Memo

SUBJECT
1650 Shea Road Guide Rail Assessment

DATE
July 31, 2024

DEPARTMENT
Transportation Engineering

COPIES TO

TO
Davidson Co-Tenancy c/o Tartan Land Corporation

OUR REF
https://arcadiso365.sharepoint.com/sites/Projects2/139185/Internal Documents/6.0_Technical/6.23_Traffic/03_Reports/
PROJECT NUMBER
139185

NAME
Eric McLaren
eric.mclaren@arcadis.com

Arcadis has been retained by Davidson Co-Tenancy (in the care of Tartan Land Corporation) to undertake a guide rail assessment for the proposed townhouse development located at 1650 Shea Road. Within the proposed development, there are three private roads which run parallel to a public road. Due to grading constraints of the site, there are significant elevation differences ranging from 0.34m to 2.85m between the site and the adjacent roadway, and a retaining wall is therefore required along the eastern and southern boundaries of the site. Due to the elevation differences between the private lanes and the adjacent public roadway, there is a risk of a vehicle overtopping the retaining wall, potentially resulting in a serious collision. This guide rail assessment therefore provides a quantitative evaluation of the potential benefits of providing a guide rail barrier system to prevent overtopping of the retaining wall. The guide rail assessment has followed the guidelines prescribed in the *Roadside Design Manual* published by the Ontario Ministry of Transportation (MTO) in December 2017.

The site plan of the proposed development is provided in **Appendix A**. The three private lanes under evaluation are:

- Private Lane 1
- Private Lane 4
- Private Lane 6

Alternative Options

There are two alternative options being evaluated as part of this assessment:

- **Option 1:** No guide rail ('Do Nothing')
- **Option 2:** Steel beam guide rail installed at the edge of the road

Evaluation Methodology

The guide rail assessment has followed the guidelines prescribed in the Roadside Design Manual published by the Ontario Ministry of Transportation (MTO) in December 2017. For each location identified for review, an assessment of the frequency and severity of collisions with and without a guide rail in place was carried out.

Benefit-cost evaluations for each location with and without guide rails in place have been carried out based on the methodology prescribed in the Roadside Evaluation Manual published by the MTO in July 2018 and using MTO's Roadside.xlsx program. Option 1 represents the baseline condition for the analysis (i.e., the 'Do Nothing' option) and assumes that there will be no guide rail. Option 2 assumes that a guide rail will be implemented. Collisions

with the guide rail are expected to be less severe than collisions where vehicles overtop the wall, however, as the guide rail would be immediately adjacent to the road, the frequency of collisions will be higher. The MTO Roadside.xlsx program predicts the frequency and severity of collisions given the characteristics of the hazard or area of concern and calculates the weighted average cost of collisions. The difference in collision costs between the two options represents the benefit of Option 2 relative to Option 1. This in turn can be compared to the cost of implementing the guard rail to determine the cost-benefit ratio. A simple benefit/cost ratio of 1.0 or greater is considered a general measure of cost-effectiveness. Improvements with a B/C ratio of less than 1.0 are not normally considered economically justified.

Measurements of the proposed roadside conditions at each location were obtained based on the proposed site grading plan. In addition to the above, the following parameters and assumptions were applied in the evaluations:

- A project life of 30 years and a discount rate of 5.0% was applied in the economic analysis. The discount rate accounts for the cost of borrowing and for inflation and is used in calculating the present worth of the mitigation measures and collision costs.
- Annual average daily traffic (AADT) volumes for each private lane were calculated based on trip generation rates from the Institute of Transportation Engineers (ITE) Trip Generation Manual (11th Edition) and the number of townhouses proposed on each road. No adjustments were applied to account for the use of non-auto modes of travel.
- A growth rate of 0% was applied to the roadways as it is assumed that traffic volumes will remain constant throughout the project life.
- Unit prices applied for the guide rail cost estimates are based on rates provided by the City of Ottawa (November 2021):
    - Steel Beam Guide Rail: $200.00/m
- End Treatment: It is assumed that no end treatment will be required in this situation.

Benefit-Cost Evaluations

Private Lane 1

The following inputs were used in the benefit-cost evaluation of this location:

Table 1 Summary of Inputs: Private Lane 1

Analysis Parameter	Parameter Value
Design Speed	50 km/h
AADT	43 veh/day
Lane Width	3.0m
Shoulder Width	1.9m
Shoulder Grade	2%
Radius of Curvature	8m
Hazard Offset from Travel Lane	1.9m
Severity Index of Unshielded Hazard	Face: 3.3, Approach Side & Corner: 0
Estimated Guide Rail Cost	$9,100.00

The results of the benefit/cost evaluation for Private Lane 1 are summarized in **Table 2**. Detailed input/output sheets from the analysis are provided in **Appendix B**.

Table 2 Summary of Outputs: Private Lane 1

Alternative	Expected Collisions	Collision Costs	Total Benefits	Net Costs	Net Present Value	Simple B/C
Option 1	0.02522	$489.81	-	-	-	-
Option 2	0.06779	$132.94	$356.87	$9,100.00	-$8,743.13	0.04

The results of the analysis suggest that there is no benefit in providing a guide rail to prevent overtopping of the retaining wall on Private Lane 1. The net costs significantly exceed the anticipated benefits.

Private Lane 4

The following inputs were used in the benefit-cost evaluation of this location:

Table 3 Summary of Inputs: Private Lane 4

Analysis Parameter	Parameter Value
Design Speed	50 km/h
AADT	130 veh/day
Lane Width	3.0m
Shoulder Width	1.9m
Shoulder Grade	2%
Radius of Curvature	8m
Hazard Offset from Travel Lane	1.9m
Severity Index of Unshielded Hazard	Face: 4.8, Approach Side & Corner: 0
Estimated Guide Rail Cost	$9,200.00

The results of the benefit/cost evaluation for Private Lane 4 are summarized in **Table 4**. Detailed input/output sheets from the analysis are provided in **Appendix B**.

Table 4 Summary of Outputs: Private Lane 4

Alternative	Expected Collisions	Collision Costs	Total Benefits	Net Costs	Net Present Value	Simple B/C
Option 1	0.07694	$4,563.85	-	-	-	-
Option 2	0.20689	$1,253.89	$3,309.96	$9,200.00	-$5,890.04	0.36

The results of the analysis suggest that there is no benefit in providing a guide rail to prevent overtopping of the retaining wall on Private Lane 4. The net costs significantly exceed the anticipated benefits.

Private Lane 6

The following inputs were used in the benefit-cost evaluation of this location:

Table 5 Summary of Inputs: Private Lane 6

Analysis Parameter	Parameter Value
Design Speed	50 km/h
AADT	180 veh/day
Lane Width	3.0m
Shoulder Width	1.9m
Shoulder Grade	2%
Radius of Curvature	8m
Hazard Offset from Travel Lane	1.9m
Severity Index of Unshielded Hazard	Face: 5.2, Approach Side & Corner: 0
Estimated Guide Rail Cost	$19,000.00

The results of the benefit/cost evaluation for Private Lane 6 are summarized in **Table 6**. Detailed input/output sheets from the analysis are provided in **Appendix B**.

Table 6 Summary of Outputs: Private Lane 6

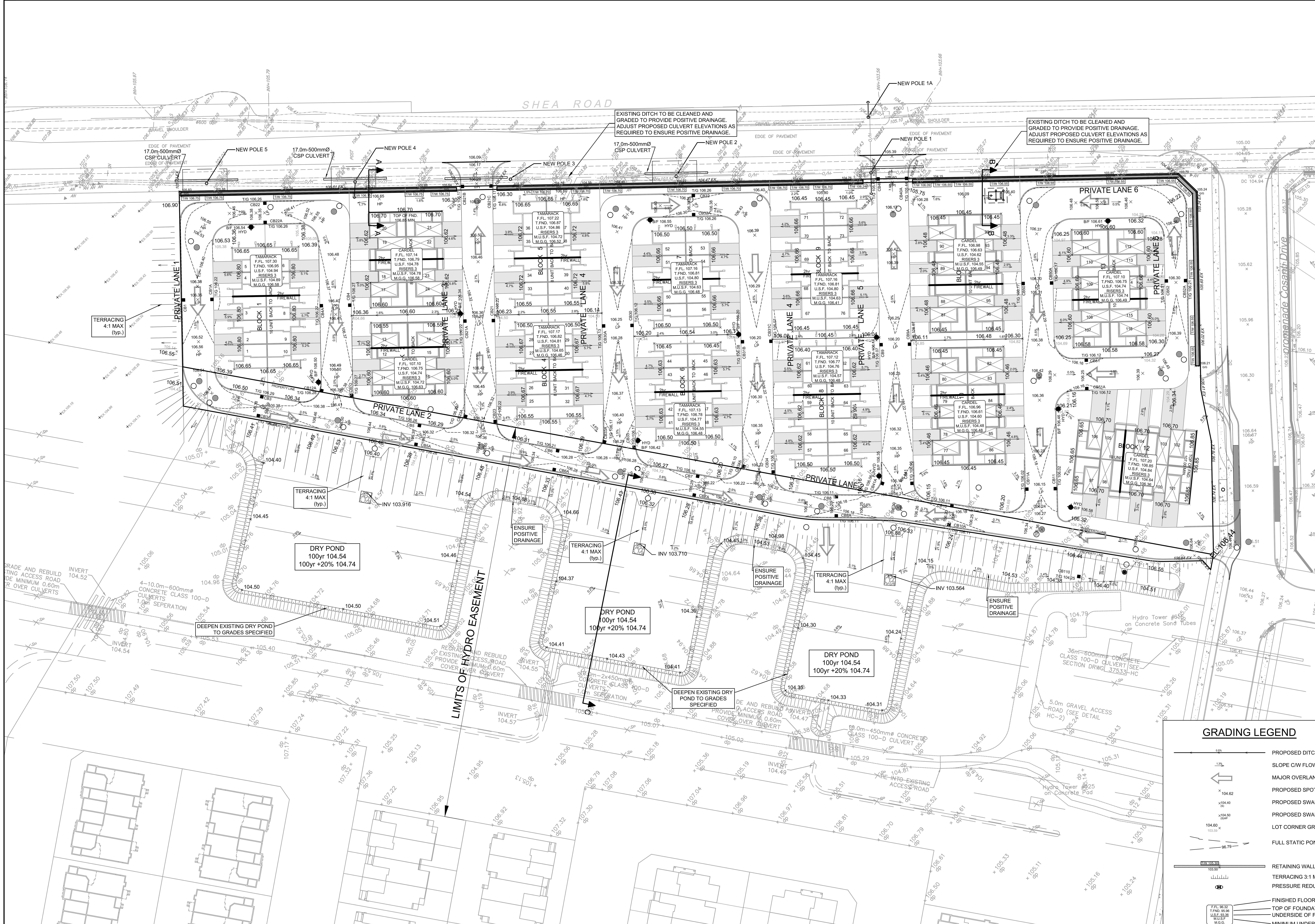
Alternative	Expected Collisions	Collision Costs	Total Benefits	Net Costs	Net Present Value	Simple B/C
Option 1	0.20196	$16,828.08	-	-	-	-
Option 2	0.55091	$3,783.89	$13,044.19	$19,000.00	-$5,955.81	0.69

The results of the analysis suggest that there is also no benefit in providing a guide rail on Private Lane 6.

Conclusion

Based on the quantitative assessment undertaken above, the safety benefit of a guide rail is not sufficient to outweigh the cost at any of the locations analyzed. The overall risk of a vehicle overtopping the retaining wall is not sufficiently high to warrant the installation of a guide rail.

Appendix A: Site Plan



CLIENT

DAVIDSON SHEA PROPERTY INC.

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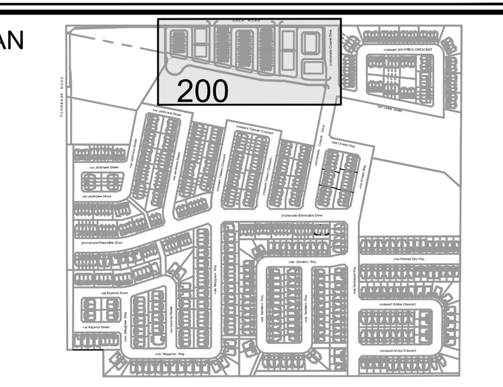
ISSUES

No.	DESCRIPTION	DATE
1	SUBMISSION NO.1 FOR CITY REVIEW	2022-09-15
2	SUBMISSION NO.2 FOR CITY REVIEW	2024-06-27
3		
4		
5		
6		
7		
8		

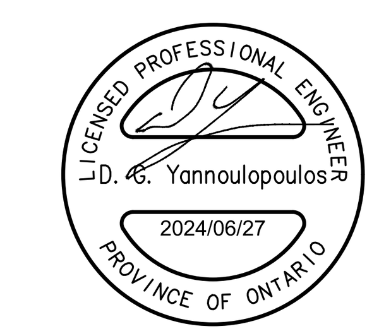
SEE 010, 011 FOR NOTES, LEGEND, CB TABLE, STREET SECTIONS AND DETAILS

KEY PLAN



CONSULTANTS

SEAL



GRADING LEGEND

- PROPOSED DITCH C/W FLOW DIRECTION AND SLOPE (0.5%)
- SLOPE C/W FLOW DIRECTION (1.3%)
- MAJOR OVERLAND FLOW ROUTE
- PROPOSED SPOT GRADE (104.62)
- PROPOSED SWALE GRADE (104.40 (S))
- PROPOSED SWALE HIGH POINT GRADE (104.50 (S)HP)
- LOT CORNER GRADE C/W EXISTING GRADE (104.60 / 103.59)
- FULL STATIC PONDING GRADE (96.79)
- RETAINING WALL C/W TOP OF WALL AND GRASS GRADE (T/W 105.30 / 103.50)
- TERRACING 3:1 MAXIMUM UNLESS NOTED OTHERWISE
- PRESSURE REDUCING VALVE
- F.FL. 96.32 — FINISHED FLOOR ELEVATION
- T.FND. 95.96 — TOP OF FOUNDATION ELEVATION
- U.S.F. 93.36 — UNDERSIDE OF FOOTING ELEVATION
- M.U.S.F — MINIMUM UNDERSIDE OF FOOTING (Based on the higher of the sewer obverts, or hydraulic grade line)
- M.G.G. — MINIMUM GARAGE GRADE
- WU — WALKUP UNIT
- WO — WALKOUT UNIT
- NS — NON-STANDARD FOUNDATION (Frost cover not provided for standard unit)
- HB — HIGHBACK UNIT (1.5m frost cover on footings)
- F — NOISE BARRIER LOCATION
- NOISE BARRIER GATE
- RIP-RAP
- TOWN HOUSE SPLITS

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PROJECT

1650 SHEA ROAD

(OTTAWA, ON)

PROJECT NO: 139185	
DRAWN BY: **M.M.**	CHECKED BY: **R.M./D.Y.**
PROJECT MGR: **R.M.**	APPROVED BY: **R.M./D.Y.**

SHEET TITLE

GRADING PLAN

SHEET NUMBER	ISSUE
200	2

CITY PLAN No. 19029

CITY FILE No. D07-12-23-0032

SCALE CHECK 1 in 10mm

File Location: J:\139185_1650_Shea_Ro\7.0_Production\7.03_Design\04_Civil\Sheets\200-GRADING PLAN.dwg Last Saved: June 27, 2024, by MMilne Plotted: Thursday, June 27, 2024 10:24:09 AM by Marian Milne

Appendix B: Roadside Design Evaluation

Input - Printable

Project Name:	1650 Shea Road
Name of Analyst:	Eric McLaren

Unadjusted Obstacle's Offset from the Travelled Lane	1.9	m
Design Speed of the Road	50	km/h
Encroachment Rate	0.00045	enc/km/yr/vpd
Initial Year	0	
Project Life	30	yr
Discount Rate	5.0	%

Choose one of:	Initial Year AADT	0	vpd
	Design Year AADT	43	vpd

Which Costing System is to be used?	MTO 2011	
Traffic Growth Rate	0.0	%
One-Way Highway or Two-Way Highway	Two-Way Highway	
Divided or Undivided	Undivided	
Number of Lanes	2	
Lane Width	3	m
Directional Split (Adjacent)	50	%

Severity Index of Upstream Side of Obstacle	0
Severity Index of Upstream Corner of Obstacle	0
Severity Index of Face of Obstacle	3.3
Severity Index of Downstream Side of Obstacle	0
Severity Index of Downstream Corner of Obstacle	0

Location of Obstacle	Shoulder	
Width of Obstacle	0	m
Length of Obstacle	45.5	m
Swath Width of Vehicle	3.6	m
Grade	2.0	%
Radius of Curvature	-8	m
Shoulder Width	1.9	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
for a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
for a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
for a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Average Damage Repair Cost of Feature after collision for:			
upstream side	$ -	/collision	
upstream corner	$ -	/collision	
face	$ -	/collision	
downstream side	$ -	/collision	
downstream corner	$ -	/collision	

OPTION 1

Method of Improvement	Steel Guide Rail	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	45.5	m
Grade	0.0	%
Radius of Curvature	0	m
*Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0
*Severity Index of Upstream Corner	0
*Severity Index of Face of Obstacle	2
*Severity Index of Downstream Side of Obstacle	0
*Severity Index of Downstream Corner of Obstacle	0

*Installation Cost	$ 9,100.00	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ 9,100.00	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

OPTION 2

Method of Improvement	0	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	0	m
Grade	0.0	%
Radius of Curvature	0	m
Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0
*Severity Index of Upstream Corner	0
*Severity Index of Face of Obstacle	0
*Severity Index of Downstream Side of Obstacle	0
*Severity Index of Downstream Corner of Obstacle	0

*Installation Cost	$ -	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ -	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

Output (Comparison) - Printable

Project Name: 1650 Shea Road

Name of Analyst: Eric McLaren

	Do Nothing	OPTION 1	OPTION 2
The Number of impacts with		Steel Guide Rail	0
the upstream side is:	0.00000 impacts/yr	0.00000 impacts/yr	0.00000 impacts/yr
the upstream corner is:	0.00012 impacts/yr	0.00007 impacts/yr	0.00007 impacts/yr
the face from adjacent traffic is:	0.00061 impacts/yr	0.00044 impacts/yr	0.00000 impacts/yr
the downstream side is:	0.00000 impacts/yr	0.00000 impacts/yr	0.00000 impacts/yr
the downstream corner is:	0.00002 impacts/yr	0.00004 impacts/yr	0.00002 impacts/yr
the face due to opposing traffic is:	0.00009 impacts/yr	0.00019 impacts/yr	0.00000 impacts/yr

Cost Analysis

	Total	Annual	Total	Annual	Total	Annual
Total Present Worth :	$ 489.81	$ 31.86	$ 9,232.94	$ 600.62	-$ 1.95	-$ 0.13
Accident Costs :	$ 489.81	$ 31.86	$ 127.17	$ 8.27	-$ 1.95	-$ 0.13
Installation Cost :	$ -	$ -	$ 9,100.00	$ 591.97	$ -	$ -
Accident Repair Costs :	$ -	$ -	$ 5.78	$ 0.38	$ -	$ -
Annual Maintenance Cost :	$ -	$ -	$ -	$ -	$ -	$ -
Salvage Value :	$ -	$ -	$ -	$ -	$ -	$ -

CFTA	0.00073	0.00051	0.00007
CFTO	0.00011	0.00023	0.00002
Initial Collision Frequency:	0.00084	0.00074	0.00009
Expected Impacts over Project Life:	0.02522	0.02218	0.00257
Project Life:	30	30	30
For the Direction Being Considered			
Initial AADT is (vpd):	21.5	21.5	21.5
Initial Encroachment Rate is (enc/yr/km):	0.0387	0.0387	0.0387
Average Cost per Impact			
upstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
upstream corner :	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
face:	$ 52,119.90	$ 15,229.96	-$ 1,697.90
downstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
downstream corner:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90

Summary of Benefits and Costs

Net Costs	$ -	$ 9,100.00	$ -
Total Benefits	$ -	$ 356.87	$ 491.76
Net Present Value	0.00	-8743.13	$ 491.76
Benefit/Cost Ratio	0.00	0.04	#DIV/0!
Change in Total Impacts	0.00	0.00	-0.02

Input - Printable

Project Name:	1650 Shea Road
Name of Analyst:	Eric McLaren

Unadjusted Obstacle's Offset from the Travelled Lane	1.9	m
Design Speed of the Road	50	km/h
Encroachment Rate	0.00045	enc/km/yr/vpd
Initial Year	0	
Project Life	30	yr
Discount Rate	5.0	%

Choose one of:	Initial Year AADT	0	vpd
	Design Year AADT	130	vpd

Which Costing System is to be used?	MTO 2011	
Traffic Growth Rate	0.0	%
One-Way Highway or Two-Way Highway	Two-Way Highway	
Divided or Undivided	Undivided	
Number of Lanes	2	
Lane Width	3	m
Directional Split (Adjacent)	50	%

Severity Index of Upstream Side of Obstacle	0
Severity Index of Upstream Corner of Obstacle	0
Severity Index of Face of Obstacle	4.8
Severity Index of Downstream Side of Obstacle	0
Severity Index of Downstream Corner of Obstacle	0

Location of Obstacle	Shoulder	
Width of Obstacle	0	m
Length of Obstacle	46	m
Swath Width of Vehicle	3.6	m
Grade	2.0	%
Radius of Curvature	-8	m
Shoulder Width	1.9	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
for a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
for a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
for a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Average Damage Repair Cost of Feature after collision for:			
upstream side	$ -	/collision	
upstream corner	$ -	/collision	
face	$ -	/collision	
downstream side	$ -	/collision	
downstream corner	$ -	/collision	

OPTION 1

Method of Improvement	Steel Guide Rail	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	46	m
Grade	0.0	%
Radius of Curvature	-8	m
*Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0
*Severity Index of Upstream Corner	0
*Severity Index of Face of Obstacle	2
*Severity Index of Downstream Side of Obstacle	0
*Severity Index of Downstream Corner of Obstacle	0

*Installation Cost	$ 9,200.00	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ 9,200.00	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

OPTION 2

Method of Improvement	0	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	0	m
Grade	0.0	%
Radius of Curvature	0	m
Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0	
*Severity Index of Upstream Corner	0	
*Severity Index of Face of Obstacle	0	
*Severity Index of Downstream Side of Obstacle	0	
*Severity Index of Downstream Corner of Obstacle	0	

*Installation Cost	$ -	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ -	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

Output (Comparison) - Printable

Project Name: 1650 Shea Road

Name of Analyst: Eric McLaren

	Do Nothing	OPTION 1	OPTION 2
The Number of impacts with		Steel Guide Rail	0
the upstream side is:	0.00000 impacts/yr	0.00000 impacts/yr	0.00000 impacts/yr
the upstream corner is:	0.00035 impacts/yr	0.00080 impacts/yr	0.00020 impacts/yr
the face from adjacent traffic is:	0.00187 impacts/yr	0.00538 impacts/yr	0.00000 impacts/yr
the downstream side is:	0.00000 impacts/yr	0.00000 impacts/yr	0.00000 impacts/yr
the downstream corner is:	0.00006 impacts/yr	0.00011 impacts/yr	0.00006 impacts/yr
the face due to opposing traffic is:	0.00029 impacts/yr	0.00059 impacts/yr	0.00000 impacts/yr

Cost Analysis

	Total	Annual	Total	Annual	Total	Annual
Total Present Worth :	$ 4,563.85	$ 296.88	$ 10,453.89	$ 680.04	-$ 5.89	-$ 0.38
Accident Costs :	$ 4,563.85	$ 296.88	$ 1,198.91	$ 77.99	-$ 5.89	-$ 0.38
Installation Cost :	$ -	$ -	$ 9,200.00	$ 598.47	$ -	$ -
Accident Repair Costs :	$ -	$ -	$ 54.98	$ 3.58	$ -	$ -
Annual Maintenance Cost :	$ -	$ -	$ -	$ -	$ -	$ -
Salvage Value :	$ -	$ -	$ -	$ -	$ -	$ -

CFTA	0.00222	0.00619	0.00020
CFTO	0.00035	0.00071	0.00006
Initial Collision Frequency:	0.00256	0.00690	0.00026
Expected Impacts over Project Life:	0.07694	0.20689	0.00776
Project Life:	30	30	30
For the Direction Being Considered			
Initial AADT is (vpd):	65	65	65
Initial Encroachment Rate is (enc/yr/km):	0.117	0.117	0.117
Average Cost per Impact			
upstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
upstream corner :	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
face:	$ 158,218.21	$ 15,229.96	-$ 1,697.90
downstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
downstream corner:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90

Summary of Benefits and Costs

Net Costs	$ -	$ 9,200.00	$ -
Total Benefits	$ -	$ 3,309.96	$ 4,569.74
Net Present Value	0.00	-5890.04	$ 4,569.74
Benefit/Cost Ratio	0.00	0.36	#DIV/0!
Change in Total Impacts	0.00	0.13	-0.07

Input - Printable

Project Name:	1650 Shea Road
Name of Analyst:	Eric McLaren

Unadjusted Obstacle's Offset from the Travelled Lane	1.9	m
Design Speed of the Road	50	km/h
Encroachment Rate	0.00045	enc/km/yr/vpd
Initial Year	0	
Project Life	30	yr
Discount Rate	5.0	%

Choose one of:	Initial Year AADT	0	vpd
	Design Year AADT	180	vpd

Which Costing System is to be used?	MTO 2011	
Traffic Growth Rate	0.0	%
One-Way Highway or Two-Way Highway	Two-Way Highway	
Divided or Undivided	Undivided	
Number of Lanes	2	
Lane Width	3	m
Directional Split (Adjacent)	50	%

Severity Index of Upstream Side of Obstacle	0
Severity Index of Upstream Corner of Obstacle	0
Severity Index of Face of Obstacle	5.2
Severity Index of Downstream Side of Obstacle	0
Severity Index of Downstream Corner of Obstacle	0

Location of Obstacle	Shoulder	
Width of Obstacle	0	m
Length of Obstacle	95	m
Swath Width of Vehicle	3.6	m
Grade	2.0	%
Radius of Curvature	-8	m
Shoulder Width	1.9	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
for a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
for a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
for a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Average Damage Repair Cost of Feature after collision for:			
upstream side	$ -	/collision	
upstream corner	$ -	/collision	
face	$ -	/collision	
downstream side	$ -	/collision	
downstream corner	$ -	/collision	

OPTION 1

Method of Improvement	Steel Guide Rail	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	95	m
Grade	0.0	%
Radius of Curvature	-8	m
*Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0
*Severity Index of Upstream Corner	0
*Severity Index of Face of Obstacle	2
*Severity Index of Downstream Side of Obstacle	0
*Severity Index of Downstream Corner of Obstacle	0

*Installation Cost	$ 19,000.00	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ 19,000.00	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

OPTION 2

Method of Improvement	0	
*Obstacle's Offset from the Travelled Lane	0	m
*Width of Obstacle	0	m
*Length of Obstacle	0	m
Grade	0.0	%
Radius of Curvature	0	m
Shoulder Width	0	m
Distance Between Edge of Shoulder and Beginning of Slope	0	m
Slope 1	0	
For a horizontal distance of	0	m
Distance Between Base Slope 1 and Edge Slope 2	0	m
Slope 2	0	
For a horizontal distance of	0	m
Distance Between Base Slope 2 and Edge Slope 3	0	m
Slope 3	0	
For a horizontal distance of	0	m
Distance Between End of Slope and Obstacle	0	m

*Severity Index of Upstream Side of Obstacle	0
*Severity Index of Upstream Corner	0
*Severity Index of Face of Obstacle	0
*Severity Index of Downstream Side of Obstacle	0
*Severity Index of Downstream Corner of Obstacle	0

*Installation Cost	$ -	
*Average Damage Repair Cost of improvement option after collision for:		
upstream side	$ -	/collision
upstream corner	$ -	/collision
face	$ -	/collision
downstream side	$ -	/collision
downstream corner	$ -	/collision
Annual Maintenance Cost	$ -	/yr
Salvage Value of Studied Feature	$ -	

Output (Comparison) - Printable

Project Name: 1650 Shea Road

Name of Analyst: Eric McLaren

	Do Nothing	OPTION 1	OPTION 2
The Number of impacts with		Steel Guide Rail	0
the upstream side is:	0.00000 impacts/yr	0.00001 impacts/yr	0.00000 impacts/yr
the upstream corner is:	0.00048 impacts/yr	0.00111 impacts/yr	0.00028 impacts/yr
the face from adjacent traffic is:	0.00534 impacts/yr	0.01539 impacts/yr	0.00000 impacts/yr
the downstream side is:	0.00000 impacts/yr	0.00000 impacts/yr	0.00000 impacts/yr
the downstream corner is:	0.00008 impacts/yr	0.00016 impacts/yr	0.00008 impacts/yr
the face due to opposing traffic is:	0.00083 impacts/yr	0.00170 impacts/yr	0.00000 impacts/yr

Cost Analysis

	Total	Annual	Total	Annual	Total	Annual
Total Present Worth :	$ 16,828.08	$ 1,094.69	$ 22,783.89	$ 1,482.12	-$ 8.15	-$ 0.53
Accident Costs :	$ 16,828.08	$ 1,094.69	$ 3,459.19	$ 225.03	-$ 8.15	-$ 0.53
Installation Cost :	$ -	$ -	$ 19,000.00	$ 1,235.98	$ -	$ -
Accident Repair Costs :	$ -	$ -	$ 324.71	$ 21.12	$ -	$ -
Annual Maintenance Cost :	$ -	$ -	$ -	$ -	$ -	$ -
Salvage Value :	$ -	$ -	$ -	$ -	$ -	$ -

CFTA	0.00583	0.01650	0.00028
CFTO	0.00091	0.00186	0.00008
Initial Collision Frequency:	0.00673	0.01836	0.00036
Expected Impacts over Project Life:	0.20196	0.55091	0.01075
Project Life:	30	30	30
For the Direction Being Considered			
Initial AADT is (vpd):	90	90	90
Initial Encroachment Rate is (enc/yr/km):	0.162	0.162	0.162
Average Cost per Impact			
upstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
upstream corner :	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
face:	$ 203,757.69	$ 15,229.96	-$ 1,697.90
downstream side:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90
downstream corner:	-$ 1,697.90	-$ 1,697.90	-$ 1,697.90

Summary of Benefits and Costs

Net Costs	$ -	$ 19,000.00	$ -
Total Benefits	$ -	$ 13,044.19	$ 16,836.23
Net Present Value	0.00	-5955.81	$ 16,836.23
Benefit/Cost Ratio	0.00	0.69	#DIV/0!
Change in Total Impacts	0.00	0.35	-0.19