories were not changed. Given a total cost, MBC applies a default breakdown of total cost for 5 cost categories, 7 different project types and urban or rural areas. Service life and residual value is calculated separately for each category.

If a cost estimate is available for a project which has the costs broken down, then this can be used, otherwise the defaults are a good estimate of cost breakdown.

Appendix A

Default BC Provincial Section Accident Rate for Microbencost

BC MoT Classification

RAU2

MBC Classification

Area Type

Rural

Access Control

N/A

Lanes

<4

Median

N/A

AADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	1.22	19.02	25.17	45.41
4,000	1.06	16.42	21.72	39.20
8,000	0.79	12.31	16.29	29.40
16,000	0.46	7.17	9.48	17.11
24,000	0.29	4.45	5.89	10.63
36,000	0.17	2.58	3.42	6.17
58,000	0.10	1.62	2.15	3.88
75,000	0.09	1.48	1.95	3.52
75,000	0.09	1.48	1.95	3.52

AADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	1.97	30.62	40.52	73.11
4,000	1.70	26.43	34.98	63.11
8,000	1.28	19.82	26.23	47.33
16,000	0.74	11.54	15.26	27.54
24,000	0.46	7.17	9.48	17.11
36,000	0.27	4.16	5.50	9.93
58,000	0.17	2.61	3.46	6.24
75,000	0.15	2.38	3.14	5.67
75,000	0.15	2.38	3.14	5.67

BC MoT Classification

RFD4

MBC Classification

Area Type	Rural
Access Control	Full
Lanes	>=4
Median	N/A

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.661	17.77	26.58	45.02
4,000	0.604	16.23	24.28	41.11
8,000	0.513	13.80	20.64	34.95
16,000	0.400	10.75	16.07	27.22
24,000	0.340	9.14	13.67	23.14
36,000	0.299	8.03	12.01	20.34
58,000	0.278	7.46	11.16	18.90
75,000	0.274	7.37	11.03	18.68
75,000	0.274	7.37	11.03	18.68

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	1.06	28.61	42.80	72.48
4,000	0.97	26.13	39.09	66.19
8,000	0.83	22.21	33.23	56.26
16,000	0.64	17.30	25.88	43.82
24,000	0.55	14.71	22.01	37.26
36,000	0.48	12.93	19.34	32.75
58,000	0.45	12.01	17.97	30.43
75,000	0.44	11.87	17.76	30.07
75,000	0.44	11.87	17.76	30.07

BC MoT Classification

RAD4

MBC Classification

Area Type	Rural
Access Control	Partial
Lanes	>=4
Median	N/A

AADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.344	11.54	13.65	25.54
4,000	0.298	9.99	11.81	22.09
8,000	0.234	7.86	9.30	17.39
16,000	0.174	5.85	6.91	12.94
24,000	0.153	5.14	6.07	11.36
36,000	0.144	4.83	5.71	10.68
58,000	0.142	4.75	5.62	10.51
75,000	0.141	4.75	5.61	10.50
75,000	0.141	4.75	5.61	10.50

AADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	0.55	18.59	21.97	41.11
4,000	0.48	16.08	19.01	35.57
8,000	0.38	12.66	14.96	28.00
16,000	0.28	9.42	11.13	20.83
24,000	0.25	8.27	9.78	18.29
36,000	0.23	7.77	9.19	17.20
58,000	0.23	7.65	9.04	16.92
75,000	0.23	7.64	9.04	16.91
75,000	0.23	7.64	9.04	16.91

BC MoT Classification

RAD4

MBC Classification

Area Type	Rural
Access Control	None
Lanes	>=4
Median	>0

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.344	11.54	13.65	25.54
4,000	0.298	9.99	11.81	22.09
8,000	0.234	7.86	9.30	17.39
16,000	0.174	5.85	6.91	12.94
24,000	0.153	5.14	6.07	11.36
36,000	0.144	4.83	5.71	10.68
58,000	0.142	4.75	5.62	10.51
75,000	0.141	4.75	5.61	10.50
75,000	0.141	4.75	5.61	10.50

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	0.55	18.59	21.97	41.11
4,000	0.48	16.08	19.01	35.57
8,000	0.38	12.66	14.96	28.00
16,000	0.28	9.42	11.13	20.83
24,000	0.25	8.27	9.78	18.29
36,000	0.23	7.77	9.19	17.20
58,000	0.23	7.65	9.04	16.92
75,000	0.23	7.64	9.04	16.91
75,000	0.23	7.64	9.04	16.91

BC MoT Classification

RAU4

MBC Classification

Area Type	Rural
Access Control	None
Lanes	>=4
Median	=0

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	1.222	19.32	22.77	43.31
4,000	0.968	15.31	18.04	34.32
8,000	0.641	10.14	11.95	22.74
16,000	0.363	5.75	6.77	12.89
24,000	0.280	4.43	5.21	9.92
36,000	0.250	3.95	4.65	8.85
58,000	0.244	3.86	4.55	8.65
75,000	0.244	3.86	4.54	8.64
75,000	0.244	3.86	4.54	8.64

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	1.97	31.11	36.65	69.73
4,000	1.56	24.66	29.05	55.26
8,000	1.03	16.33	19.24	36.60
16,000	0.59	9.26	10.90	20.75
24,000	0.45	7.12	8.39	15.97
36,000	0.40	6.36	7.49	14.25
58,000	0.39	6.21	7.32	13.92
75,000	0.39	6.21	7.31	13.91
75,000	0.39	6.21	7.31	13.91

BC MoT Classification

UAU2

MBC Classification

Area Type	Urban
Access Control	N/A
Lanes	<4
Median	N/A

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	1.075	29.67	40.08	70.82
4,000	0.690	19.06	25.76	45.51
8,000	0.326	9.01	12.18	21.52
16,000	0.152	4.20	5.68	10.04
24,000	0.131	3.60	4.87	8.60
36,000	0.128	3.52	4.76	8.41
58,000	0.127	3.52	4.75	8.40
75,000	0.127	3.52	4.75	8.40
75,000	0.127	3.52	4.75	8.40

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	1.73	47.76	64.54	114.03
4,000	1.11	30.69	41.47	73.28
8,000	0.53	14.51	19.61	34.64
16,000	0.25	6.77	9.15	16.16
24,000	0.21	5.80	7.84	13.85
36,000	0.21	5.67	7.66	13.54
58,000	0.21	5.66	7.65	13.52
75,000	0.21	5.66	7.65	13.52
75,000	0.21	5.66	7.65	13.52

BC MoT Classification

UFD4

MBC Classification

Area Type

Urban

Access Control

Full

Lanes

4

Median

N/A

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.517	17.34	25.92	43.77
4,000	0.506	16.96	25.36	42.83
8,000	0.485	16.26	24.31	41.05
16,000	0.448	15.01	22.44	37.90
24,000	0.416	13.95	20.85	35.22
36,000	0.377	12.64	18.90	31.92
58,000	0.326	10.93	16.33	27.59
75,000	0.299	10.03	15.00	25.33
75,000	0.299	10.03	15.00	25.33

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	0.83	27.91	41.72	70.47
4,000	0.81	27.31	40.83	68.95
8,000	0.78	26.18	39.13	66.10
16,000	0.72	24.17	36.13	61.02
24,000	0.67	22.46	33.57	56.70
36,000	0.61	20.36	30.43	51.39
58,000	0.52	17.59	26.30	44.42
75,000	0.48	16.15	24.14	40.78
75,000	0.48	16.15	24.14	40.78

BC MoT Classification

UFD4

MBC Classification

Area Type	Urban
Access Control	Full
Lanes	>4
Median	N/A

AA DT	Fat	Inj	PDO	All
acc/100m vk				
2,000	0.517	17.34	25.92	43.77
4,000	0.506	16.96	25.36	42.83
8,000	0.485	16.26	24.31	41.05
16,000	0.448	15.01	22.44	37.90
24,000	0.416	13.95	20.85	35.22
36,000	0.377	12.64	18.90	31.92
58,000	0.326	10.93	16.33	27.59
75,000	0.299	10.03	15.00	25.33
75,000	0.299	10.03	15.00	25.33

AA DT	Fat	Inj	PDO	All
acc/100m vm				
2,000	0.83	27.91	41.72	70.47
4,000	0.81	27.31	40.83	68.95
8,000	0.78	26.18	39.13	66.10
16,000	0.72	24.17	36.13	61.02
24,000	0.67	22.46	33.57	56.70
36,000	0.61	20.36	30.43	51.39
58,000	0.52	17.59	26.30	44.42
75,000	0.48	16.15	24.14	40.78
75,000	0.48	16.15	24.14	40.78

BC MoT Classification

UED4

MBC Classification

Area Type	Urban
Access Control	Partial
Lanes	4
Median	N/A

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	1.552	52.02	77.76	131.34
4,000	1.375	46.09	68.89	116.35
8,000	1.091	36.58	54.68	92.35
16,000	0.725	24.32	36.35	61.40
24,000	0.525	17.59	26.30	44.41
36,000	0.380	12.74	19.04	32.15
58,000	0.300	10.05	15.02	25.36
75,000	0.286	9.59	14.33	24.20
75,000	0.286	9.59	14.33	24.20

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	2.50	83.76	125.20	211.45
4,000	2.21	74.20	110.91	187.33
8,000	1.76	58.90	88.03	148.69
16,000	1.17	39.16	58.53	98.85
24,000	0.84	28.32	42.34	71.50
36,000	0.61	20.50	30.65	51.76
58,000	0.48	16.18	24.18	40.83
75,000	0.46	15.43	23.07	38.96
75,000	0.46	15.43	23.07	38.96

BC MoT Classification

UED4

MBC Classification

Area Type

Urban

Access Control

Partial

Lanes

>4

Median

N/A

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	1.552	52.02	77.76	131.34
4,000	1.375	46.09	68.89	116.35
8,000	1.091	36.58	54.68	92.35
16,000	0.725	24.32	36.35	61.40
24,000	0.525	17.59	26.30	44.41
36,000	0.380	12.74	19.04	32.15
58,000	0.300	10.05	15.02	25.36
75,000	0.286	9.59	14.33	24.20
75,000	0.286	9.59	14.33	24.20

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	2.50	83.76	125.20	211.45
4,000	2.21	74.20	110.91	187.33
8,000	1.76	58.90	88.03	148.69
16,000	1.17	39.16	58.53	98.85
24,000	0.84	28.32	42.34	71.50
36,000	0.61	20.50	30.65	51.76
58,000	0.48	16.18	24.18	40.83
75,000	0.46	15.43	23.07	38.96
75,000	0.46	15.43	23.07	38.96

BC MoT Classification

UAD4

MBC Classification

Area Type

Urban

Access Control

None

Lanes

>=4

Median

>0

AADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.445	12.41	16.84	29.69
4,000	0.384	10.70	14.52	25.60
8,000	0.287	8.00	10.85	19.14
16,000	0.166	4.61	6.26	11.04
24,000	0.101	2.83	3.84	6.76
36,000	0.057	1.60	2.17	3.82
58,000	0.035	0.97	1.31	2.31
75,000	0.031	0.87	1.18	2.08
75,000	0.031	0.87	1.18	2.08

AADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	0.72	19.98	27.11	47.81
4,000	0.62	17.23	23.37	41.22
8,000	0.46	12.88	17.47	30.81
16,000	0.27	7.43	10.07	17.77
24,000	0.16	4.55	6.18	10.89
36,000	0.09	2.57	3.49	6.16
58,000	0.06	1.56	2.11	3.73
75,000	0.05	1.40	1.90	3.35
75,000	0.05	1.40	1.90	3.35

BC MoT Classification

UAU4

MBC Classification

Area Type

Urban

Access Control

None

Lanes

>=4

Median

=0

AAADT	Fat	Inj	PDO	All
acc/100mvk				
2,000	0.729	13.55	18.58	32.86
4,000	0.613	11.41	15.64	27.66
8,000	0.442	8.22	11.27	19.93
16,000	0.250	4.65	6.37	11.27
24,000	0.164	3.04	4.17	7.38
36,000	0.114	2.13	2.92	5.16
58,000	0.095	1.78	2.43	4.31
75,000	0.094	1.74	2.39	4.22
75,000	0.094	1.74	2.39	4.22

AAADT	Fat	Inj	PDO	All
acc/100mvm				
2,000	1.17	21.82	29.91	52.90
4,000	0.99	18.37	25.18	44.53
8,000	0.71	13.23	18.14	32.08
16,000	0.40	7.48	10.26	18.14
24,000	0.26	4.90	6.71	11.87
36,000	0.18	3.42	4.69	8.30
58,000	0.15	2.86	3.92	6.93
75,000	0.15	2.80	3.84	6.79
75,000	0.15	2.80	3.84	6.79

Default Signalised and Stop Controlled
Intersection Accident Rates for Microbencost

**Urban
Stop Control
acc/100mv**

AADT Range	Fat	Inj	PDO	All
0-1,999	0.07	13.5	10.9	24.49
2,000-3,999	0.09	17.1	13.7	30.85
4,000-7,999	0.11	19.7	15.8	35.68
8,000-15,999	0.13	22.8	18.3	41.27
16,000-23,999	0.14	25.4	20.4	45.94
24,000-35,999	0.15	27.7	22.2	50.03
36,000-57,999	0.17	30.4	24.4	54.97
58,000-75,999	0.18	32.8	26.3	59.22
80,000+	0.19	34.0	27.3	61.47

**Urban
Signal
acc/100mv**

AADT Range	Fat	Inj	PDO	All
0-1,999	0.27	49.6	39.8	89.59
2,000-3,999	0.22	39.8	31.9	71.92
4,000-7,999	0.19	34.6	27.8	62.61
8,000-15,999	0.17	30.1	24.2	54.50
16,000-23,999	0.15	27.2	21.8	49.21
24,000-35,999	0.14	25.1	20.1	45.38
36,000-57,999	0.13	22.9	18.4	41.48
58,000-75,999	0.12	21.4	17.1	38.64
80,000+	0.11	20.6	16.5	37.29

**Rural
Stop Control
acc/100mv**

AADT Range	Fat	Inj	PDO	All
0-1,999	0.26	13.3	10.1	23.66
2,000-3,999	0.33	16.7	12.7	29.79
4,000-7,999	0.39	19.3	14.7	34.46
8,000-15,999	0.45	22.4	17.1	39.86
16,000-23,999	0.50	24.9	19.0	44.38
24,000-35,999	0.54	27.1	20.7	48.32
36,000-57,999	0.59	29.8	22.7	53.10
58,000-75,999	0.64	32.1	24.5	57.20
80,000+	0.66	33.3	25.4	59.37

**Rural
Signal
acc/100mv**

AADT Range	Fat	Inj	PDO	All
0-1,999	0.94	47.3	36.0	84.23
2,000-3,999	0.76	37.9	28.9	67.61
4,000-7,999	0.66	33.0	25.2	58.86
8,000-15,999	0.57	28.7	21.9	51.24
16,000-23,999	0.52	26.0	19.8	46.26
24,000-35,999	0.48	23.9	18.2	42.66
36,000-57,999	0.44	21.9	16.7	39.00
58,000-75,999	0.41	20.4	15.5	36.33
80,000+	0.39	19.7	15.0	35.06

Appendix B

Comparisons of Microbencost Results using 2003 and 2007 Defaults

Several test cases were run using the 2003 and 2007 default values and the federally prescribed **10% discount rate** to test the impact on overall results. Overall, the new defaults improve benefits for projects driven by delay savings, while projects driven by safety may see slightly less benefits.

The findings suggest that B/C ratios increase about 0.1. Time savings increase since a larger portion of truck costs are now time based. Accident savings increase slightly with the higher unit accident costs. Vehicle operating cost savings show no particular pattern associated with the new defaults. Higher unit costs push up the values while excluding time related depreciation from VOC pushes it down. In addition, VOC normally fluctuates between positive and negative depending on speeds and fuel consumption.

Bentley Road to North Beach – This is a 3.3 km section of Highway 97 in the Okanagan Valley just north of Summerland. The project includes 4-laning a winding 2-lane along Okanagan Lake with 12,000 AADT.

Default Values	2003	2007
B/C ratio	0.71	0.82
NPV	-\$4.57	-\$2.88
Time Savings	\$7.01	\$8.56
Accident Savings	\$4.22	\$4.47
VOC Savings	\$0.13	\$0.03
Total Benefits	\$11.36	\$13.05

Domano Intersection – The Domano Boulevard intersection is a signalized intersection located on Highway 16, in the south west end of Prince George, 3.5 km west of Highway 97. Traffic in 2006 was estimated to be 23,000 AADT on Highway 16 with 8% trucks and 15,000 AADT on Domano Blvd. The intersection is approaching capacity and also averages over 8 accidents per year. Proposed improvements to the intersection include:

	2003	2007
B/C ratio	1.1	1.3
NPV	\$1.00	\$2.12
Time Savings	\$3.17	\$3.54
Accident Savings	\$2.85	\$2.89
VOC Savings	\$1.88	\$2.54
Total Benefits	\$7.90	\$9.06

- Double left turn lanes on the WB and EB Highway 16 approaches with protected left turn phasing
- Extending right turn deceleration and acceleration lanes
- Flattening the super elevation through the intersection
- Raised median islands on Highway 16

Pine Pass - The project is located on Highway 97 south of Chetwynd between Prince George and Dawson Creek. AADT is less than 1,000 with an estimated 20% trucks. The existing highway follows 11.2 km along the Pine River from Bennett Creek to Link Creek (segment 1160 LKI 59.3 to 70.5) winding along the banks of

	2003	2007
B/C ratio	0.38	0.41
NPV	-\$11.30	-\$10.67
Time Savings	\$1.05	\$1.41
Accident Savings	\$5.98	\$6.30
VOC Savings	-\$0.17	-\$0.23
Total Benefits	\$6.86	\$7.48

the Pine River. There are several speed advisory curves and narrow shoulders adjacent to the River and the existing accident rate is estimated to be 0.98 acc/mvk compared to a Provincial average 2-lane section at 0.34 acc/mvk. The improved highway will eliminate about 2 accidents per year and improve running speed from about 75 km/hr to 90km/hr.

Test Section – This is a hypothetical section of 2-lane highway 10,000 AADT, 2% growth upgraded to 4 lane divided. Length is 1 km and upgrading cost is \$5 million. Except for the 10% discount rate, default values are used throughout for 2003 and 2007.

	2003	2007
B/C ratio	0.28	0.31
NPV	-\$3.03	-\$2.90
Time Savings	\$0.17	\$0.21
Accident Savings	\$0.94	\$0.99
VOC Savings	\$0.07	\$0.11
Total Benefits	\$1.18	\$1.31

Test Intersection – This is a 2-lane rural intersection with 10,000 AADT, 2% growth on the major road and 1,000 AADT on the minor road controlled by a semi-activated signal. The intersection is upgraded to 4 lanes divided. Except for the 10% discount rate, default values are used throughout for 2003 and 2007.

	2003	2007
B/C ratio	0.45	0.54
NPV	-\$2.31	-\$1.95
Time Savings	\$0.56	\$0.68
Accident Savings	\$0.94	\$0.99
VOC Savings	\$0.38	\$0.57
Total Benefits	\$1.88	\$2.24