draft

Benefit Cost Analysis
Agassiz Rosedale Highway 9/Yale Road East
Intersection Improvement

Prepared for:

BC Ministry of Transportation
South Coast Region

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Project No. MoT-66
22 June, 2004

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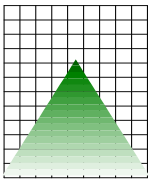

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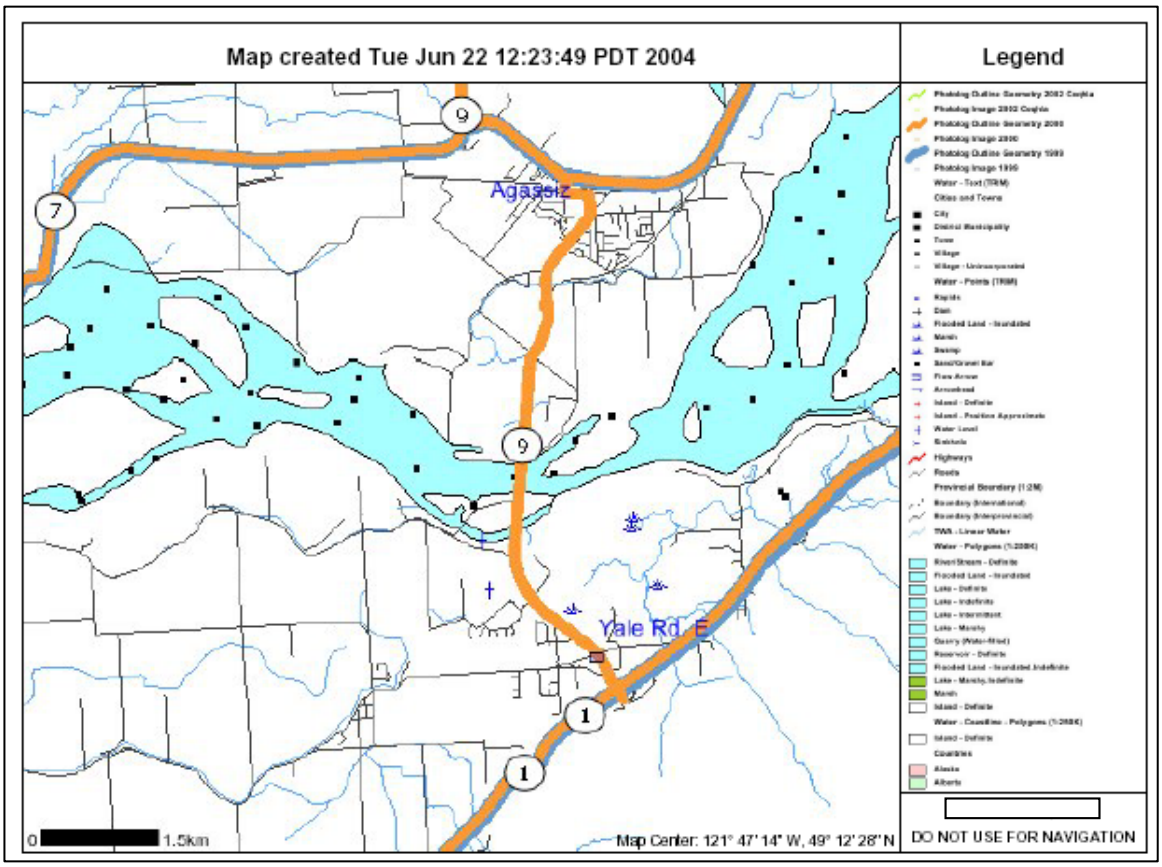
1 Background

The project is located on Highway 0.56 km north of the Bridal Falls Overpass on Highway 1. Highway 9 is rural posted 60 km/hr with some commercial development near the intersection. Yale Road E. Intersects the highway at a 60 degree skew angle with a horizontal curve on Highway 9.

Exhibit 1-1 Highway 9 at Yale Road East

Exhibit 1-2 General Location



2 General Assumptions

Exhibit 2-1 presents the general assumptions used for analysis. Safety assumptions are examined in section 3.

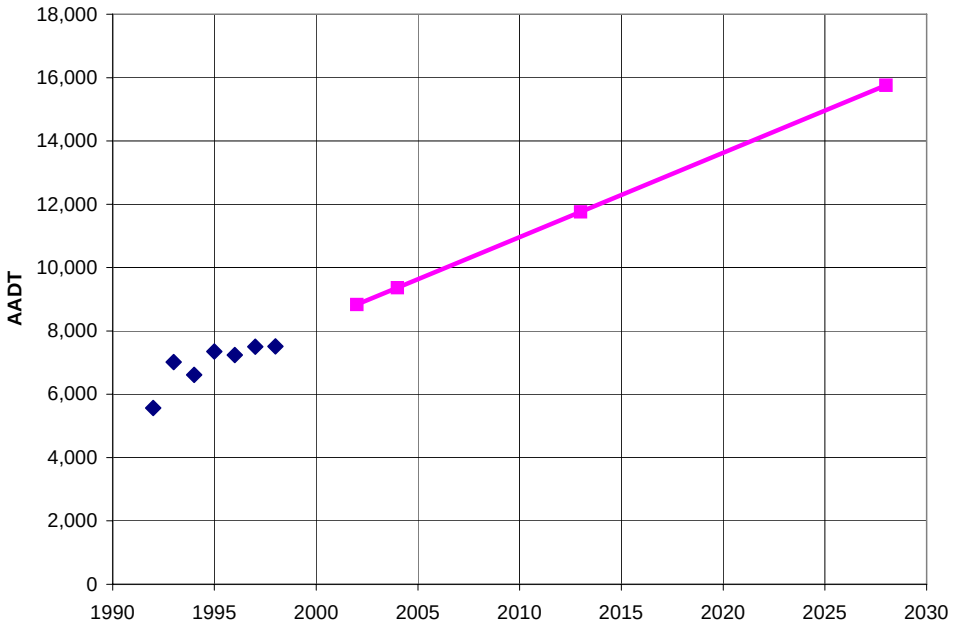
The signal option includes the cost of constructing an additional southbound approach lane. This is required to compensate for the loss of capacity on Highway 9 when a signalized intersection is introduced. Highway 9 is currently free flow with stop control only on Yale Road.

Exhibit 2-1 General Assumptions

	Roundabout	**Signal**
Segment 2762		
from LKI	0.046	0.046
to LKI	0.066	0.066
Length (km)	0.02	0.02
AADT 2004		
Highway 9	9,367	9,367
Counter	17-014	42-018
Minor Road Traffic		
Yale Road E.	1,756	1,756
Compound Growth Rate	2.2%	2.2%
% Trucks	10%	10%
Posted Speed	60	60
Lanes	1 SB, 1 NB	2 SB, 1 NB

Traffic volumes in Exhibit 2-2 are from short count station 17-014 located on Highway 9 just south of the intersection. Traffic on Highway 9 north of the intersection is about 1,000 AADT greater (year 2000 count).

Exhibit 2-2 Historical and Projected AADT



3 Safety Performance

The accident analysis uses data for 7 years from 1996 to 2002. The estimated existing intersection accident rate is 0.59 a/mev (accidents per million entering vehicles). The provincial average for rural intersections is 0.3 a/mev but is typically for intersections with a lower minor street volume.

The sample size is not adequate to assess severity. The Provincial Highway Accident System (HAS) shows 12 accidents at this location including one fatal accident in the 7 year period of record. Severity is assumed to be typical of a rural highway intersection.

Previous work supplied by MoT reports 27 ICBC claims including 15 injury accidents in connection with crashes at Highway 9 and Yale Road. The difference has not been reconciled at this time. This analysis uses the lower figure from HAS.

Proposed case accident severity for both the signal and roundabout has been assessed assuming the severity is more typical of an urban intersection where speeds are generally lower.

Proposed case accident rate for the signalized option has been assessed using the IHSDM model which suggests a slight increase in the accident rate accompanied by the lower severity. The increased rate is typical for signalized intersections due mainly to the increase in rear end accidents.

The proposed case accident rate for the roundabout is assessed based on research which suggests about a 50% reduction in accidents is typical, due to the reduction in conflict points and rear end accidents.

Exhibit 3-1 Accident Rates Used for Analysis

Base Case

	Highway 9/Yale Rd. E. Intersection				
Observed Base Case Accidents	**1996 to 2002**				
Segment	2762				
Start LKI	0.50				
Finish LKI	0.70				
Length (km)	0.20				
AADT Average 1996-2002					
Hwy 8	7,893				
Yale Road E	1,480				
Years	7				
Exposure (mev)	20.2				
	Fat	Inj	PDO	Fat & Inj	All
Number	1	5	6	6	12
Observed Rate (a/mev)	0.050	0.25	0.30	0.30	0.60
Severity	8.3%	41.7%	50.0%	50.0%	100.0%

Predicted Base Case Accidents	**1996 to 2002**				
Intersection Accidents					
Severity	1.8%	50.1%	48.1%	51.9%	100.0%
Predicted Accidents (7yrs)	0.2	5.3	5.0	5.5	10.5

	1996 to 2002			Empirical Bayes Estimate.	
Base Case Estimate used for Analysis	Fat	Inj	PDO	Fat & Inj	All
Overdispersion Parameter					1.0
Number	0.2	5.9	5.7	6.2	11.9
Rate (a/mev)	0.0108	0.295	0.283	0.31	0.59
Severity	1.8%	50.1%	48.1%	51.9%	100.0%

Option 1 - Roundabout

	Highway 9/Yale Rd. E. Intersection				
	1996 to 2002				
Predicted Accidents for Proposed Case	Fat	Inj	PDO	Fat & Inj	All
Intersection					
Predicted Accidents (7 yrs)	0.03	2.9	3.0	2.9	5.9
Prov Avg. Severity	0.5%	48.6%	50.9%	49.1%	100%
Accident Rate (a/mev)	0.0014	0.143	0.150	0.144	0.294
Accident Reduction Potential (7 Years)	Fat	Inj	PDO	Fat & Inj	All
Number	0.19	3.06	2.68	3.25	5.93
Percent	87.4%	51.5%	47.0%	52.7%	50.0%

Option 2 - Signal

	Highway 9/Yale Rd. E. Intersection				
	1996 to 2002				
Predicted Accidents for Proposed Case	Fat	Inj	PDO	Fat & Inj	All
Intersection					
Predicted Accidents (7 yrs)	0.06	6.0	6.3	6.1	12.4
Prov Avg. Severity	0.5%	48.6%	50.9%	49.1%	100%
Accident Rate (a/mev)	0.0029	0.300	0.314	0.303	0.617
Accident Reduction Potential (7 Years)	Fat	Inj	PDO	Fat & Inj	All
Number	0.16	-0.10	-0.63	0.06	-0.57
Percent	73.5%	-1.7%	-11.0%	1.0%	-4.8%

4 Financial Account

Exhibit 4-1 presents the capital cost assumptions used for analysis. The project lies within MoT ROW so there is no new property cost.

Exhibit 4-1 Project Costs

	Roundabout	Signal
Engineering & Mgmt Reserve	$80,000	$50,000
Land	$0	$0
Construction	$820,000	$400,000
Total	$900,000	$450,000

5 Benefit Cost Analysis

5.1 Results

The results are presented in Exhibit 5-1 Both the roundabout and the signal return good benefits cost ratios of 10 and 7 respectively. B/C ratios greater than 1.0 are deemed to be economically justified from society's perspective.

Most of the benefits stem from a reduction in accident severity. The roundabout achieves greater safety benefits since it reduces both the severity and the rate. The roundabout forces a speed reduction at the intersection which reduces severity. It also reduces the number of conflict points which results in a lower accident rate. The signal will likely have a slight increase in accidents due to an increase in rearend accidents but , there is likely to be a decrease in average accident severity due to lower risk taking behaviour by minor street traffic, fewer sever right angle accidents and an increase in lower severity rearend accidents.

Time savings are greatest for the roundabout because this substantially reduces the delay to minor street traffic without imposing any significant delay to major street traffic. The signalized option has relatively little delay reduction because the time savings to minor street traffic are offset by increased delay to Highway 9 through traffic.

Savings in vehicle operating costs are positive for the roundabout due to the reduced stop delay. For the signal, savings are negative due to the increased

operating costs associated with stop delay on Highway 9 where the majority of traffic is.

Exhibit 5-1 Benefit Cost Analysis - Highway 9/Yale Road E. Intersection

Discounted Costs (2004 $millions)	**Roundabout**	**Signal**
Project Cost	$0.85	$0.43
Salvage Value	$0.18	$0.09
Increased Mtce & Rehab Cost	$0.02	$0.06
Total Discounted Cost	$0.69	$0.40
Discounted Benefits		
Delay Reduction	$1.7	$0.5
VOC Reduction	$0.6	-$0.5
Accident Reduction	$4.4	$2.8
Total Discounted Benefits	$6.8	$2.8
Net Present Value (NPV)	$6.08	$2.44
NPV/Project Cost	6.75	5.41
B/C Ratio	**9.9**	**7.1**

5.2 Sensitivity Analysis

This is intended to show the impact of alternative project assumptions on the results. In this case, the Net Present Value remains positive over the range of options tested.

Exhibit 5-2 Sensitivity Analysis

	Normal Assump-tions	4% Discount Rate	8% Discount Rate	+25% Construc-tion Cost	-25% Construc-tion Cost	Traffic Growth 2.7%	Traffic Growth -1.7%
			Net Present Value (millions $)				
Roundabout	6.1	7.8	4.8	5.9	6.3	6.5	5.7
Signal	2.4	3.1	1.9	2.3	2.5	2.6	2.3

5.3 Optimum Timing

The optimum timing is the implementation year that would maximize the net present value of the investment. It is measured as the year when the annual rate of return on investment (annual benefits/capital costs) exceeds the discount rate. In this case, the analysis suggests the optimum timing is past due.

Exhibit 5-3 Optimum Timing

Discount Rate	Option 1	Option 2
	Year	
4%	1983	1986
6%	1984	1987
8%	1985	1988

5.4 Conclusions

The benefit cost analysis returns a B/C ratio of 9.9 for the Roundabout and 7.1 for the signal. Both options would be beneficial in a benefit cost context but the roundabout is preferred. It offers lower accident severity and rate without increasing intersection delay significantly for Highway 9 traffic.

The accident reduction potential for the roundabout is slightly less than 1 accident per year including 1 fatal accident every 35 years. The Signalized intersection will likely increase the overall accident rate but reduce the severity, saving about 1fatal accident every 40 years.

The optimum timing analysis suggests the project is past due.