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August 20, 2008 08-1111-0004

iTRANS Consulting Inc.
100 York Blvd., Suite 300
Richmond Hill, ON
L4B 1J8

Attention: Mr. Matthew McCumber, M.Eng., E.I.T
Transportation Planner

RE: PROPOSED QUARRY NEAR FLAMBOROUGH ONTARIO: EVALUATION OF ALTERNATIVE HAUL ROUTES – PAVEMENT ENGINEERING PERSPECTIVE

Dear Sirs:

Attached please find the Evaluation Report on matters relating to pavement engineering, for alternative haul routes that would serve the proposed Flamborough Quarry. If you have any questions, please do not hesitate to contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

Robert A. Douglas, BASc(CE), PhD, PEng.
Senior Geotechnical Engineering, Low-volume Roads

RAD/ACB/rad/jl

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REPORT
ON

PROPOSED QUARRY NEAR FLAMBOROUGH ONTARIO: EVALUATION OF ALTERNATIVE HAUL ROUTES – PAVEMENT ENGINEERING PERSPECTIVE

Submitted to:

iTRANS Consulting Inc.
100 York Blvd., Suite 300
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L4B 1J8

Attention: Mr. Matthew McCumber, M.Eng., E.I.T
Transportation Planner

DISTRIBUTION:

3 Copies	-	iTRANS Inc.
1 Copy	-	St Marys Cement Inc.
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August 20, 2008 08-1111-0004

1.0 INTRODUCTION

St. Marys Cement (Canada) Inc. has proposed to develop a Dolostone Quarry on Parts of Lots 1, 2 and 3, Concession 11, Geographic Township of East Flamborough, in the City of Hamilton. The property is located on the north side of 11th Concession, just west of Milburough Line (see Key Plan, Figure 1, following the text of this report).

In April 2006 Dillon Consulting Limited prepared the Terms of Reference for the Quarry Haul Route Evaluation on behalf of the City of Hamilton. Components of the Terms of Reference require that alternative haul routes be identified, the existing baseline conditions of each alternative route described, and a comparative analysis and evaluation carried out. iTRANS Consulting Inc. (iTRANS) has identified five alternative haul routes (see Appendix 1), that are described and analyzed in the context of pavement engineering in the following report.

At a meeting held on December 19, 2007, at the offices of iTRANS, St. Marys CBM requested that Golder Associates Ltd. (Golder) evaluate the five alternate routes from the pavement engineering point of view. The evaluation was to be based on our experience and on a report iTRANS provided to Golder, entitled *Roadway evaluation report, Flamborough Quarry, potential truck routes, Flamborough, Ontario*, prepared for BA Group by Shaheen and Peaker Limited, dated February 5, 2007 (Shaheen and Peaker Report). The evaluation report to be prepared by Golder was to be based on an office study only.

This report documents the consultant team, describes the environment, defines the analysis criteria and indicators, reports the analysis and results, and offers recommendations.

2.0 DESCRIPTION OF THE CONSULTANT TEAM

Andrew Balasundaram, P.Eng. (Golder's Project Director for the study), a Principal with Golder, has over 20 years experience in pavement and materials engineering as applied to the construction and rehabilitation of provincial and municipal roads, airports, ports and parking lots. He has been responsible for the management of over 50 projects for the Ministry of Transportation of Ontario (MTO) and has been fulfilling MTO pavement design assignments since 1997. Andrew has been the Geotechnical/Pavement Design Engineer for the rehabilitation of more than 300 km of MTO highways and municipal roads in the Greater Toronto Area.

Robert A. Douglas, Ph.D., P.Eng. (Golder's Project Manager for the study) is a Senior Geotechnical Engineer. He has managed projects involving geotechnical and pavement investigation and analysis including rehabilitation design, and preliminary and detailed design for

various roads within the Regions of Halton and Peel, on Manitoulin Island, and in Northern Ontario.

3.0 DESCRIPTION OF THE ENVIRONMENT

It is understood that the proposed quarry will be capable of producing approximately 3 million tonnes of aggregate annually, which will generate a substantial number of truck movements – as many as 1,100 per day. It is anticipated that approximately 75% of the product would be delivered to markets to the east via Highway 401, 10% to the west via Highway 401, 10% to the southeast to markets in the Mississauga, Oakville and Burlington areas, and 5% to the south to the Hamilton area.

An informal windshield survey was performed at the site by Golder staff on January 8 and 9, 2008 by driving along each alternative haul route segment previously identified by iTRANS at a speed of approximately 50-60 km/hr, and noting the condition of the pavement surface. A simple rating of 0 (worst) to 10 (best), in increments of 2, was assigned to each road segment. The types of pavement distresses, such as cracking, rutting, and potholing were observed, together with the condition of the shoulders and drainage. The survey was limited to the relevant segments of Concession 11E, Campbellville Road, Centre Road, Milburough Line, Twiss Road, and Reid Side Road, shown on Figure 2. Highway 6 was not included in the survey.

The observed conditions are shown in Table 1.

Table 1
Observed pavement condition

Route 1	
Conc 11E, Milburough to Centre Rd (Link 18)	**condition rated 10** smooth surface, asphalt road narrow, no shoulders new surface treatment applied 0.7 km of swampy land, north side
Conc 11E, Centre Rd to Hwy 6 (Link 17)	**condition rated 10** smooth new asphalt narrow, no shoulders

Table 1 Observed pavement condition	
Route 2	
Conc 11E, Milburough to Centre Rd (Link 18)	**condition rated 10** smooth surface, asphalt road narrow, no shoulders new surface treatment applied 0.7 km of swampy land, north side
Centre Rd, Conc 11E to Campbellville Rd (Link 1)	**condition rated 10** very new asphalt surface road narrow, no shoulders
Campbellville Rd, Centre Rd to Hwy 6 (Link 11)	**condition rated 6** transverse cracking some centreline cracking occasional patching some alligator cracking
Route 3	
Milburough Line, Conc 11E to Campbellville Rd (Link 5)	**condition rated 6** chip seal surface, good condition road narrow, no ditches, poorly drained
Campbellville Rd, Milburough Line to Twiss Rd (Link 13)	**condition rated 4** longitudinal cracking alligator cracking edge breaks routing and sealing done
Twiss Rd, Campbellville Rd to Reid Side Rd (Link 26)	**condition rated 8** half of its length chip sealed, some edge cracking half of its length asphalt, very good condition
Reid Side Rd, Twiss to Hwy 401 ramp (Link 27)	**condition rated 8** good surface, asphalt some transverse cracking

Note that alternative routes 4 and 5 are combinations of Routes 1-3.

Existing drainage was poor along the alternative routes. Based on the observations made during the windshield survey, drainage improvements to varying degrees will be required along any haul route selected as the preferred route.

None of the existing pavements on the alternative routes will be able to support the anticipated heavy traffic imposed by quarry haul trucks. The pavements on the selected route will need to be upgraded.

Truck performance will be better and truck operating costs will be less for the more gentle vertical alignments. The costs of improving the vertical grades of some of the road segments by

cutting high areas and filling low areas may be offset by the savings in trucking costs over the lifetime of the project.

4.0 EXISTING BASELINE CONDITIONS

The pavement layer thicknesses reported in the Shaheen and Peaker report are summarized in Table 2. The table also presents the type of subgrade soil typically underlying the pavement layers along each road segment.

Table 2
Existing pavement layer thicknesses and details, summarized from Shaheen and Peaker Report (2007)

Road segment	BH	Link	Average asphalt thickness (mm)	Average base thickness (mm)	Average subbase thickness (mm)	Typical subgrade
Concession 11E	66-71	18	100	290	0	sandy silt fill
Concession 11E	72-76	17	100	270	0	sandy silt fill
Centre Road	37-43	1	120	160	0	clayey silt fill
Campbellville Road	32-36	11	115	200	0	clayey silt fill
Campbellville Road	20-25	13	155	330	80	sandy silt fill
Milburough Line	5-9, 13, 14	5	45	200	60	clayey silt till
Twiss Rd / Reid Sideroad	1-4	26, 27	105	310	150	silty clay fill

5.0 EVALUATION CRITERIA

The assigned task was to evaluate the five alternative routes from the road and pavement engineering point of view using the information in the Shaheen and Peaker report. The evaluation was limited to the relevant segments of Concession 11E, Campbellville Road, Centre Road, Milburough Line, Twiss Road, and Reid Side Road, shown on Figure 2. Highway 6 was not included in the evaluation.

To accomplish the task, following were investigated:

- estimated pavement upgrading requirements: comparative evaluation of the amount of strengthening needed in each road's pavement to carry the anticipated future traffic and additional truck traffic to be generated by quarrying activities
- an analysis of falling weight deflectometer (FWD) pavement deflection results provided in the Shaheen and Peaker report

5.1 Pavement upgrading requirements

The five alternative routes were compared in terms of an estimate of the quantity of asphalt that would be needed to overlay the pavements along each route, to provide the needed increase in strength to carry the anticipated future traffic and additional quarry traffic. Traffic data, consisting of annual average daily traffic (AADT) and truck traffic percentages, estimated for 2021 and 2031 were provided by iTRANS in an email dated March 17, 2008. The borehole logs provided in the Shaheen and Peaker report were examined to determine the pavement structures that existed along each of the proposed haul routes at the time the report was prepared by Shaheen and Peaker, and the types of subgrade soils underlying the pavements.

The strengths of the existing pavements were characterized using a pavement structural analysis computer program, Darwin Version 3.1.011, in terms of a *structural number*, and compared to the higher structural number that would be required to carry the additional quarry traffic, with no seasonal load restrictions. The difference in structural numbers was used to estimate the additional thickness of asphalt that would be required to support the estimated future traffic and the anticipated traffic generated by quarrying operations. With an assumed pavement width, the estimated lengths of the road segments, and the calculated additional pavement thickness required, an estimate of the additional volume of asphalt (implying the cost of upgrading the road with an asphalt overlay) could be made. These estimates are presented in Table 5, in the Results section of the report.

It should be noted that in this comparison, we have assumed that all pavements have the same width. The analysis is insensitive to small variations in pavement width from one road segment to another, and is independent of the cross section type selected for two-lane cross sections.

5.2 FWD results

The mean normalized FWD pavement deflection values given in the Shaheen and Peaker report are shown in Table 3. These values are an indication of the pavement strengths (the smaller the deflection, the stronger the pavement) that existed at the time the field work for the report was performed, in December, 2006. The results should be treated with caution, given that temperature has an impact on the results, and the testing was carried out in ambient temperatures near freezing.

Table 3
FWD Results

Road	Mean normalized† deflection (mm)	Standard deviation (mm)
Campbellville Road	0.37	0.11
Centre Road	0.60	0.21
Concession 11E Road	0.37	0.08
Milburough Road	0.55	0.22
Reid Side Road	0.30	0.03
2nd Line Road	0.49	not reported by Shaheen and Peaker

† normalized to a uniform load of 40 kN and a temperature of 21ºC

The average pavement deflections weighted by the lengths of the road segments can be taken as an indication of the average strength of the existing pavement along a proposed route. It was calculated for each of the proposed routes, with the results shown in Table 4. Given that the weighted normalized deflections were so close, varying at most 13% from their average, it was decided that the differences were insufficient to distinguish one alternative route from another on the basis of pavement deflection. Therefore, the FWD results were dropped from the analysis.

Table 4
Weighted Normalized Pavement Deflections

Alternative route	Components			Weighted normalized pavement deflection† (mm)
	Road	Normalized pavement deflection† (mm)	Length (m)	
1	Conc 11E Rd	0.37	5700	0.37
2	Conc 11E Rd	0.37	3100	0.46
	Centre Rd	0.60	3800	
	Campbellville Rd	0.37	2500	
3	Milburough Rd	0.55	3300	0.44
	Campbellville Rd	0.37	2800	
	2nd Line Rd	0.49	600	
	Reid Side Rd	0.30	1500	
4	Routes 1 and 3 combined			0.41
5	Routes 2 and 3 combined			0.45

† normalized to a uniform load of 40 kN and a temperature of 21ºC

6.0 RESULTS

The ratings for pavement upgrading are shown in Table 5. The ratings were interpolated between their extreme values, and rounded off to the nearest 0.1.

Table 5 Rating of Alternative Routes		
Alternative route	**Pavement overlay**	
	Relative volume of asphalt needed†	**Rating (1-5, 1=best)**
1	1.0	1.0
2	1.8	2.8
3	1.5	2.1
4	2.1	3.4
5	2.8	5.0

† route with least calculated volume given a value of 1, others are multiples of that volume

7.0 DISCUSSION AND RECOMMENDATIONS

It is understood that iTRANS has proposed two types of cross-sections: a rural cross section which would require property acquisition, and an urban cross section which would not encroach on land outside the existing right-of-way. Appendix 2 presents iTRANS' analysis of the two cross sections, comparing their advantages and disadvantages. With regard to the analysis from the pavement engineering perspective presented here, the results are independent of the cross section type finally selected.

The results show that based on the methodology followed and the assumptions made, Route 1 to Highway 6 is the preliminary preferred route from the pavement engineering perspective. The implications are that Route 1 would require the least overall expenditure for pavement upgrading, It should be noted that the analysis is strongly influenced by route length. From the pavement engineering point of view, this is unavoidable.

Pavement engineering is just one of many criteria that have been considered in the selection of the overall preferred route. Other criteria (wildlife, noise, capacity, etc.) being studied by others have had an impact on the selection as well. When all inputs were considered, it is understood that Route 3 was identified as the overall preferred route. This route was rated second best from the pavement engineering point of view, representing a reasonable compromise on pavement considerations.

8.0 CLOSURE

A analysis has been performed on the five alternative haul routes proposed by St. Marys CBM, from the pavement engineering point of view. Based on the method followed and the assumptions made, Alternative Route 1, running from a proposed quarry gate on 11th Concession

Road East, west on 11th Concession Road East to Highway 6 (Links 18 and 17), is the preliminary preferred route.

This study was based in part on a review of the report prepared by Shaheen and Peaker, dated February 5, 2007. It is possible that the pavements on some of the roads studied have been improved since the Shaheen and Peaker report was prepared. A review of construction records could be used to update the conclusions drawn in the current report.

When/if a haul route has been selected, a programme of geotechnical field work should be undertaken along the selected route, and pavement design recommendations made regarding the most suitable strategy to upgrade the selected route.

It has been a pleasure to have been given an opportunity to contribute to the project. If you have any questions or need clarification, please do not hesitate to contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

Robert A. Douglas, BASc(CE), PhD, PEng.
Senior Geotechnical Engineer (Low-volume Roads)

Andrew C. Balasundaram, PEng.
Principal, Pavement and Materials Engineering

RAD/ACB/jl

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REFERENCE:

6 0 6 12

SCALE 1:300000 KM

Golder Associates
Mississauga, Ontario, Canada

SCALE	AS SHOWN
DATE	Feb. 12, 2008
DESIGN	
CAD	DD
CHECK	
REVIEW	

TITLE

KEY PLAN

FILE No. 0811110004AA001.dwg

PROJECT No. 08-1111-0004 REV. A

PROPOSED FLAMBOROUGH QUARRY HAUL ROAD STUDY

FIGURE 1

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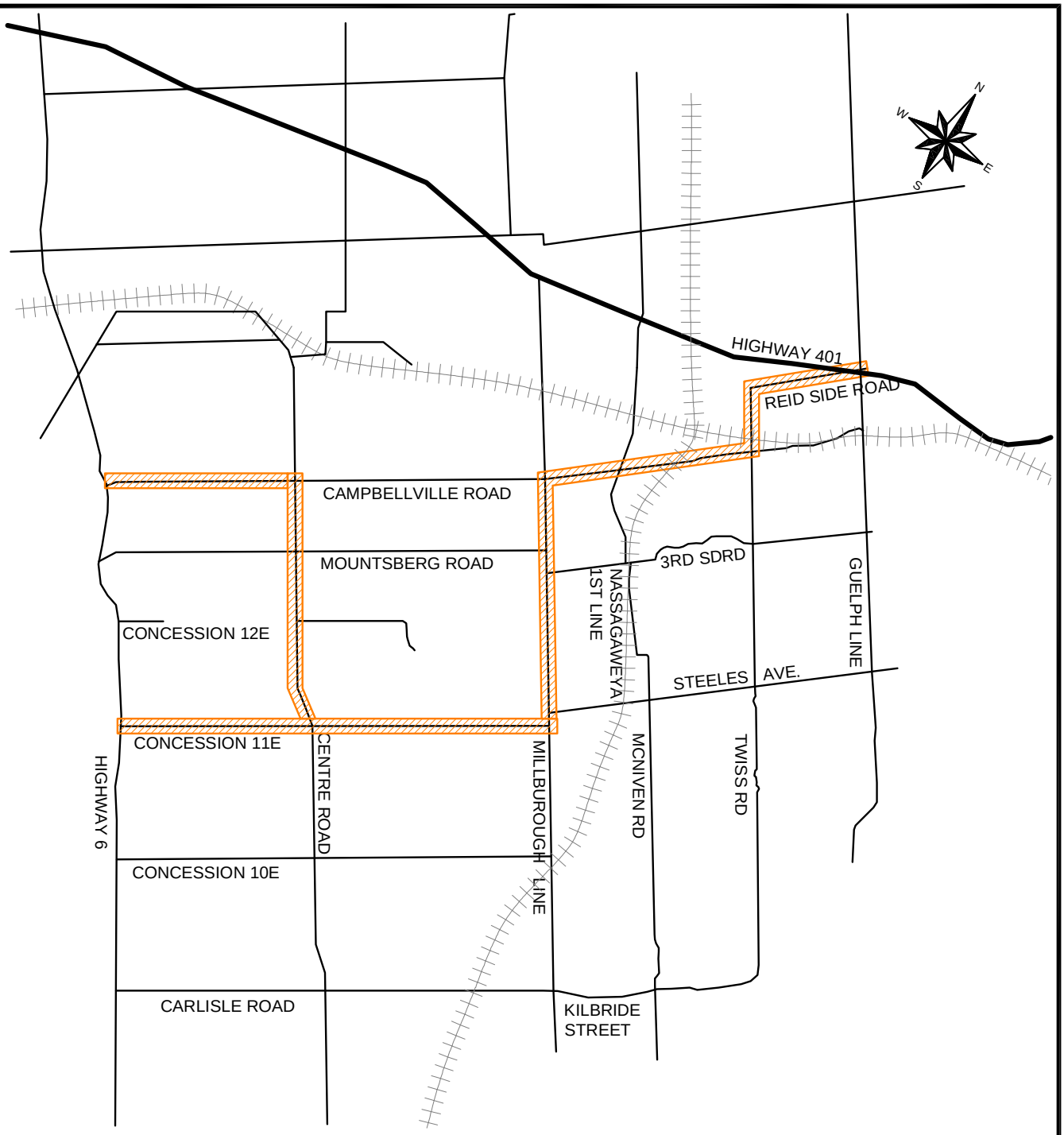

LEGEND:

ROADS UNDER STUDY

PLOT DATE: February 28, 2008
FILENAME: T:\Projects\2008\08-1111-0004 (CBM AGGREGATES, Toronto)\-AA- Flamborough Route Study\0811110004AA002.dwg

Golder Associates
Mississauga, Ontario, Canada

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LOCATION PLAN

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PROPOSED FLAMBOROUGH QUARRY
HAUL ROAD STUDY

FIGURE **2**

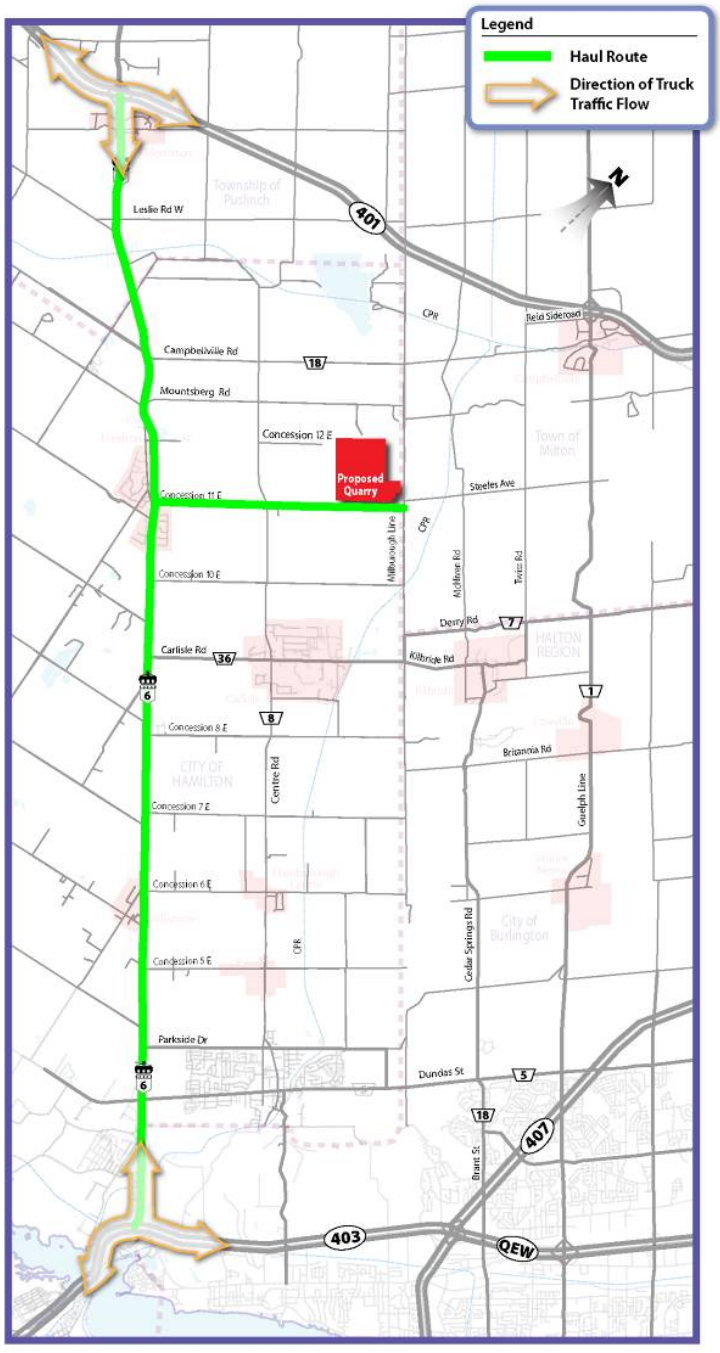
Appendix 1

Alternative Haul Routes

(graphics and text provided by iTRANS Consulting Inc.)

DESCRIPTION OF ALTERNATIVE HAUL ROUTES

Alternative Haul Route 1



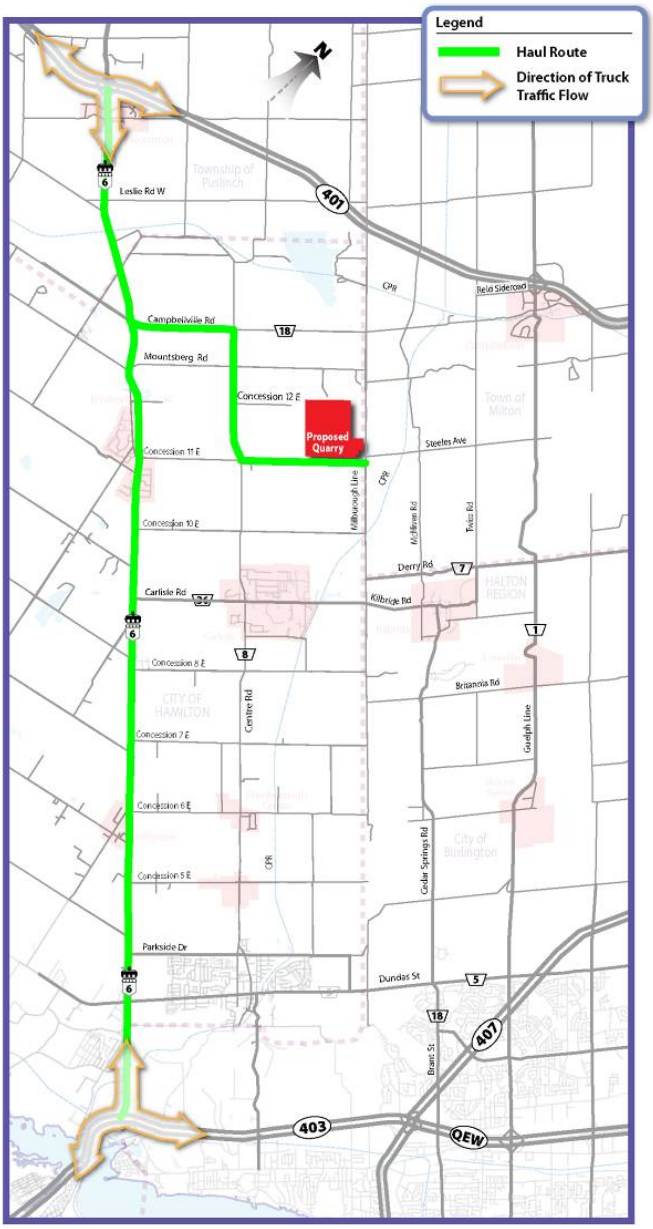
In the case of Alternative Haul Route 1, truck traffic destined for Highway 401 east would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403/QEW westbound on-ramp.

Alternative Haul Route 2



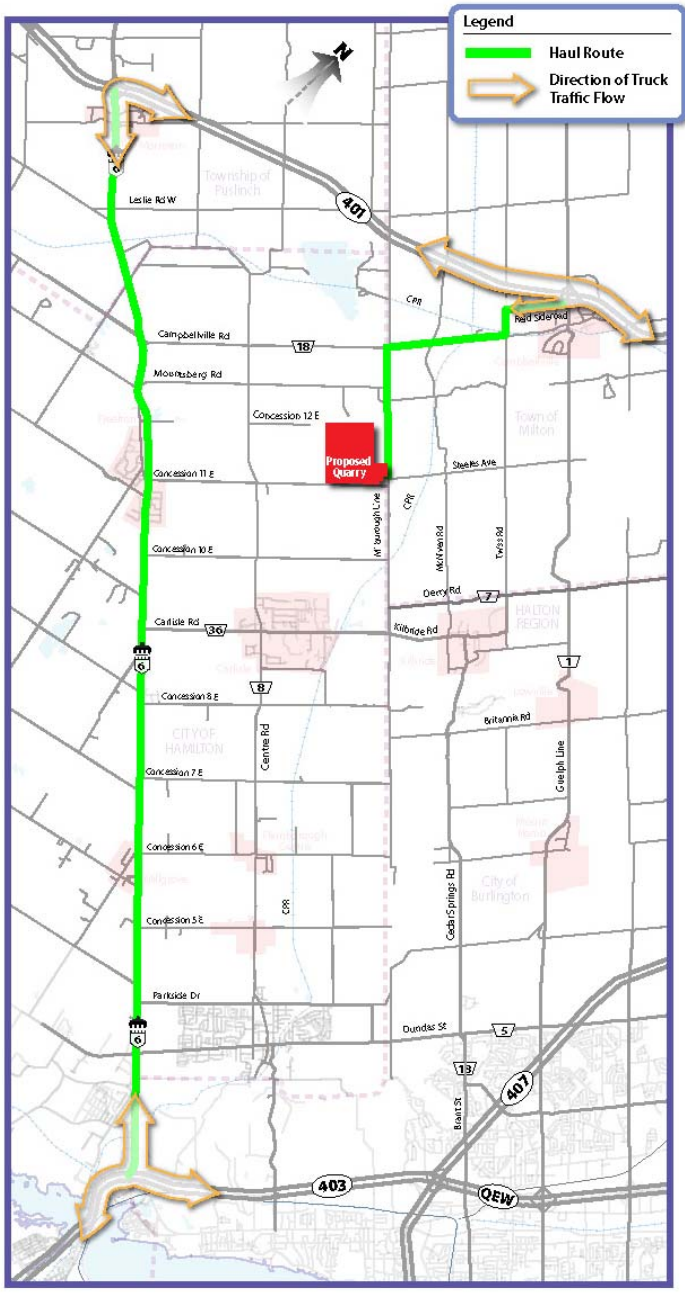
In the case of Alternative Haul Route 2 truck traffic destined for Highway 401 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and north on Highway 6 to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403 /QEW westbound on-ramp.

Alternative Haul Route 3



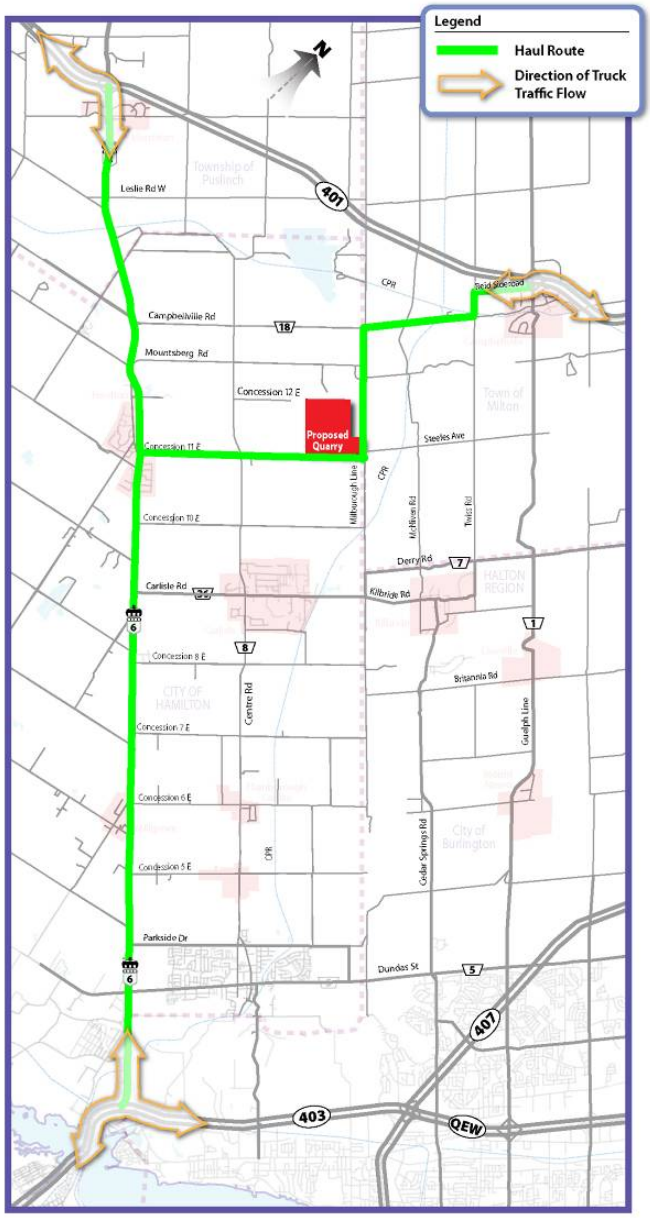
In the case of Alternative Haul Route 3, truck traffic destined for Highway 401 east would travel north on Milburough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel north on Milburough Line, then east on Campbellville Road, north on Twiss Road, east on Reid Sideroad and north on Guelph Line to the Highway 401 westbound on-ramp

Truck traffic destined for Highway 403/QEW east would travel north on Milburough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp. From here, there are several alternatives to reach the destination including taking the 407 ETR south to Highway 403.

Finally, truck traffic destined for Highway 403 west would travel north on Milburough Line, east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401. From here, there are several alternatives to reach the destination including taking the 407 ETR southwest or Highway 6 south to the 403/QEW.

Alternative Haul Route 4



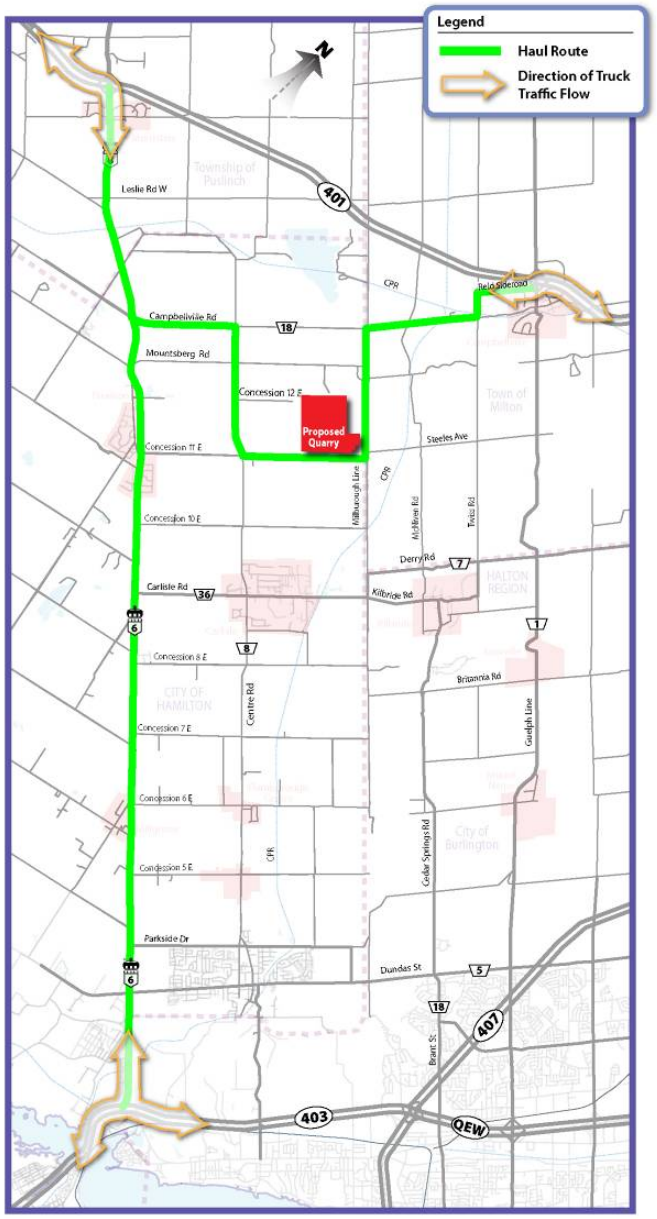
In the case of Alternative Haul Route 4, truck traffic destined for Highway 401 east would travel north on Milburough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403 eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, and then south on Highway 6 to the Highway 403 westbound on-ramp.

Alternative Haul Route 5



In the case of Alternative Haul Route 5, truck traffic destined for Highway 401 east would travel north on Milburough Line, then east on Campbellville Road, north on Twiss Road, and east on Reid Sideroad to the Highway 401 eastbound on-ramp.

Truck traffic destined for Highway 401 west would travel west on Concession 11 E, then north on Centre Road, then west on Campbellville, and then north on Highway 6 to the Highway 401 westbound on-ramp.

Truck traffic destined for Highway 403 east would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403/QEW eastbound on-ramp.

Finally, truck traffic destined for Highway 403 west would travel west on Concession 11 E, then north on Centre Road, west on Campbellville, and south on Highway 6 to the Highway 403 /QEW westbound on-ramp.

Appendix 2

Cross-Section Design and Analysis

(graphics and text provided by iTRANS Consulting Inc.)

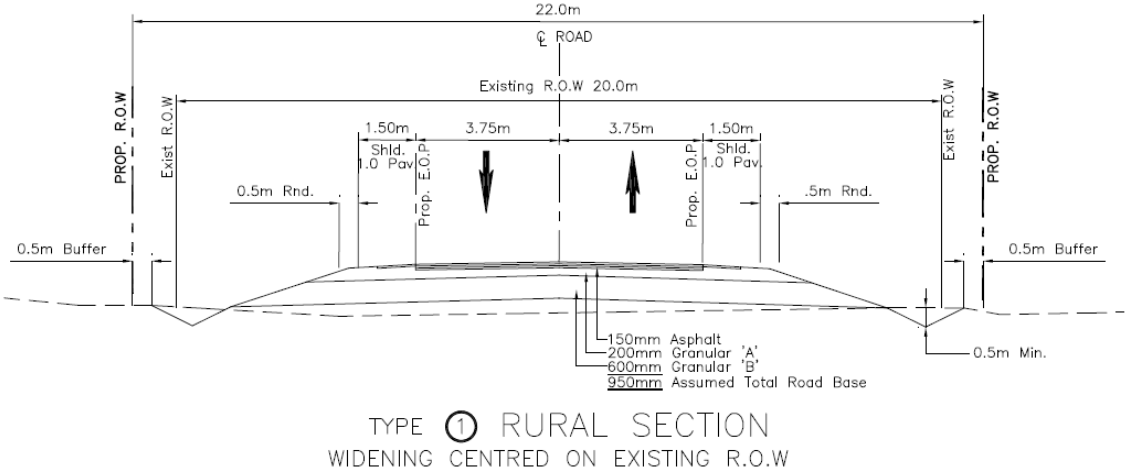
CROSS-SECTION DESIGN AND ANALYSIS

For this study two types of cross-sections are proposed: rural (requires property acquisition) and urban (within the existing right-of-way). For the purpose of the analysis the rural cross-section was applied as it has the most significant impacts due to property acquisition and was therefore deemed more conservative. However, given the challenges that can be associated with land acquisition, the urban design that fits the existing right-of-way was also given consideration. It was concluded that this design would not require land acquisition however it would have a more significant impact on the existing character of the road and has a higher associated cost of construction.

Figure 1, Figure 2, Figure 3 and Figure 4 illustrate the proposed road bed design and shows rural and urban alternative cross-sections for both Type 1 and Type 3 sections.

Type 1

With the rural cross-section the proposed right-of-way is 2.0m greater than the existing 20m right of way. This cross-section allows for 3.75m travel lanes, 1.0m paved shoulder, 0.5m gravel shoulder, 0.5m rounding, and a drainage ditch.



TYPE ① RURAL SECTION
WIDENING CENTRED ON EXISTING R.O.W

Figure 1: Type 1 Rural Cross-Section

With the urban cross-section the proposed right-of-way fits into the existing 20m right-of-way. The cross-section allows for 3.75m travel lanes, and a 1.5m paved shoulder with curb and gutter.

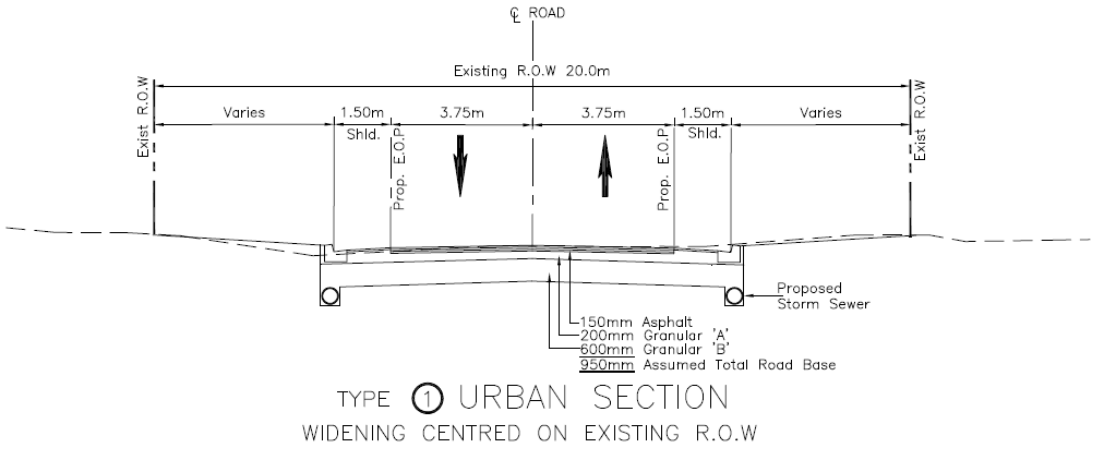


Figure 2: Type 1 Urban Cross-Section

Type 3

With the rural cross-section the proposed right-of-way is 3m to 7.5m greater than the existing right-of-way depending on the varying existing cross-section. This cross-section allows for 3.75m travel lanes, 1.0m paved buffer, 1.5m paved bike lane, 1.0m gravel shoulder, 0.5m rounding, a drainage ditch and a 0.5m buffer.

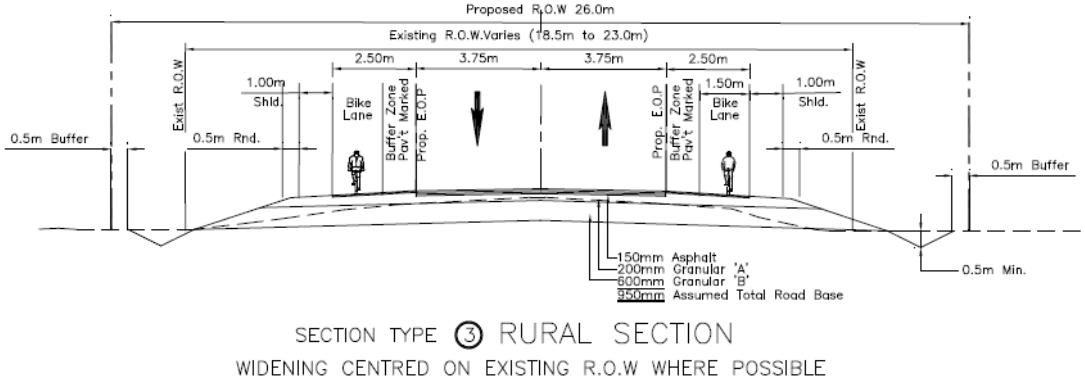


Figure 3: Type 3 Rural Cross-Section

With the urban cross-section the proposed right-of-way can be fit into the existing right-of-way that varies from 18.5m to 23m. The cross-section allows for 3.75m travel lanes, a 1.0m paved buffer, a 1.5m paved bike lake, and curb and gutter with a minimum boulevard of 3m.

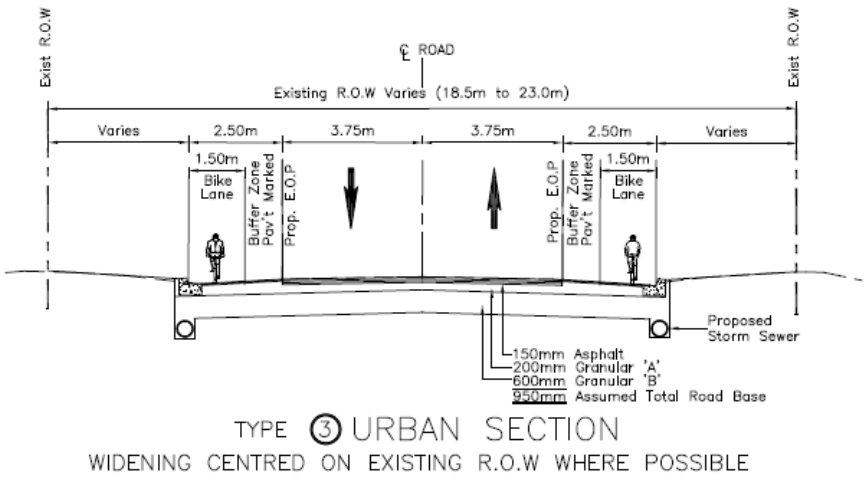


Figure 4: Type 3 Urban Cross-Section

It is important to note that both Type 1 and Type 3 section designs do not account for any changes in the existing profile and assume that widening is at existing profile grade.

While the urban cross-section fits into the existing right-of-ways, the storm sewer infrastructure and appurtenances increase the construction costs approximately 50 percent over the rural design. It is a trade off between the cost (and challenge) of purchasing land and constructing a more expensive infrastructure.

Applying the rural cross-section that would require land acquisition is a conservative approach for haul route comparative evaluation purposes. The decision on which cross-section to move forward with would be decided at the detailed design stage of an Environmental Assessment when pavement recommendations are finalized. Typically, resolution of the design details would occur during the subsequent Municipal Class EA process.